



DataLab
Release 0.19.0

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CONTENTS

1	Getting started	3
1.1	Installation	3
1.2	Use cases, main features and key strengths	9
1.3	Key features	11
1.4	Tutorials	14
2	Features	81
2.1	Validation	81
2.2	General features	90
2.3	Signal processing	136
2.4	Image processing	163
3	API	199
3.1	Algorithms (<code>cdl.algorithms</code>)	199
3.2	Parameters (<code>cdl.param</code>)	217
3.3	Object model (<code>cdl.obj</code>)	259
3.4	Computation (<code>cdl.computation</code>)	298
3.5	Proxy objects (<code>cdl.proxy</code>)	374
3.6	GUI	393
3.7	Main window	394
3.8	Panel	400
3.9	Action handler	418
3.10	Object view	423
3.11	Plot handler	426
3.12	ROI editor	429
3.13	Processor	430
3.14	Docks	447
3.15	HDF5 I/O	448
4	Contributing	449
4.1	Share your ideas and experiences	449
4.2	Share your scientific/technical knowledge	449
4.3	Contribute to new features	450
4.4	Develop new features	450
	Python Module Index	489

DataLab is an **open-source platform for signal and image processing and visualization** for research, education and industry. Leveraging the richness of the scientific Python ecosystem¹, DataLab is the ideal complement to your data analysis workflows as it can be extended with your Python code through *Plugins* or directly from *your IDE* or *your Jupyter notebooks*. Go to *Installation* to get started!

To immediately see DataLab in action, you have two options:

- Read or view our *Tutorials*,
- Try DataLab online, without installation, using our *Binder environment*.

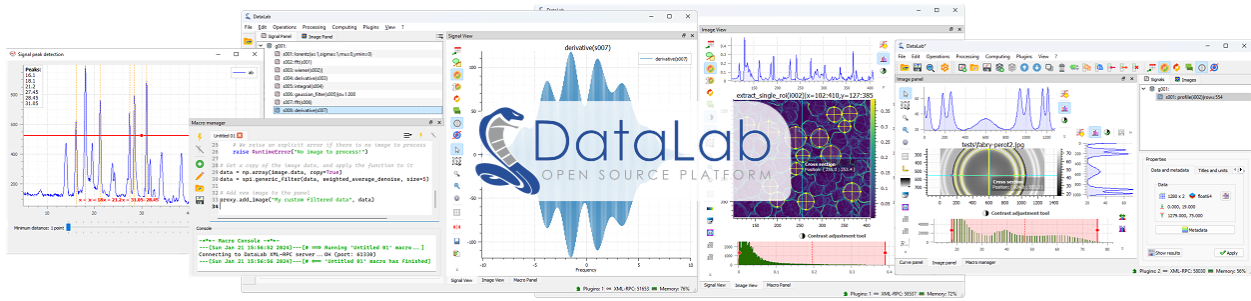


Fig. 1: Signal and image visualization in DataLab

DataLab has been funded, chronologically, by the following takeholders:

CEA, the French Alternative Energies and Atomic Energy Commission, is the major investor in DataLab, and is the main contributor to the project.

CODRA, a software editor and engineering company, has supported DataLab open-source journey since its inception, through financial and technical contributions.

NLnet Foundation, as part of the NGI0 Commons Fund, backed by the European Commission, has funded the redesign of DataLab's core architecture.



Fig. 2: DataLab is powered by **PlotPyStack**, the scientific Python-Qt visualization and graphical user interface stack.

¹ DataLab processing features are mainly based on **NumPy**, **SciPy**, **scikit-image**, **OpenCV** and **PyWavelets** libraries. DataLab visualization capabilities are based on **PlotPyStack** toolkit, a set of Python libraries for building scientific applications with Qt graphical user interfaces.

GETTING STARTED

DataLab is an open platform for signal and image processing, designed to be used by scientists, engineers, and researchers in academia and industry, while offering the reliability of industrial-grade software. It is a versatile software that can be used for a wide range of applications, from simple data analysis to complex signal processing and image analysis tasks.

DataLab integrates seamlessly into your workflow thanks to three main operating modes:

Stand-alone application, with a graphical user interface that allows you to interact with your data and visualize the results of your analysis in real time.

Python library, allowing you to integrate DataLab functions (or graphical user interfaces) into your own Python scripts and programs or Jupyter notebooks.

Remotely controlled from your own software, or from an IDE (e.g., Spyder) or a Jupyter notebook, using the DataLab API.

DataLab leverages the power of Python and its scientific ecosystem, through the use of the following libraries:

- [NumPy](#) for numerical computing (arrays, linear algebra, etc.)
- [SciPy](#) for scientific computing (interpolation, special functions, etc.)
- [scikit-image](#) and [OpenCV](#) for image processing
- [PyWavelets](#) for wavelet transform
- [PlotPyStack](#) for Qt-based interactive data visualization

1.1 Installation

This section provides information on how to install DataLab on your system. Once installed, you can start DataLab by running the `cdl` command in a terminal, or by clicking on the DataLab shortcut in the Start menu (on Windows).

See also:

For more details on how to execute DataLab and its command-line options, see [Command line features](#).

1.1.1 How to install

DataLab is available in several forms:

- As a *Conda package*.
- As a Python package, which can be installed using the *Package manager pip*.
- Windows As a stand-alone application, which does not require any Python distribution to be installed. Just run the *All-in-one installer* and you're good to go!
- Windows Within a ready-to-use *Python distribution*, based on *WinPython*.
- As a precompiled *Wheel package*, which can be installed using *pip*.
- As a *Source package*, which can be installed using *pip* or manually.

See also:

Impatient to try the next version of DataLab? You can also install the latest development version of DataLab from the master branch of the Git repository. See *Development version* for more information.

Conda package

GNU/Linux Windows macOS

To install *datalab* package from the *conda-forge* channel (<https://anaconda.org/conda-forge/datalab>), run the following command:

```
$ conda install conda-forge::datalab
```

Package manager pip

GNU/Linux Windows macOS

DataLab's package *cdl* is available on the Python Package Index (PyPI) on the following URL: <https://pypi.python.org/pypi/cdl>.

Installing DataLab from PyPI with Qt is as simple as running this command (you may need to use *pip3* instead of *pip* on some systems):

```
$ pip install cdl[qt]
```

Or, if you prefer, you can install DataLab without the Qt library (not recommended):

```
$ pip install cdl
```

Note: If you already have a previous version of DataLab installed, you can upgrade it by running the same command with the *--upgrade* option:

```
$ pip install --upgrade cdl[qt]
```

All-in-one installer

Windows

DataLab is available as a stand-alone application for Windows, which does not require any Python distribution to be installed. Just run the installer and you're good to go!

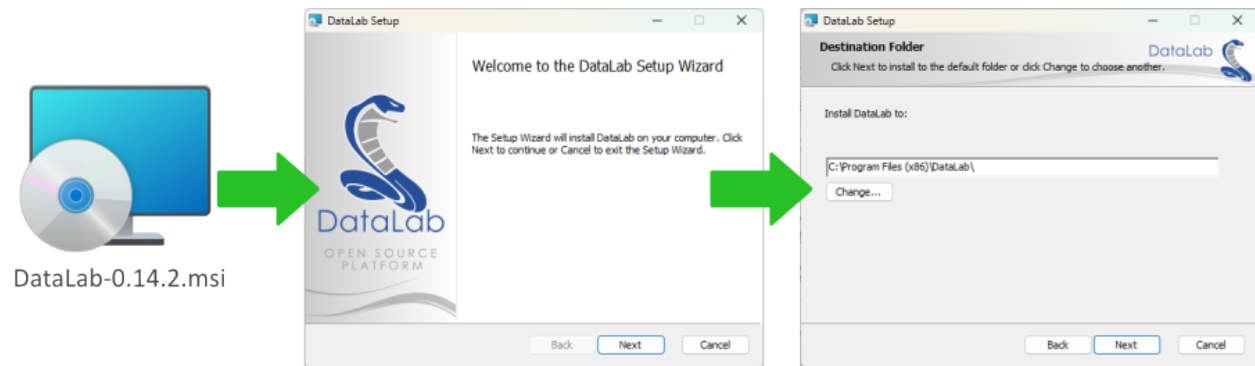


Fig. 1: DataLab all-in-one installer for Windows

The installer package is available in the [Releases](#) section. It supports automatic uninstall and upgrade feature (no need to uninstall DataLab before running the installer of another version of the application).

Warning: DataLab Windows installer is available for Windows 7 SP1, 8, 10 and 11.

On Windows 7 SP1, before running DataLab (or any other Python 3 application), you must install Microsoft Update *KB2533623 (Windows6.1-KB2533623-x64.msu)* and also may need to install [Microsoft Visual C++ 2015-2022 Redistributable package](#).

Python distribution

Windows

DataLab is also available within a ready-to-use Python distribution, based on [WinPython](#). This distribution is called [DataLab-WinPython](#) and is available in the [DataLab-WinPython Releases](#) section.



Fig. 2: DataLab-WinPython is a ready-to-use Python distribution including the DataLab platform.

The main difference with the all-in-one installer is that you can use the Python distribution for other purposes than running DataLab, and you may also extend it with additional packages. On the downside, it is also *much bigger* than the all-in-one installer because it includes a full Python distribution.

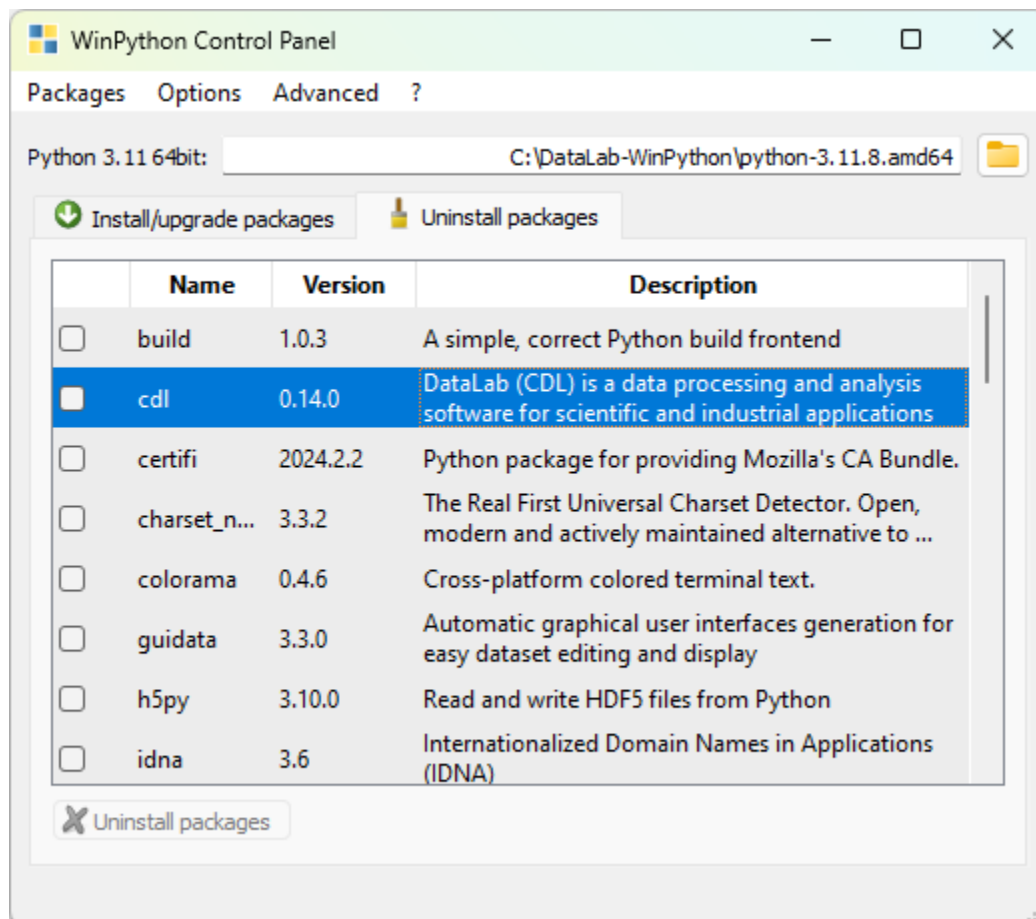


Fig. 3: DataLab-WinPython Control Panel

Warning: Whereas the all-in-one installer provides a monolithic package that guarantees the compatibility of all its components because it cannot be modified by the user, the WinPython distribution is more flexible and thus can be broken by a bad manipulation of the Python distribution by the user. This should be taken into account when choosing the installation method.

Wheel package

GNU/Linux Windows macOS

On any operating system, using pip and the Wheel package is the easiest way to install DataLab on an existing Python distribution:

```
$ pip install --upgrade DataLab-0.11.1-py2.py3-none-any.whl
```

Source package

GNU/Linux Windows macOS

Installing DataLab directly from the source package may be done using pip:

```
$ pip install --upgrade cdl-0.11.1.tar.gz
```

Or, if you prefer, you can install it manually by running the following command from the root directory of the source package:

```
$ pip install --upgrade .
```

Finally, you can also build your own Wheel package and install it using pip, by running the following command from the root directory of the source package (this requires the build and wheel packages to be installed):

```
$ pip install build wheel # Install build and wheel packages (if needed)
$ python -m build # Build the wheel package
$ pip install --upgrade dist/cdl-0.11.1-py2.py3-none-any.whl # Install the wheel package
```

Development version

GNU/Linux Windows macOS

If you want to try the latest development version of DataLab, you can install it directly from the master branch of the Git repository.

The first time you install DataLab from the Git repository, enter the following command:

```
$ pip install git+https://github.com/DataLab-Platform/DataLab.git
```

Then, if at some point you want to upgrade to the latest version of DataLab, just run the same command with options to force the reinstall of the package without handling dependencies (because it would reinstall all dependencies):

```
$ pip install --force-reinstall --no-deps git+https://github.com/DataLab-Platform/
↪DataLab.git
```

Note: If dependencies have changed, you may need to execute the same command as above, but without the `--no-deps` option.

1.1.2 Dependencies

Note: The DataLab all-in-one installer already include all those required libraries as well as Python itself.

The `cdl` package requires the following Python modules:

Name	Version	Summary
Python	>=3.9, <4	Python programming language
guidata	>= 3.7	Automatic GUI generation for easy dataset editing and display
PlotPy	>= 2.7	Curve and image plotting tools for Python/Qt applications
SciPy	>= 1.5, < 1.15.0	Fundamental algorithms for scientific computing in Python
scikit-image	>= 0.18	Image processing in Python
pandas	>= 1.2	Powerful data structures for data analysis, time series, and statistics
Py-Wavelets	>= 1.1	PyWavelets, wavelet transform module
psutil	>= 5.7	Cross-platform lib for process and system monitoring in Python. NOTE: the syntax of this script MUST be kept compatible with Python 2.7.
PyQt5	>=5.11	Python bindings for the Qt cross platform application toolkit

Optional modules for development:

Name	Version	Summary
ruff		An extremely fast Python linter and code formatter, written in Rust.
pylint		python code static checker
Coverage		Code coverage measurement for Python
pyinstaller	>=6.0	PyInstaller bundles a Python application and all its dependencies into a single package.

Optional modules for building the documentation:

Name	Version	Summary
PyQt5		Python bindings for the Qt cross platform application toolkit
sphinx		Python documentation generator
sphinx_intl		Sphinx utility that make it easy to translate and to apply translation.
sphinx-sitemap		Sitemap generator for Sphinx
myst_parser		An extended [CommonMark](https://spec.commonmark.org/) compliant parser,
sphinx_design		A sphinx extension for designing beautiful, view size responsive web components.
sphinx-copybutton		Add a copy button to each of your code cells.
pydata-sphinx-theme		Bootstrap-based Sphinx theme from the PyData community

Optional modules for running test suite:

Name	Version	Summary
pytest		pytest: simple powerful testing with Python
pytest-xvfb		A pytest plugin to run Xvfb (or Xephyr/Xvnc) for tests.

Note: Python 3.11 and PyQt5 are the reference for production release

1.2 Use cases, main features and key strengths

DataLab is a platform for data processing and visualization (signals or images) that includes many functions. Developed in Python, it benefits from the richness of the associated ecosystem in terms of scientific and technical libraries.

1.2.1 What are the applications for Datalab?

Real world examples

A few concrete and specific examples illustrate the nature of the work that can be carried out with DataLab:

- Processing of experimental data (signals and images) acquired on a scientific facility in the nuclear field
- Processing of data acquired by a sensor in an industrial context
- Processing of images acquired by a camera in a medical context
- Automatic detection of defects on a surface, in the context of quality control
- Automatic detection of laser spots on a target, in the context of laser alignment
- Instrument alignment through image processing
- Automatic pattern detection on images and geometric correction of the images, in the context of non destructive testing

Usage modes

Depending on the application, DataLab can be used in three different modes:

- **Stand-alone mode:** DataLab is a full-fledged processing application that can be adapted to the client's needs through the addition of industry-specific plugins.
- **Embedded mode:** DataLab is integrated into your application to provide the necessary processing and visualization features.
- **Remote-controlled mode:** DataLab communicates with your application, allowing it to benefit from its functionality without disrupting the user experience.

Use cases

See also:

For practical examples of use cases, see the [Tutorials](#) section:

- Most of the tutorials are describing concrete examples of use of DataLab in a scientific or technical context.
- Regarding the use of DataLab with an IDE (Integrated Development Environment) such as Visual Studio Code or Spyder, see the tutorial [DataLab and Spyder: a perfect match](#).
- As for the use of DataLab with Jupyter notebooks, that is one of the topics covered in the tutorial [Add your own features](#).

DataLab is a versatile tool that can be used in different contexts:

Data processing

DataLab is a powerful tool for processing signals and images. It can be used to develop complex algorithms, or to quickly prototype a processing chain.

See our [Tutorials](#) for practical examples of use in data processing.

Companion tool for scientific/technical work

DataLab can be used as a companion tool for scientific/technical work. It allows you to visualize and process data, and to share your results with your colleagues. It can easily be adapted to your needs through the addition of plugins, and it may even be used together with your every day tools (e.g., Visual Studio Code, Spyder... or Jupyter notebooks).

See our [Tutorials](#) for practical examples of use in a scientific/technical context.

Prototyping a data processing application

DataLab can be used to quickly prototype a data processing application. It can then be used as a basis for the development of a full-fledged application.

See the tutorial [Prototyping a custom processing pipeline](#) for a concrete example.

Debugging a data processing application

DataLab can be used as an advanced debugging tool for your data processing applications, independently from the development environment or the language used (Python, C#, C++, etc.). All you need is to be able to communicate with DataLab via its remote control interface (standard XML-RPC protocol). This allows you to send data to DataLab (signals, images or even geometric shapes), visualize the data at each step of the processing chain, manipulate them to better understand the behavior of your algorithms, and even modify them to test the robustness of your code.

See the tutorial [Debugging your algorithm with DataLab](#) for a quick overview of this feature.

Note: DataLab can also be controlled from your familiar development environment (e.g., Visual Studio Code, Spyder...) or from a Jupyter notebook, in order to perform calculations using your processing functions while leveraging the advanced features of DataLab. See the tutorials [Prototyping a custom processing pipeline](#) or [DataLab and Spyder: a perfect match](#) for examples of use.

With its user-friendly experience and versatile usage modes, DataLab enables efficient development of your data processing and visualization applications while benefiting from an industrial-grade technological platform.

1.2.2 Main features

The main technical features of DataLab include:

- Support for numerous standard and proprietary data formats
- Opening an arbitrary number of objects (signals or images) for batch processing, with the possibility of defining groups of objects
- Simultaneous viewing of multiple objects with annotation support
- Standard operations and processing on signals and images
- Advanced image processing (restoration, morphology, edge detection, etc.)
- Management of multiple regions of interest (calculations, extractions)
- Macro-command editor
- Remote-controllable API
- Embedded interactive Python console

1.2.3 Key strengths

To summarize, the four key strengths of DataLab are:

Extensibility

The DataLab plugin system makes it easy to code new features (specific processing, specific file formats, custom graphical interfaces). It can also be used as a customizable platform.

Interoperability

DataLab can also be embedded in your own application. For example, within data processing software, machine-level control systems, or test bench applications.

Automation

A high-level public API allows for full remote control of DataLab to open and process data.

Maintainability and testability

DataLab is an industrial-grade scientific and technical processing software. The built-in automated tests in DataLab cover 90% of its features, which is significant for software with graphical interfaces and helps mitigate regression risks. Moreover, the test suite includes validation tests based either on ground truth data or analytical solutions.

See also:

See section [Validation](#) for more information on DataLab's validation strategy.

1.3 Key features

This page presents briefly DataLab key features.

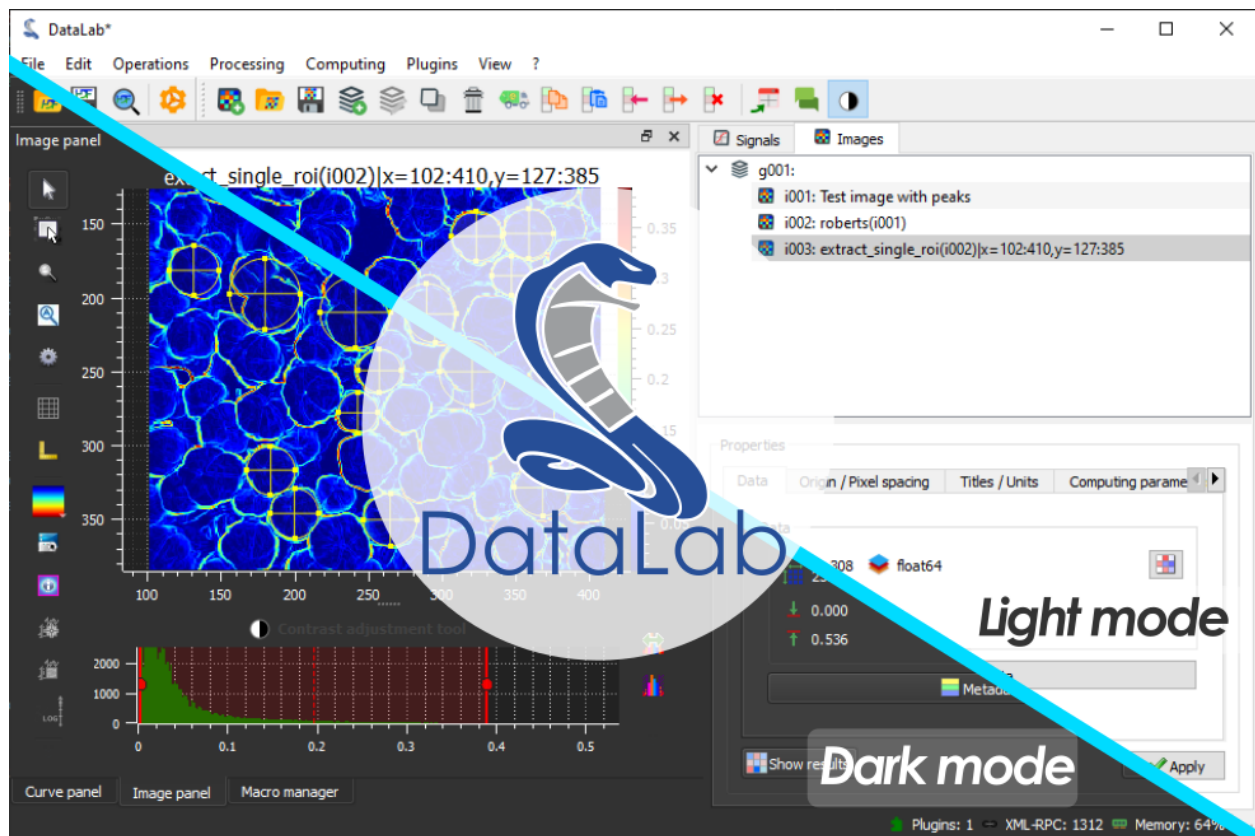


Fig. 4: DataLab supports dark and light mode depending on your platform settings (this is handled by the `guidata` package, and may be overridden by setting the `QT_COLOR_MODE` environment variable to `dark` or `light`).

1.3.1 Data visualization

Signal	Image	Feature
✓	✓	Screenshots (save, copy)
✓	Z-axis	Lin/log scales
✓	✓	Data table editing
✓	✓	Statistics on user-defined ROI
✓	✓	Markers
	✓	Aspect ratio (1:1, custom)
	✓	50+ available colormaps (customizable)
	✓	Intensity profiles (line, average, radial)
✓	✓	Annotations
✓	✓	Persistence of settings in workspace
	✓	Distribute images on a grid
✓	✓	Single or superimposed views

1.3.2 Data processing

Signal	Image	Feature
✓	✓	Process isolation for running computations
✓	✓	Remote control from Jupyter, Spyder or any IDE
✓	✓	Remote control from a third-party application
✓	✓	Sum, average, difference, product...
✓	✓	Operations with a constant
✓	✓	ROI extraction, Swap X/Y axes
✓		Semi-automatic multi-peak detection
✓		Convolution
	✓	Flat-field correction
	✓	Flip, rotation, scaling...
	✓	Intensity profiles (line, average, radial)
	✓	Pixel binning
✓	✓	Square root, power, logarithm, exponential...
✓		Derivative, integral
✓	✓	Linear calibration
✓	✓	Normalization, Clipping, Offset correction
✓		Reverse X-axis
	✓	Thresholding (manual, Otsu...)
✓	✓	Gaussian filter, Wiener filter
✓	✓	Moving average, moving median
✓	✓	FFT, inverse FFT, Power/Phase/Magnitude spectrum, Power Spectral Density
✓		Interpolation, resampling
✓		Detrending
✓		Interactive fit: Gauss, Lorentz, Voigt, polynomial, CDF...
✓		Interactive multigaussian fit
✓		Frequency filters (low-pass, high-pass, band-pass, band-stop)
✓		Windowing (Hamming, Hanning...)
	✓	Butterworth filter
	✓	Exposure correction (gamma, log...)
	✓	Restoration (Total Variation, Bilateral...)

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Table 1 – continued from previous page

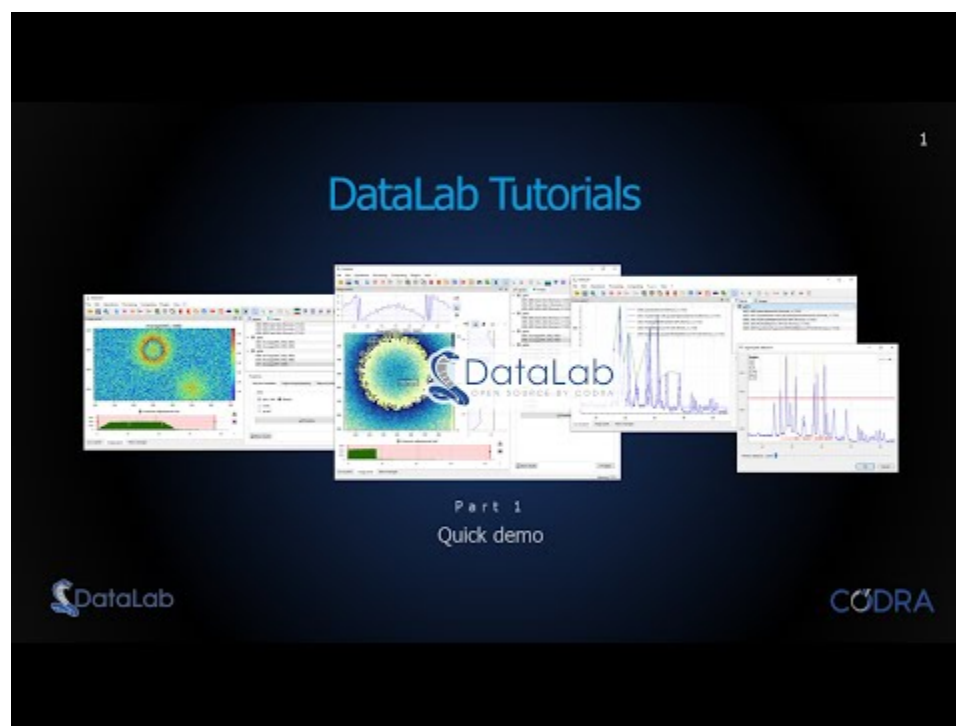
Signal	Image	Feature
	✓	Morphology (erosion, dilation...)
	✓	Edges detection (Roberts, Sobel...)
✓	✓	Analysis on custom ROI
✓		FWHM, FW @ $1/e^2$
✓		Dynamic parameters (ENOB, SNR...), Sampling period/Rate
	✓	Centroid (robust method w/r noise)
	✓	Minimum enclosing circle center
	✓	2D peak detection
	✓	Contour detection
	✓	Circle Hough transform
	✓	Blob detection (OpenCV, Laplacian of Gaussian...)

1.4 Tutorials

1.4.1 Video Tutorials

DataLab video tutorials intend to provide a complementary material to the documentation and other tutorials available here.

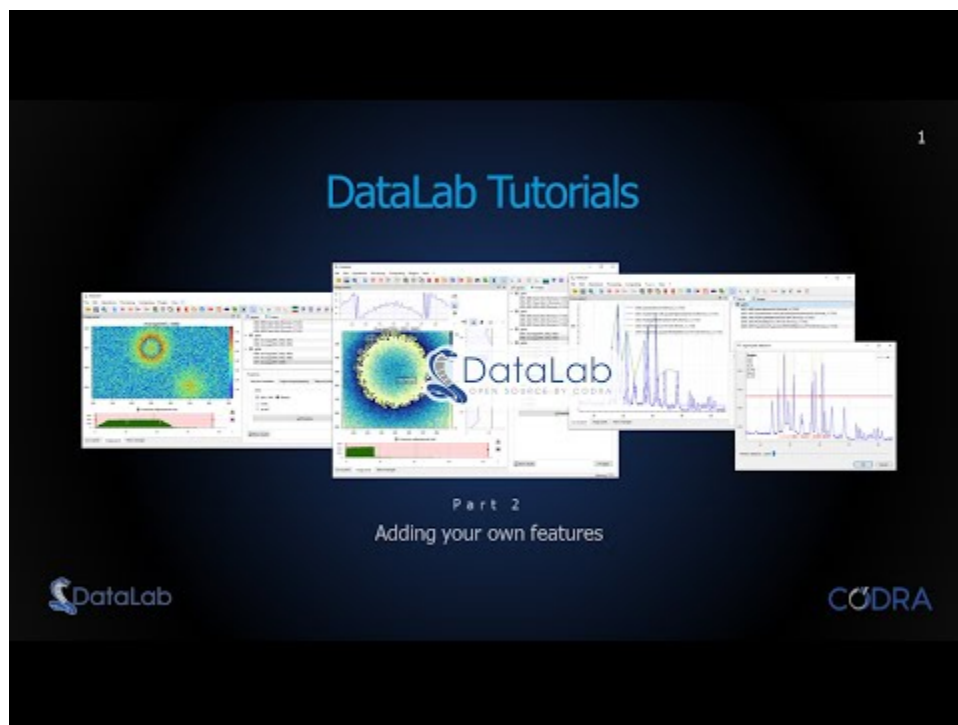
Quick demo



In this first video, we will quickly go through the main features of DataLab, and show how to do some basic signal and image processing.

Warning: This video is intentionally short and does not cover all the features of DataLab. It is meant to give you a quick overview of the software. For a more detailed description of the features, please watch the other videos or read the documentation.

Add your own features



In this tutorial, we will show how to add your own features to DataLab using three different approaches:

1. Macro-commands, using the integrated macro manager
2. Remote control of DataLab from an external IDE (e.g. Spyder) or a Jupyter notebook
3. Plugins

The first common point between these three approaches is that they all rely on DataLab's high-level API, which allow to interact with almost every aspect of the software. This API is here accessed using Python scripts, but it may also be accessed using any other language when using the remote control approach (because it relies on a standard communication protocol, XML-RPC).

The second common point is that they all use Python code, and compatible proxy objects, so that the same code can be at least partially reused in the three approaches.

1.4.2 Other Tutorials

The following tutorials are detailed step-by-step guides to perform specific tasks with DataLab, or to illustrate features of the software in the context of a scientific or technical problem. Each tutorial focuses on a specific aspect of the software and is intended to be self-contained.

Processing a spectrum

This example shows how to process a spectrum with DataLab:

- Read the spectrum from a file
- Apply a filter to the spectrum
- Extract a region of interest
- Fit a model to the spectrum
- Save the workspace to a file

First, we open DataLab and read the spectrum from a file.

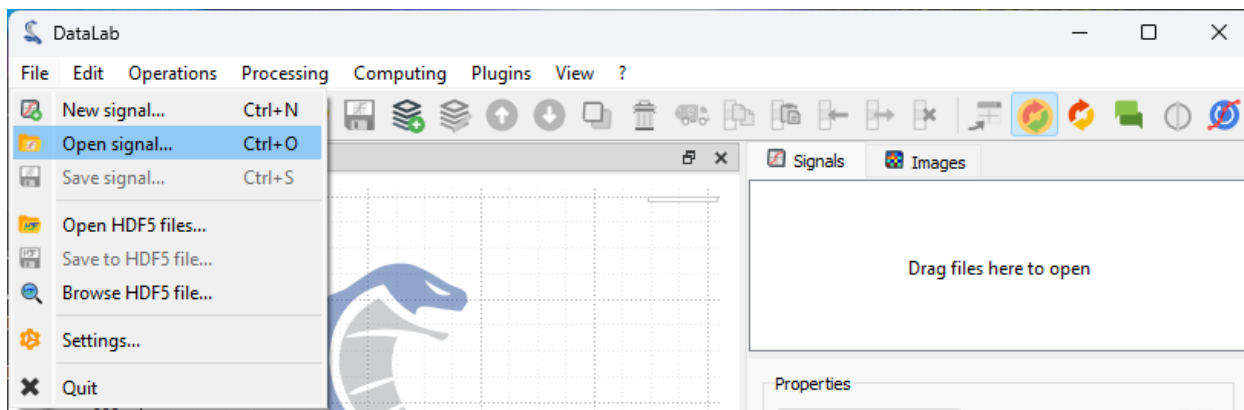


Fig. 5: Open the spectrum file with “File > Open...”, or with the button in the toolbar, or by dragging and dropping the file into DataLab (on the panel on the right).

Here, we are actually generating the signal from a test data file (using “Plugins > Test data > Load spectrum of paracetamol”), but the principle is the same.

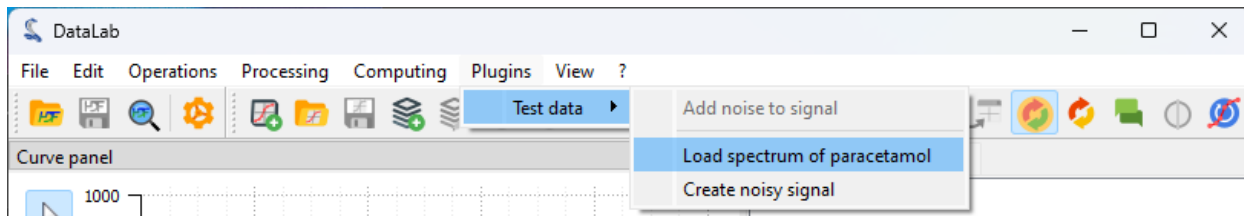


Fig. 6: Using the “Test data” plugin is a convenient way to generate test data for tutorials, but you can use any file containing a spectrum, such as a spectrum from a real experiment.

The spectrum is displayed in the main window.

Now, let’s process this spectrum by applying a filter to it. We will use a Wiener filter, which is a filter that can be used to remove noise from a signal, even if this is not absolutely necessary in this case.

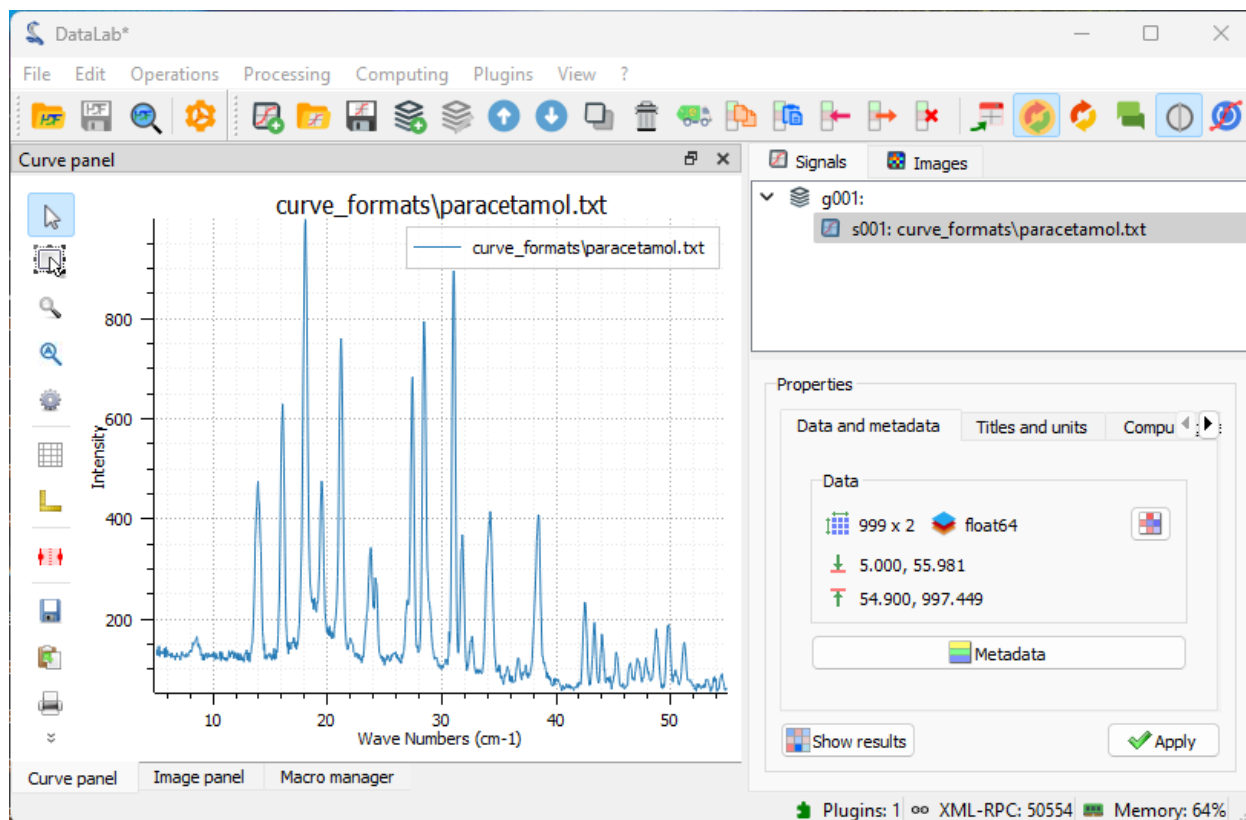


Fig. 7: The spectrum is a 1D signal, so it is displayed as a curve. The horizontal axis is the energy axis, and the vertical axis is the intensity axis.

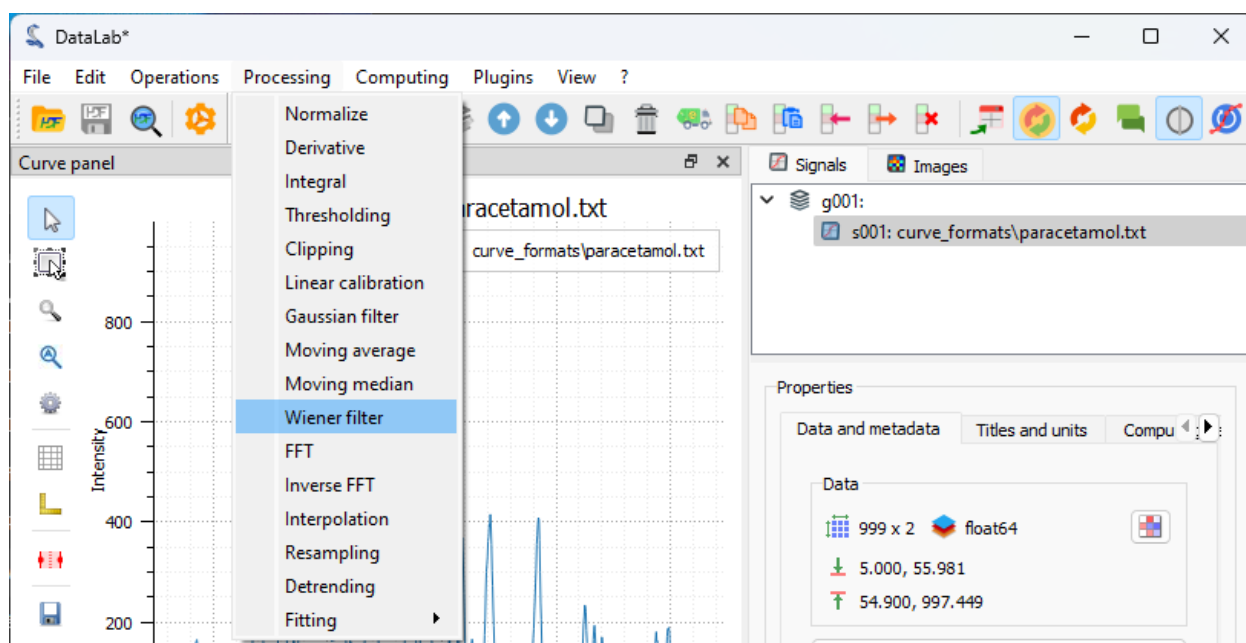


Fig. 8: Open the filter window with “Processing > Wiener filter”.

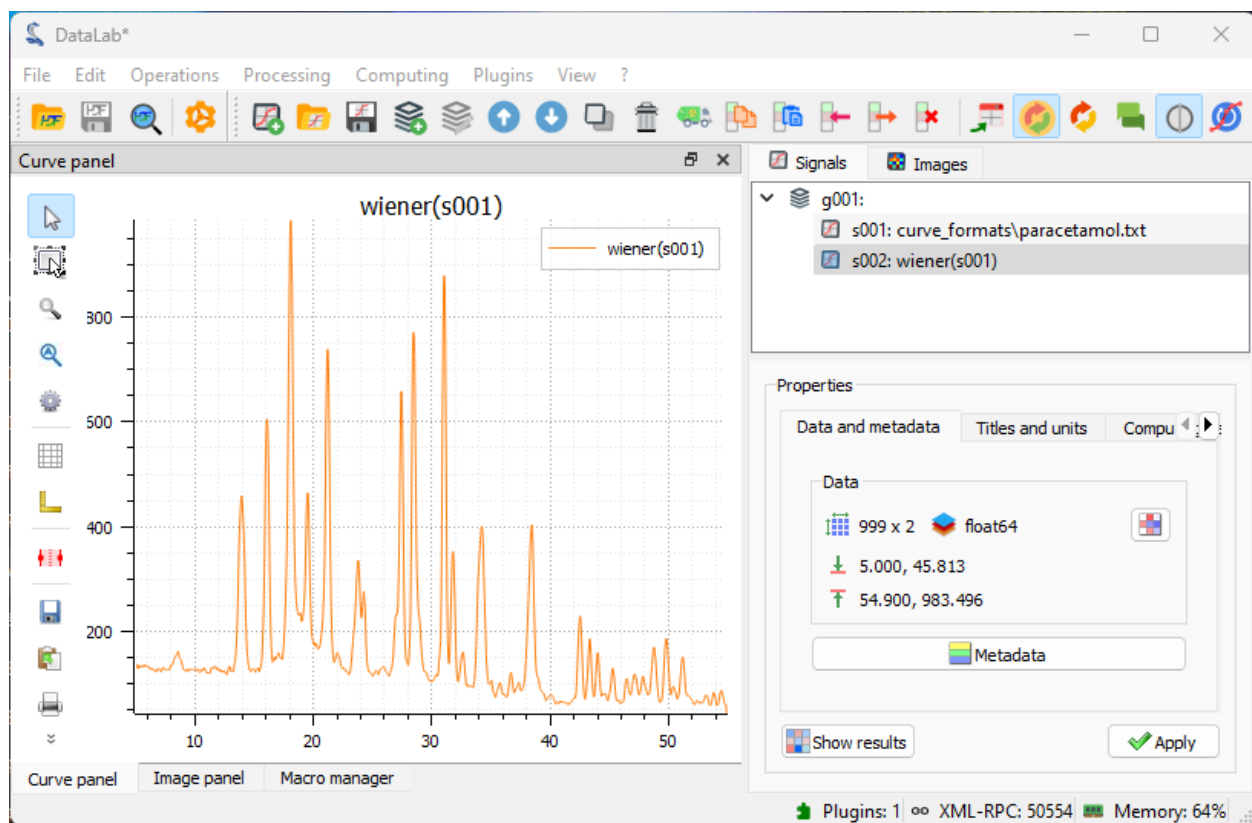


Fig. 9: The result of the filter is displayed in the main window.

If we want to analyze a specific region of the spectrum, we can extract it from the spectrum using the “ROI extraction” feature from the “Operations” menu.

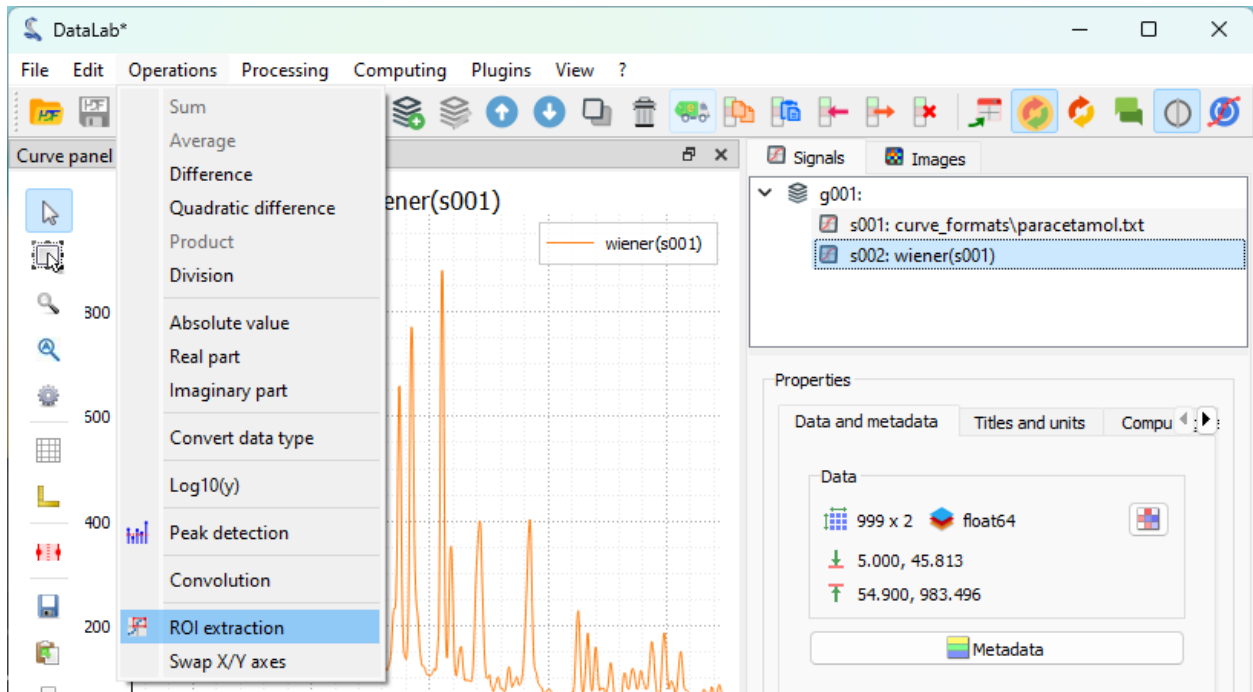


Fig. 10: Open the ROI extraction window with “Operations > ROI extraction”.

Let’s try to fit a model to the spectrum. We will use a Gaussian model, which is a model that can be used to fit a peak in a spectrum.

To demonstrate another processing feature, we can also try to detrend the spectrum.

When analyzing a spectrum, it can be useful to try to identify the peaks in the spectrum. We can do this by fitting a multi-Gaussian model to the spectrum, using the “Processing > Fitting > Multi-Gaussian fit” feature.

We also could have used the “Peak detection” feature from the “Operations” menu to detect the peaks in the spectrum.

Finally, we can save the workspace to a file. The workspace contains all the signals that were loaded in DataLab, as well as the processing results. It also contains the visualization settings (curve colors, etc.).

If you want to load the workspace again, you can use the “File > Open HDF5 file...” (or the button in the toolbar) to load the whole workspace, or the “File > Browse HDF5 file...” (or the button in the toolbar) to load only a selection of data sets from the workspace.

Detecting blobs on an image

This example shows how to detect blobs on an image with DataLab, and also covers other features such as the plugin system:

- Add a new plugin to DataLab
- Denoise an image
- Detect blobs on an image
- Save the workspace to a file

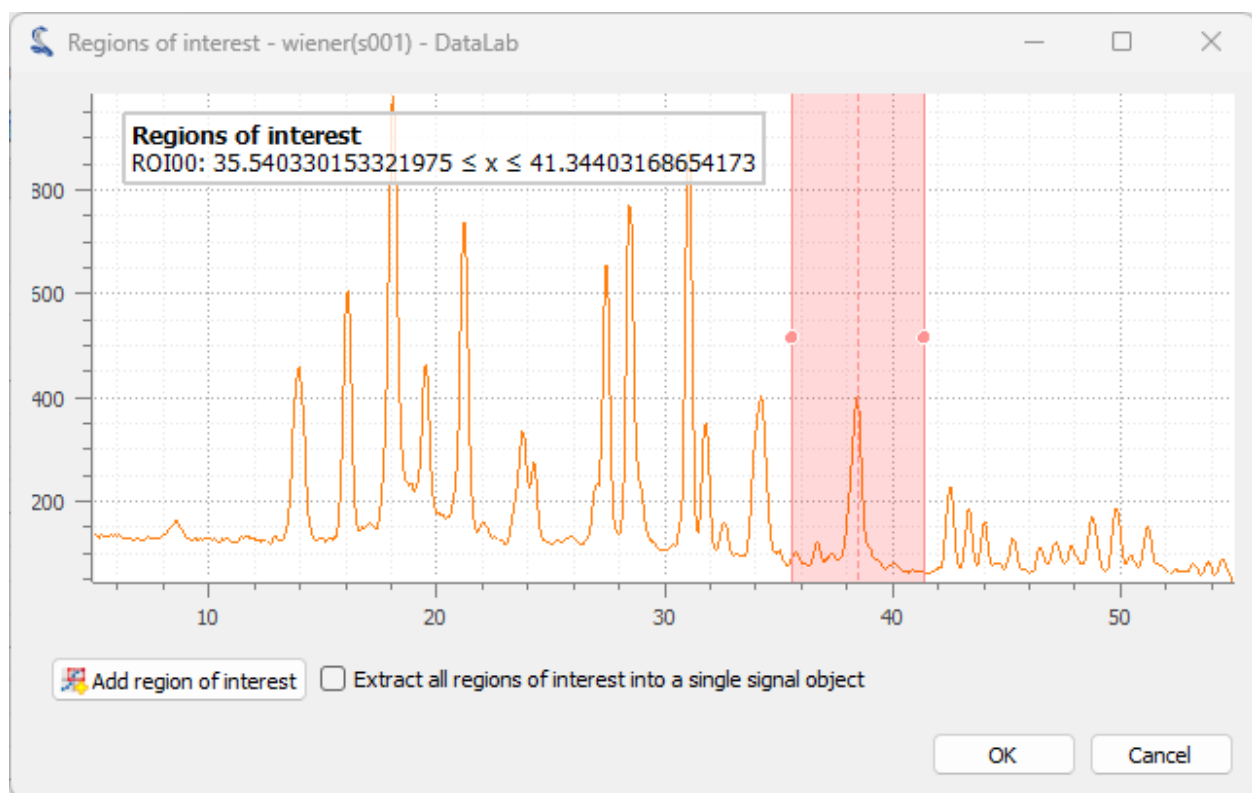


Fig. 11: The “Regions of interest” dialog box is displayed. Click on “Add ROI” and resize the horizontal window to select the area. Then, click on “OK”.

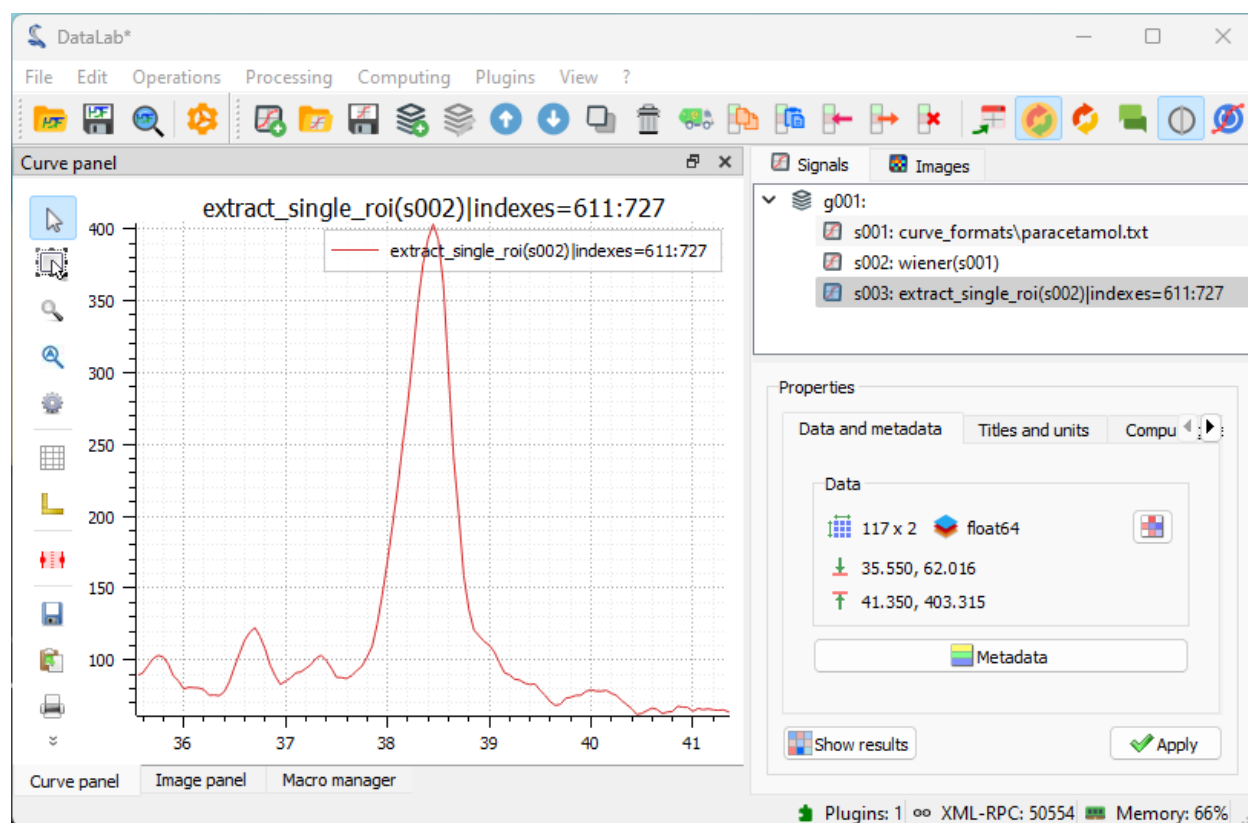


Fig. 12: The region of interest is displayed in the main window.

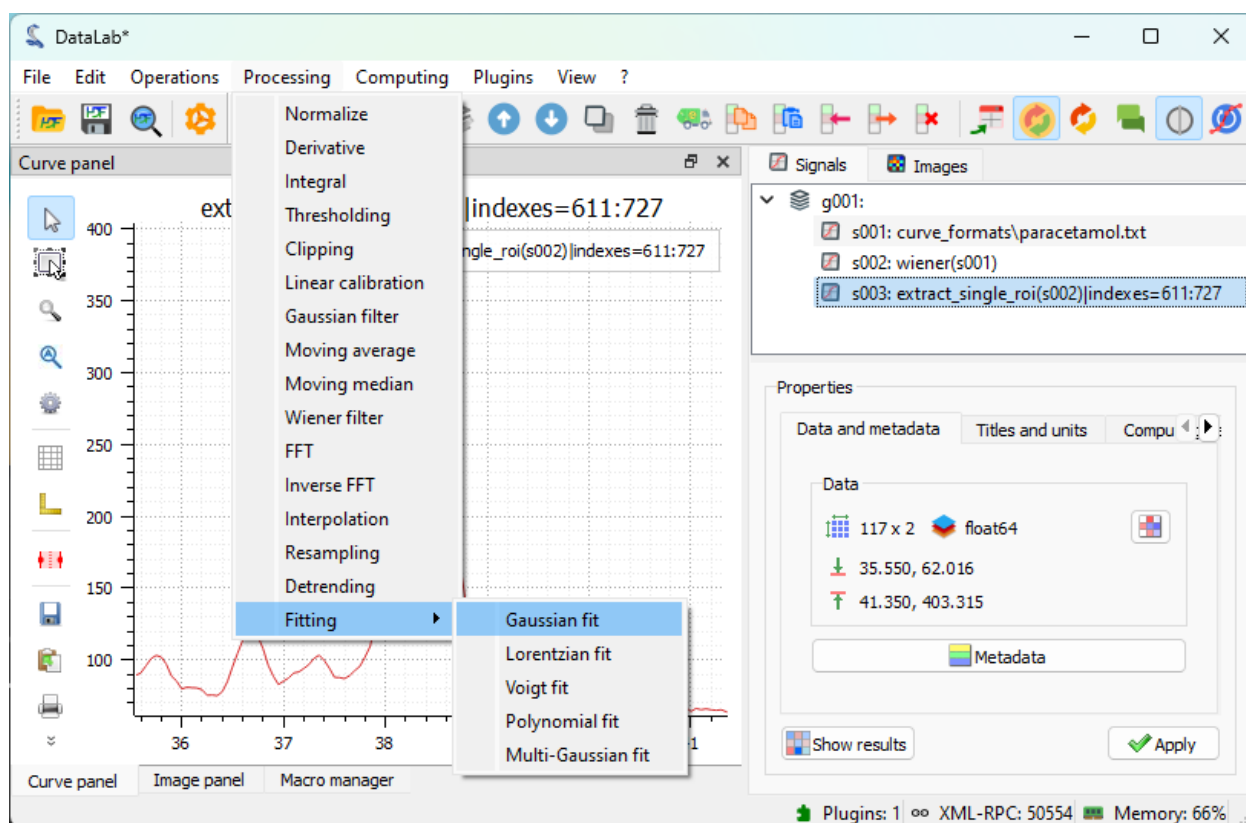


Fig. 13: Open the model fitting window with “Processing > Fitting > Gaussian fit”.

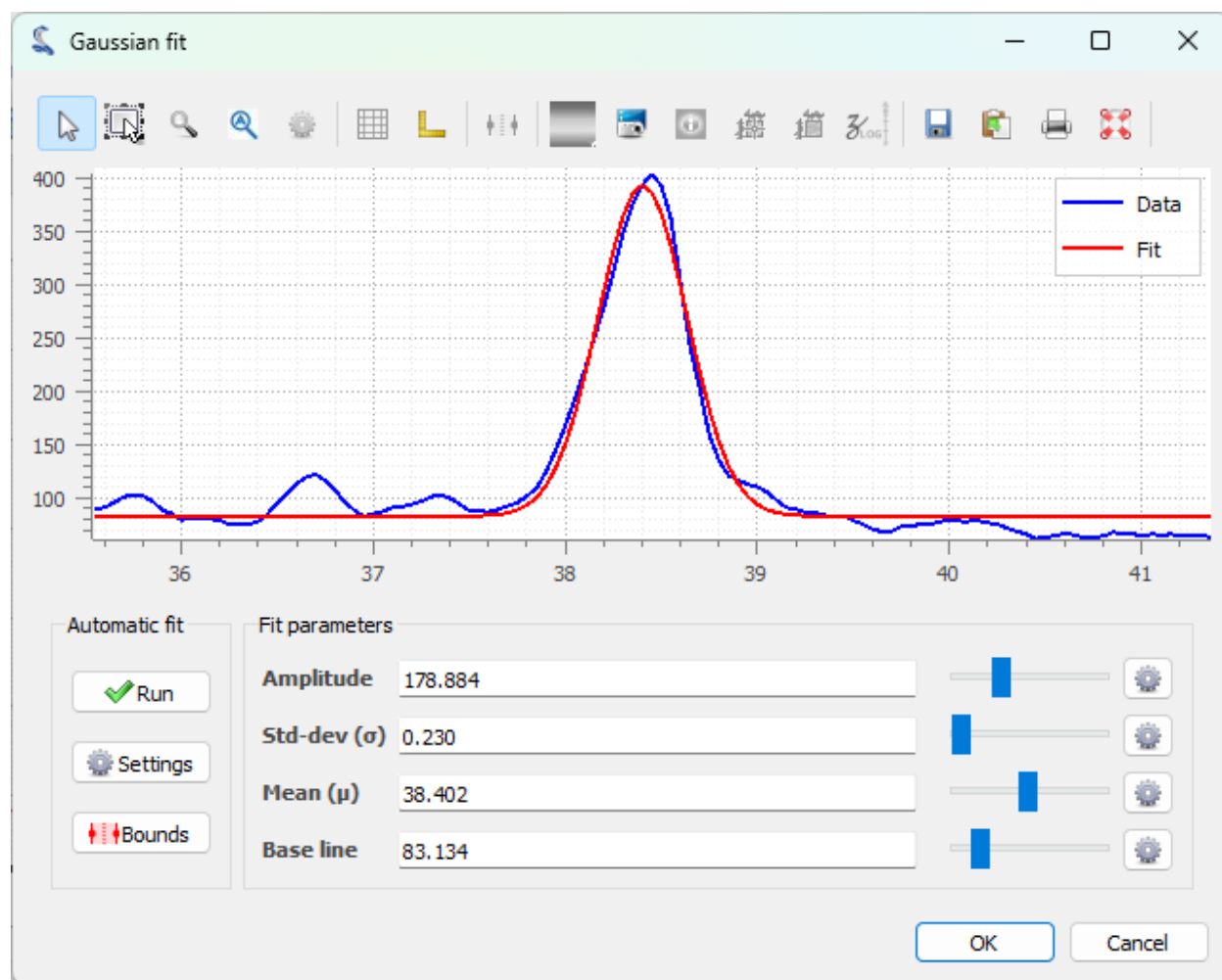


Fig. 14: The “Gaussian fit” dialog box is displayed. An automatic fit is performed by default. Click on “OK” (or eventually try to fit the model manually by adjusting the parameters or the sliders, or try to change the automatic fitting parameters).

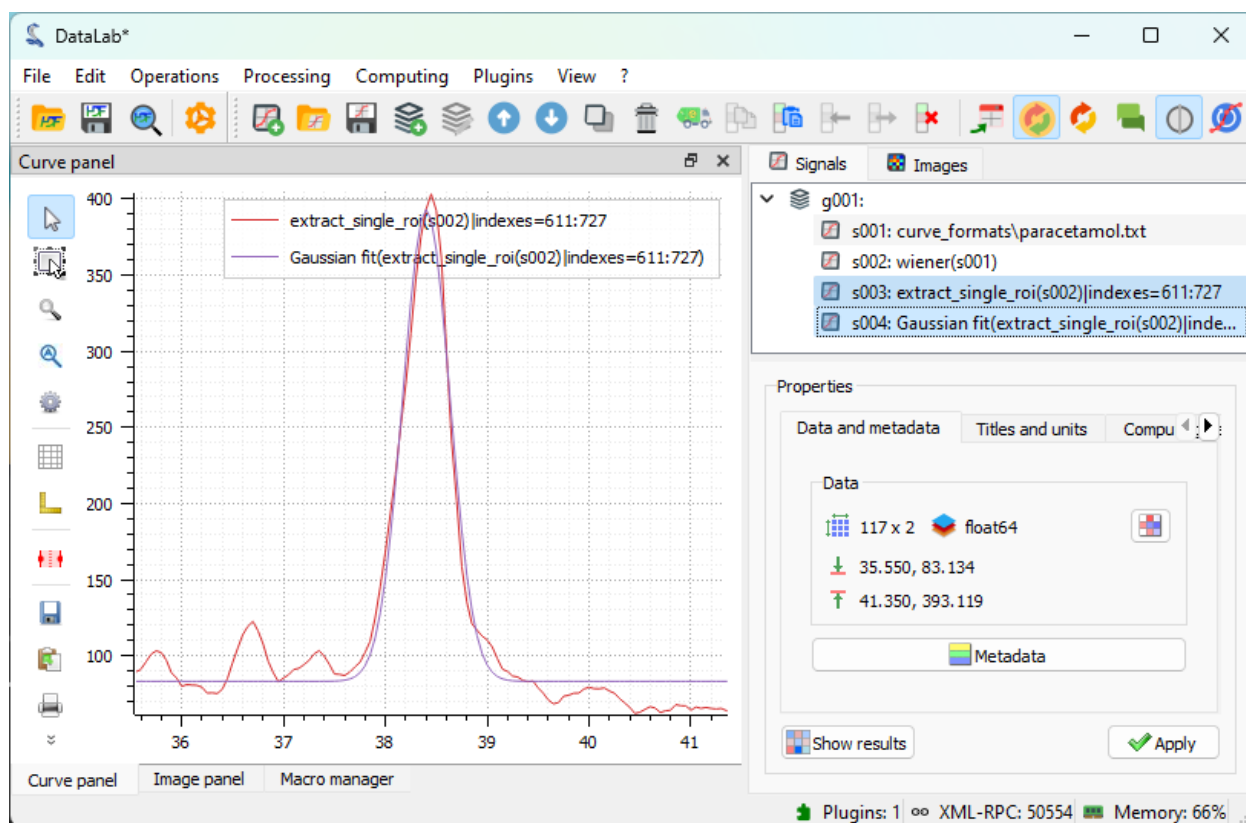


Fig. 15: The result of the fit is displayed in the main window. Here we selected both the spectrum and the fit in the “Signals” panel on the right, so both are displayed in the visualization panel on the left.

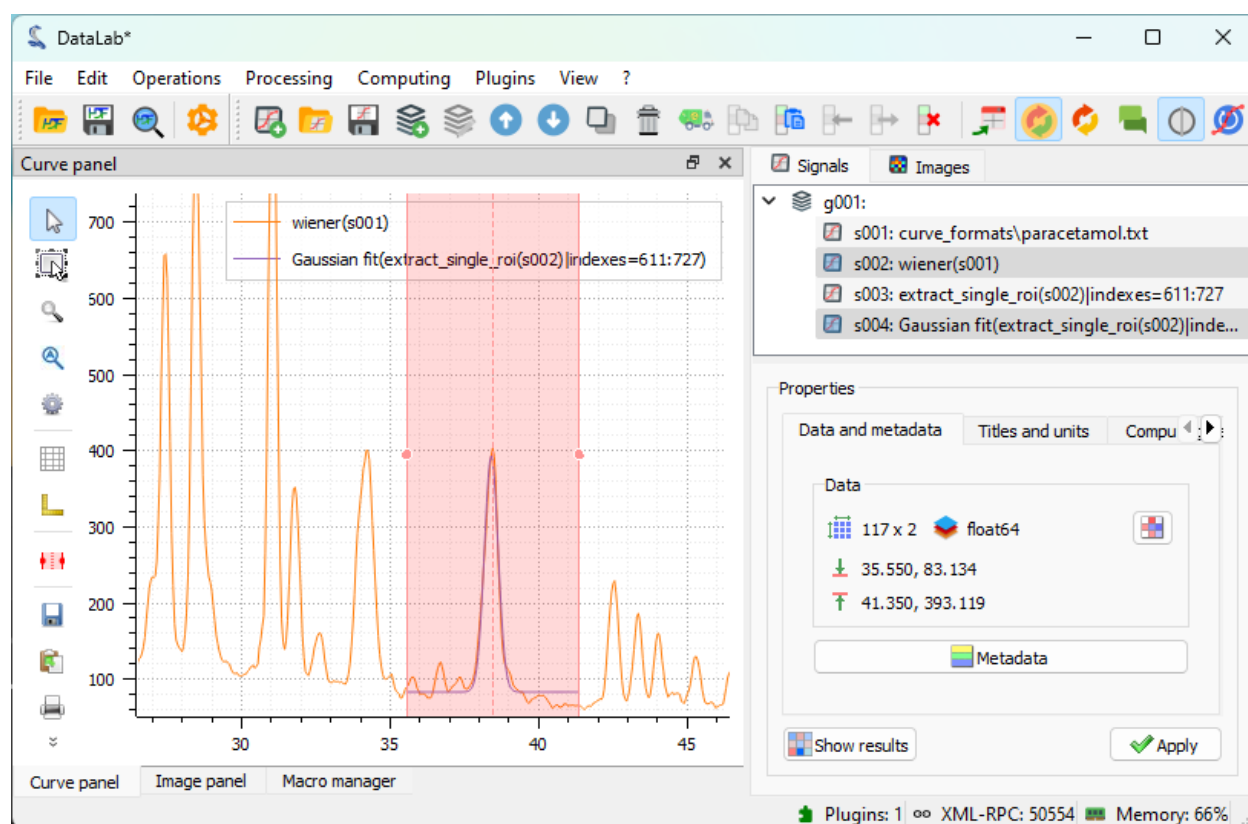


Fig. 16: We may also select the full spectrum and the fit in the “Signals” panel on the right, so that both are displayed in the visualization panel on the left, if this has a sense for the analysis we want to perform. Note that the full spectrum visualization also contains the region of interest we extracted previously.

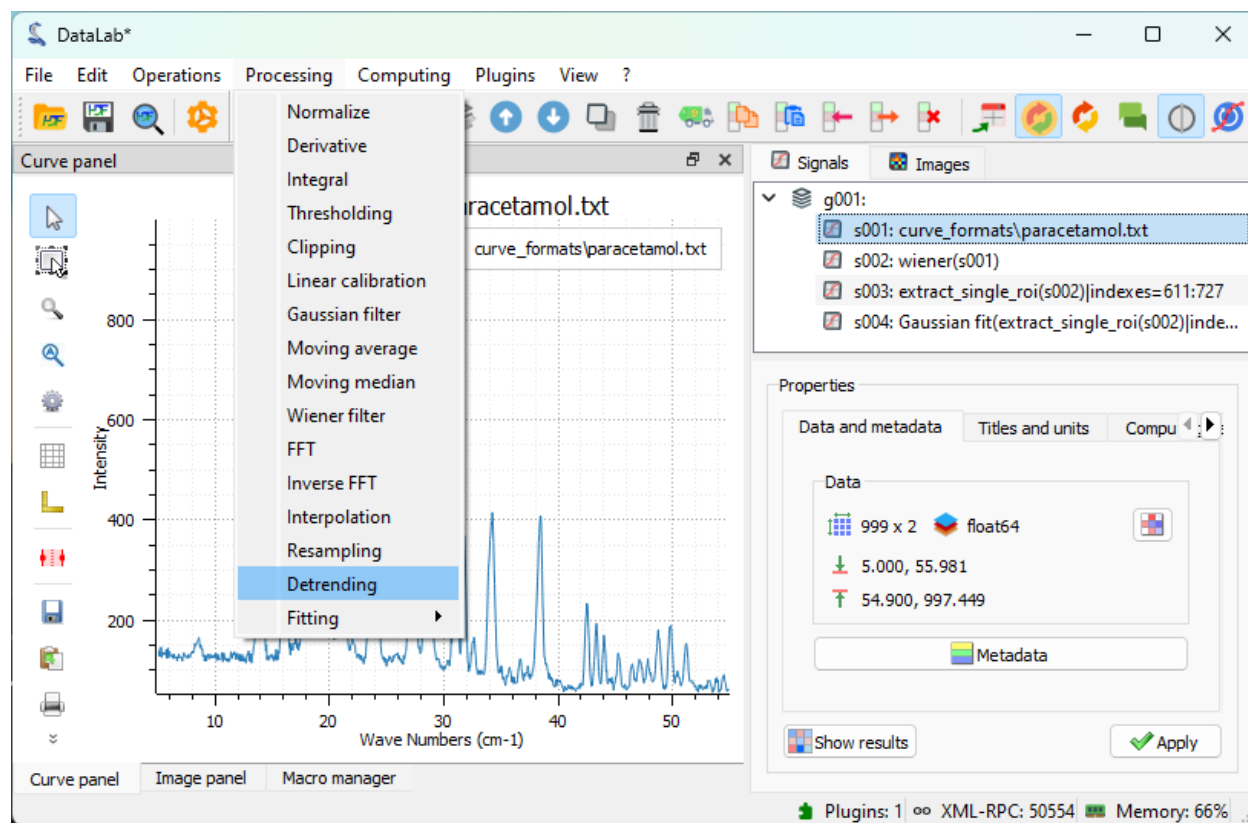


Fig. 17: Execute the “Processing > Detrending” feature.

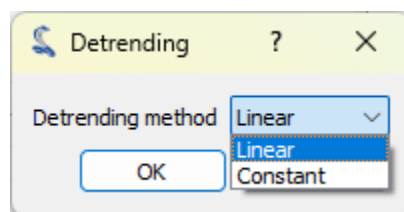


Fig. 18: We choose a linear detrending method, and we click on “OK”.

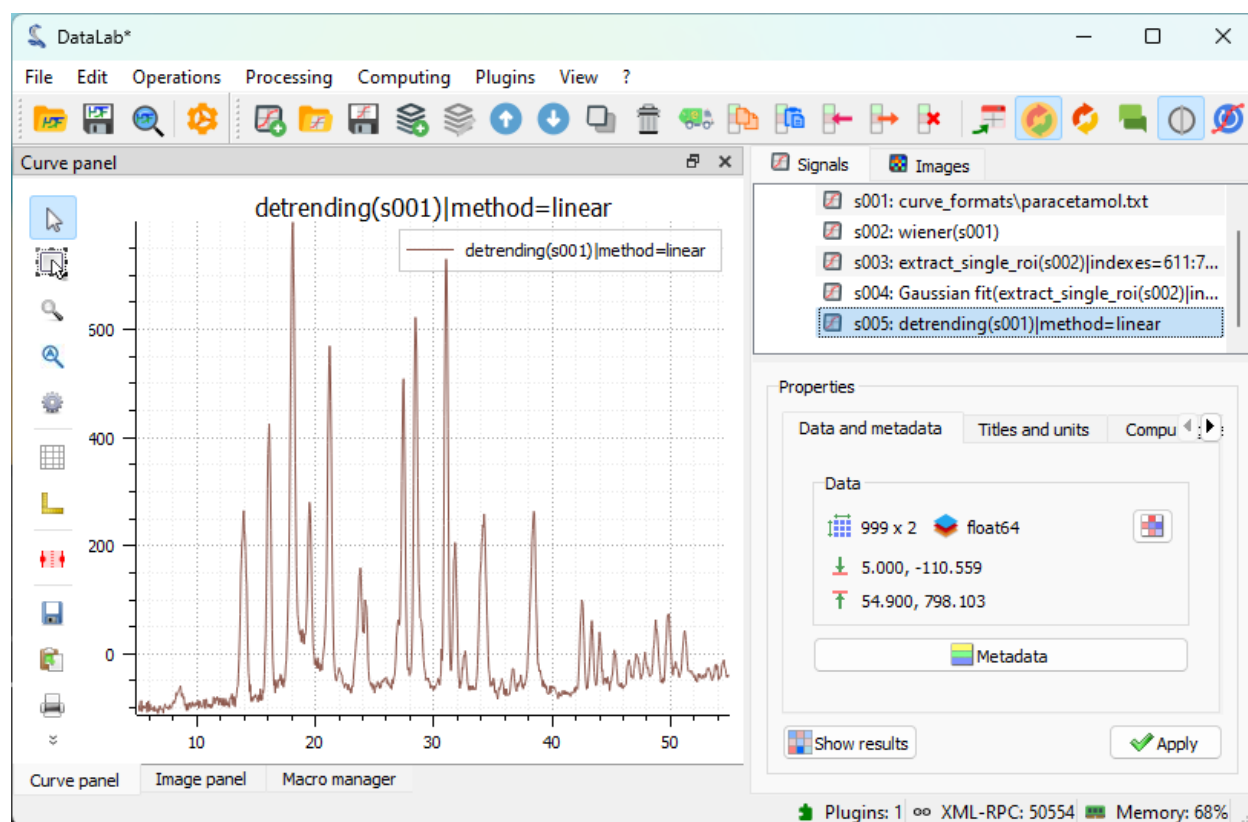


Fig. 19: The result of the detrending is displayed in the main window (in that specific case, the detrending may not be appropriate, but it is just to demonstrate the feature).

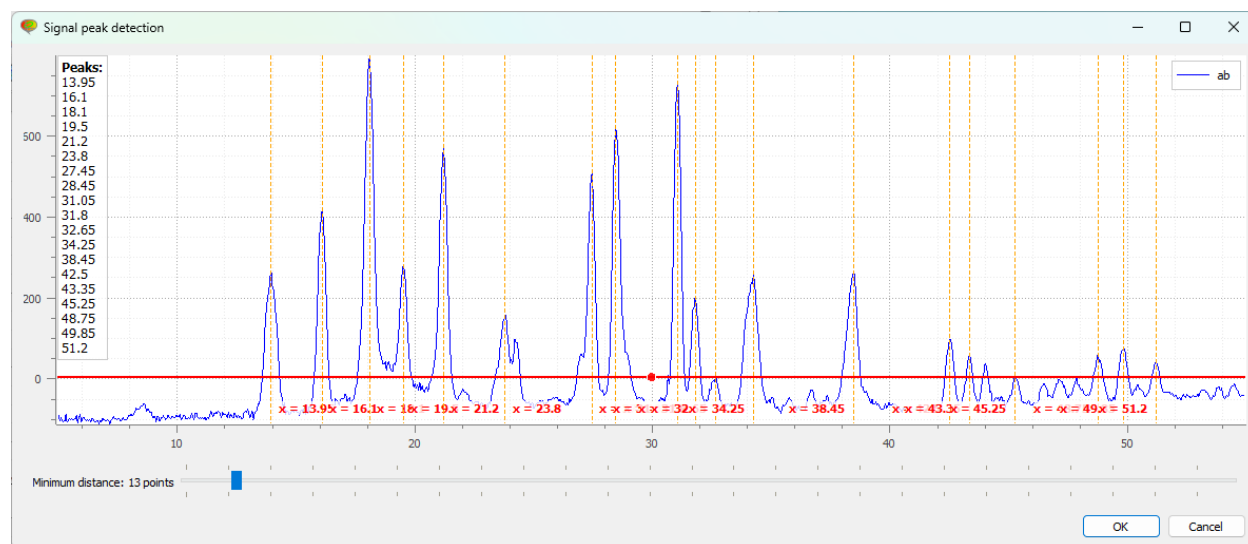


Fig. 20: First, a “Signal peak detection” dialog box is displayed. We can adjust the the vertical cursor position to select the threshold for the peak detection, as well as the minimum distance between two peaks. Then, we click on “OK”.

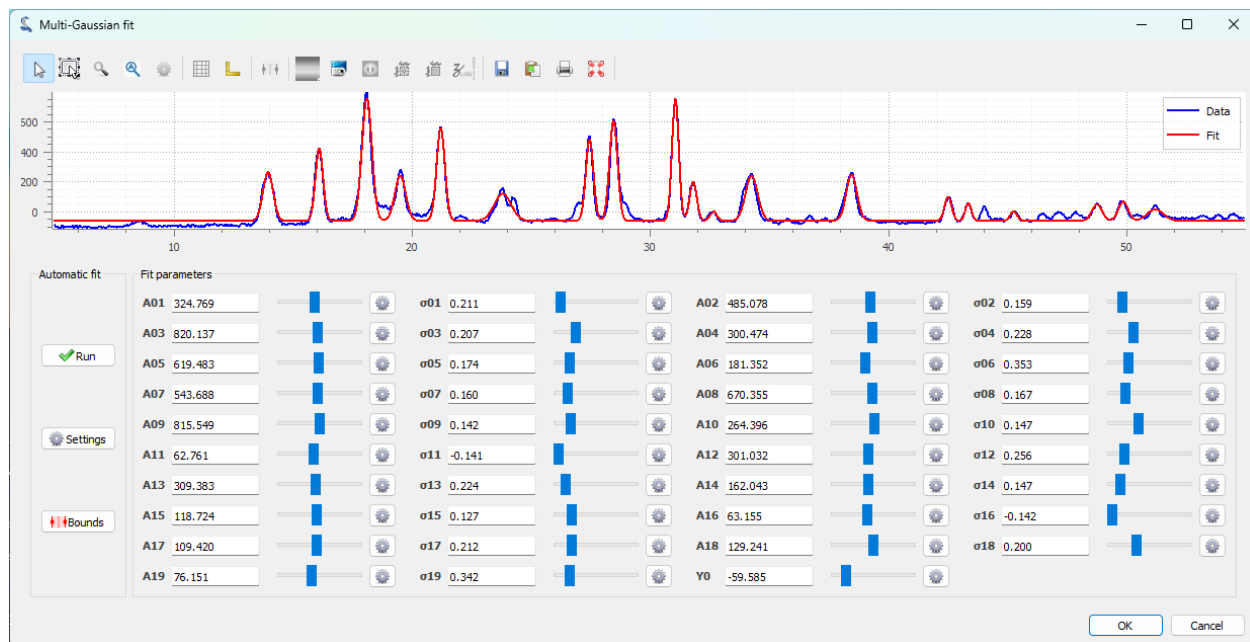


Fig. 21: The “Multi-Gaussian fit” dialog box is displayed. An automatic fit is performed by default. Click on “OK” (or eventually try to fit the model manually by adjusting the parameters or the sliders, or try to change the automatic fitting parameters).

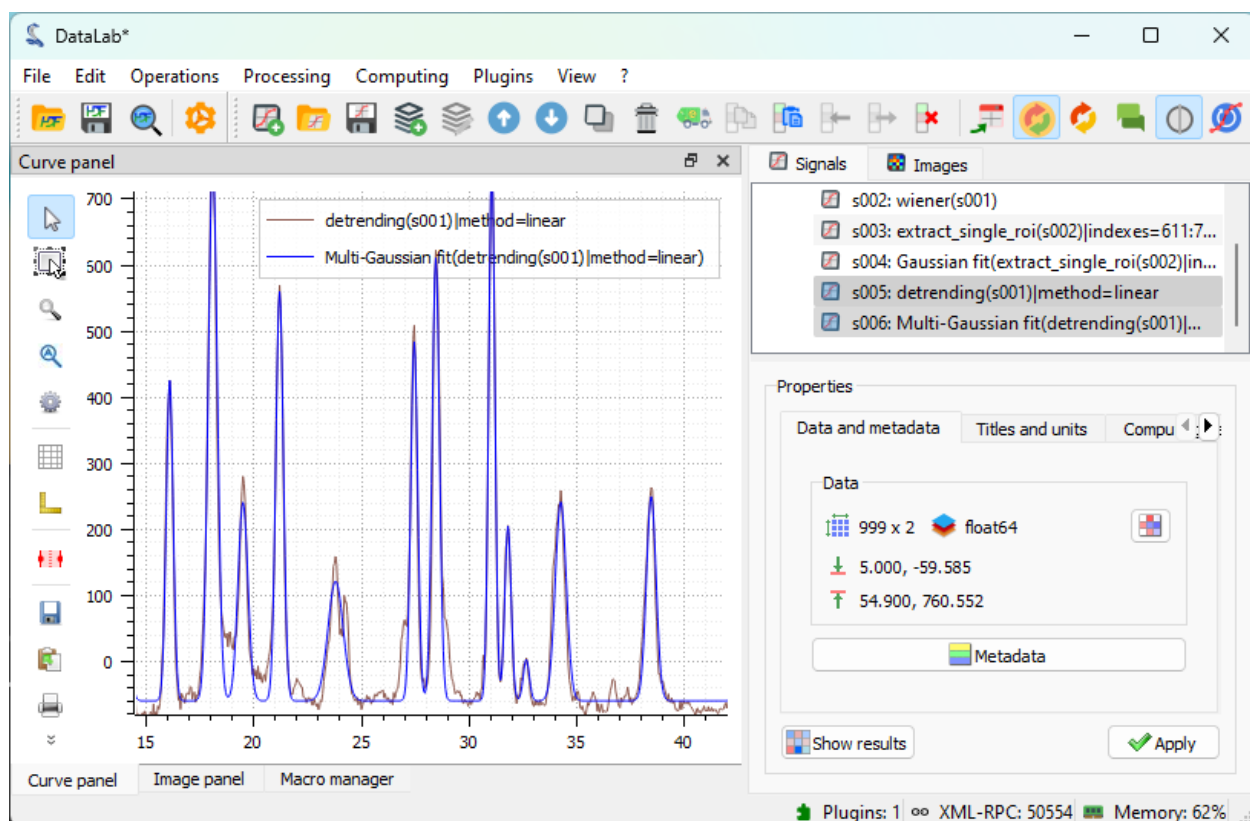


Fig. 22: The result of the fit is displayed in the main window. Here we selected both the spectrum and the fit in the “Signals” panel on the right, so both are displayed in the visualization panel on the left.

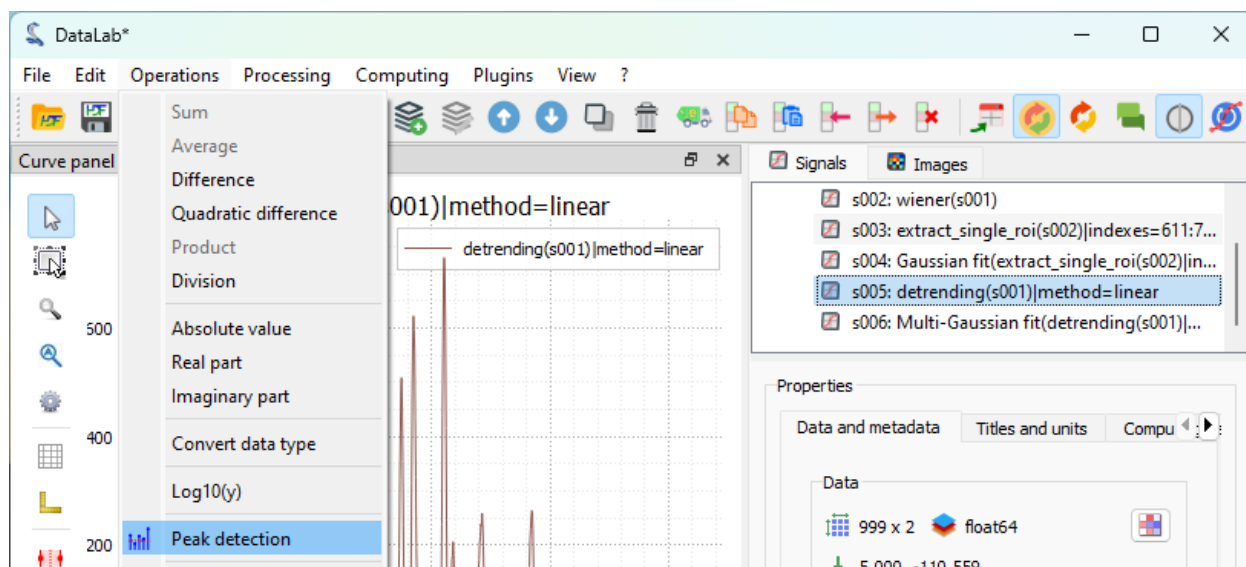


Fig. 23: Open the “Peak detection” window with “Operations > Peak detection”.

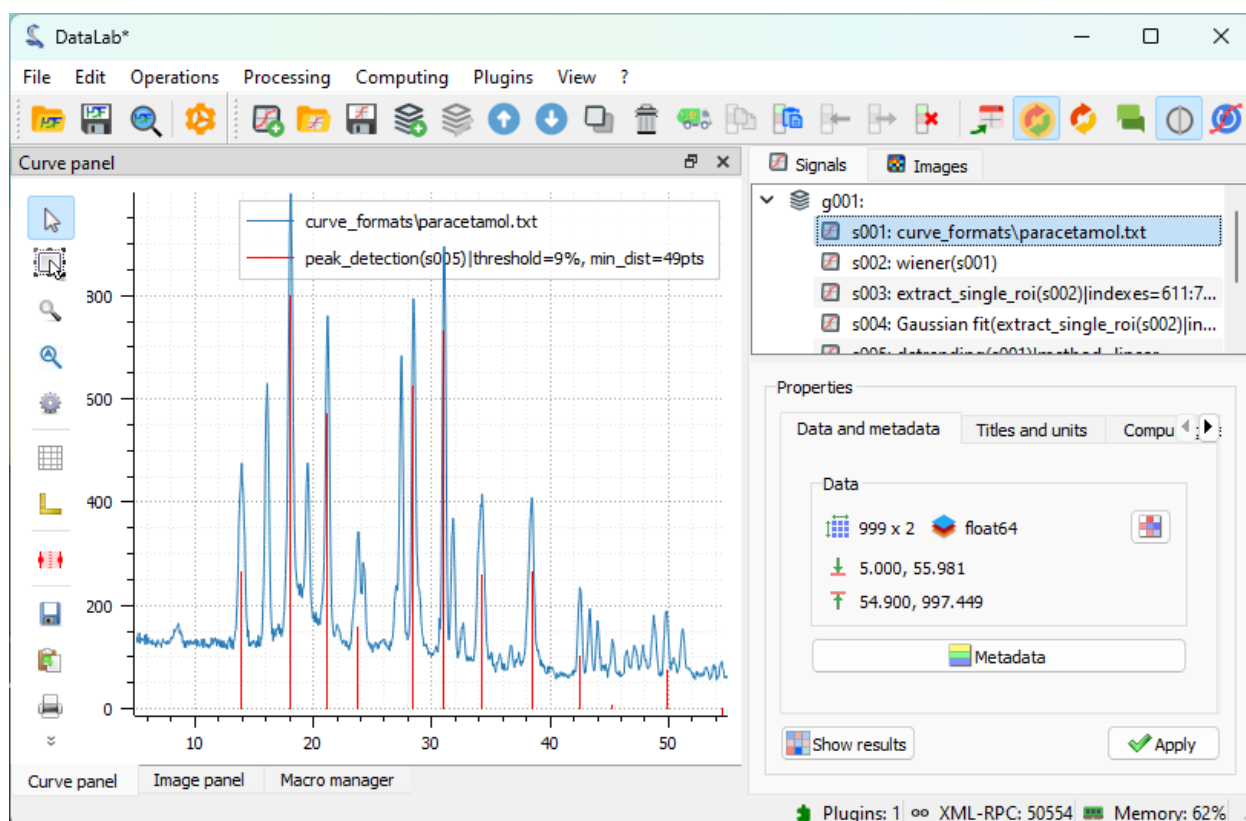


Fig. 24: After having adjusted the parameters of the peak detection dialog (same dialog as the one used for the multi-Gaussian fit), click on “OK”. Then, we select the “peak_detection” and the original spectrum in the “Signals” panel on the right, so that both are displayed in the visualization panel on the left.

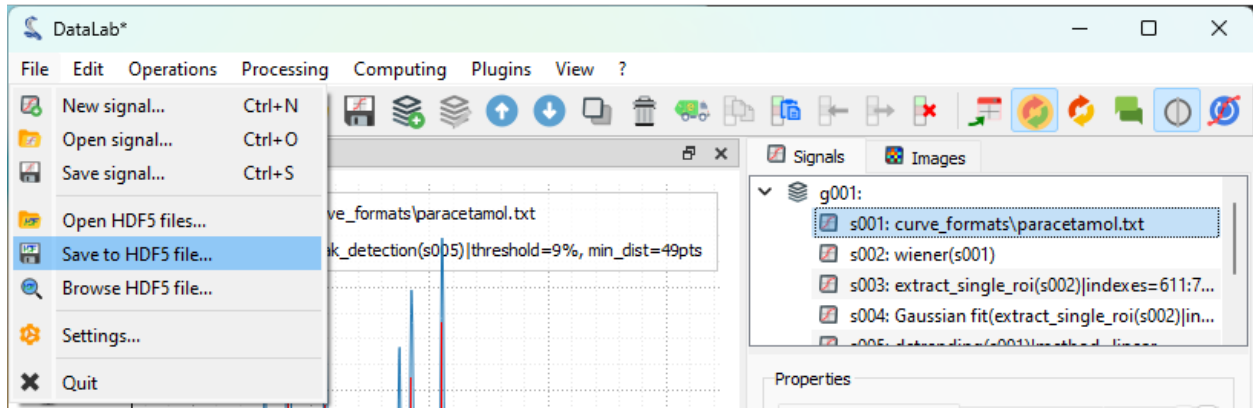


Fig. 25: Save the workspace to a file with “File > Save to HDF5 file...”, or the button in the toolbar.

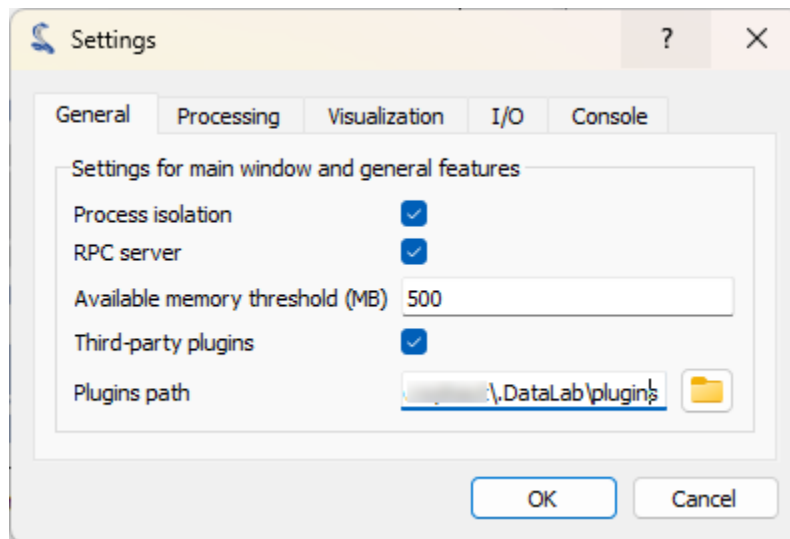



Fig. 26: In the “General” tab, we can see the “Plugins path” field. This is the path where DataLab will look for plugins. We can add a new plugin by copying/pasting the plugin file in this directory.

First, we open DataLab, and open the settings dialog (using “File > Settings...”, or the  icon in the toolbar).

See also:

The plugin system is described in the [Plugins](#) section.

Let’s add the `cdl_example_imageproc.py` plugin to DataLab (this is an example plugin that is shipped with DataLab source package, or may be downloaded from [here on GitHub](#)).

If we close and reopen DataLab, we can see that the plugin is now available in the “Plugins” menu: there is a new “Extract blobs (example)” entry.

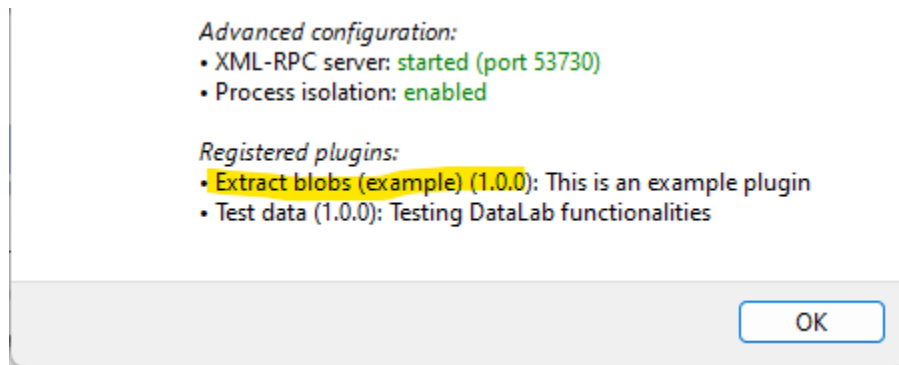


Fig. 27: The “About DataLab” dialog shows the list of available plugins.

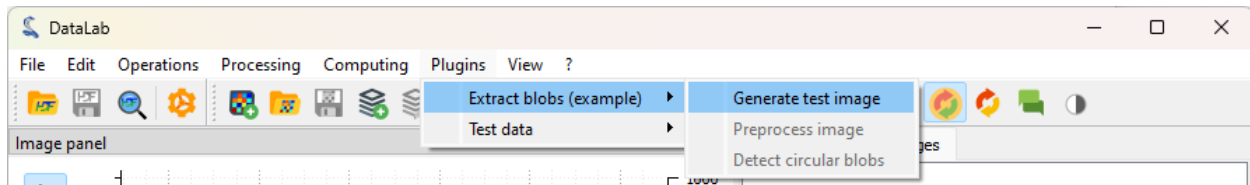


Fig. 28: Let’s click on “Extract blobs (example) > Generate test image”

For information, the image is generated by the plugin using the following code:

```
def generate_test_image(self) -> None:
    """Generate test image"""
    # Create a NumPy array:
    arr = np.random.normal(10000, 1000, (2048, 2048))
    for _ in range(10):
        row = np.random.randint(0, arr.shape[0])
        col = np.random.randint(0, arr.shape[1])
        rr, cc = skimage.draw.disk((row, col), 40, shape=arr.shape)
        arr[rr, cc] -= np.random.randint(5000, 6000)
    icenter = arr.shape[0] // 2
    rr, cc = skimage.draw.disk((icenter, icenter), 200, shape=arr.shape)
    arr[rr, cc] -= np.random.randint(5000, 8000)
    data = np.clip(arr, 0, 65535).astype(np.uint16)

    # Create a new image object and add it to the image panel
    image = cdl.obj.create_image("Test image", data, units=("mm", "mm", "lsb"))
    self.proxy.add_object(image)
```

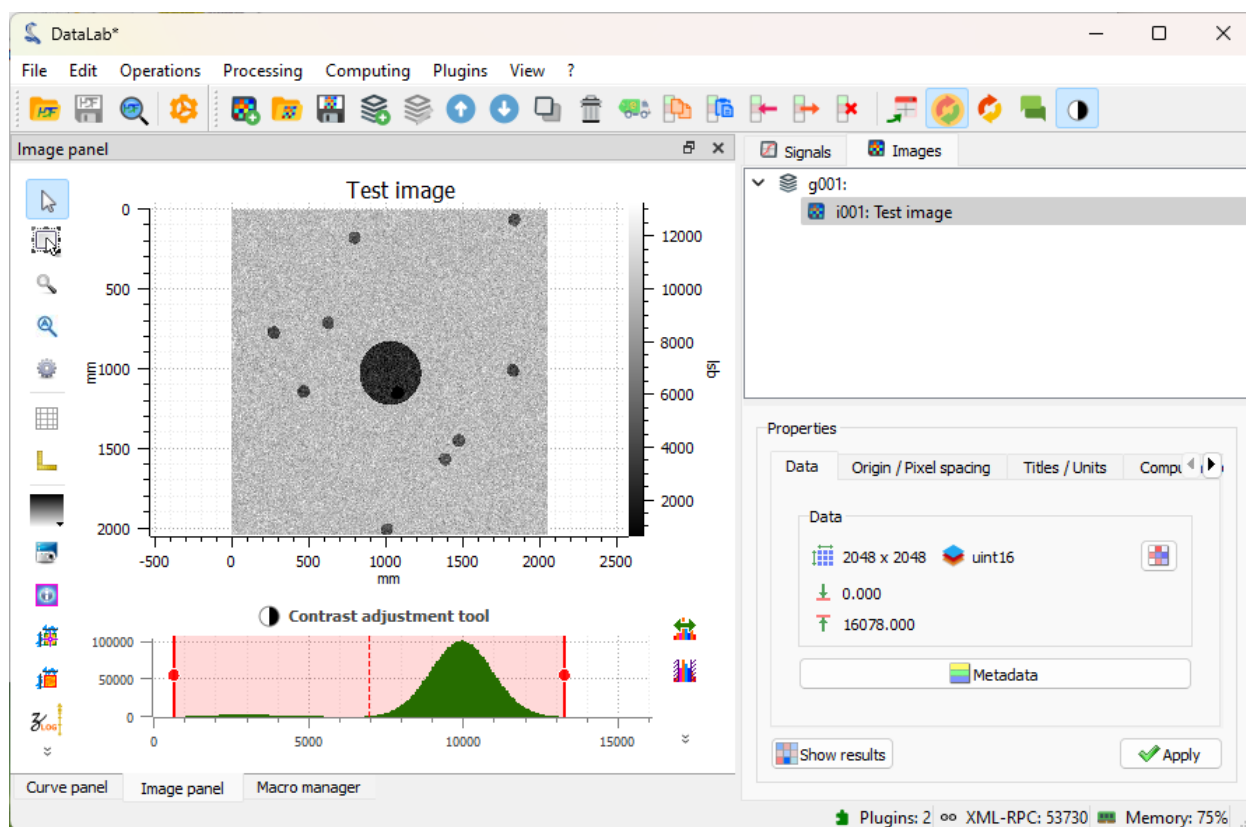


Fig. 29: The plugin has generated a test image, and added it to the “Images” panel. The image shows a few blobs, with a central dark disk, and a noisy background.

The plugin has other features, such as denoising the image, and detecting blobs on the image, but we won't cover them here: we will use the same DataLab native features as the plugin, manually.

The image is a bit noisy, and also quite large. Let's reduce the size of the image while denoising it a bit by binning the image by a factor of 2.

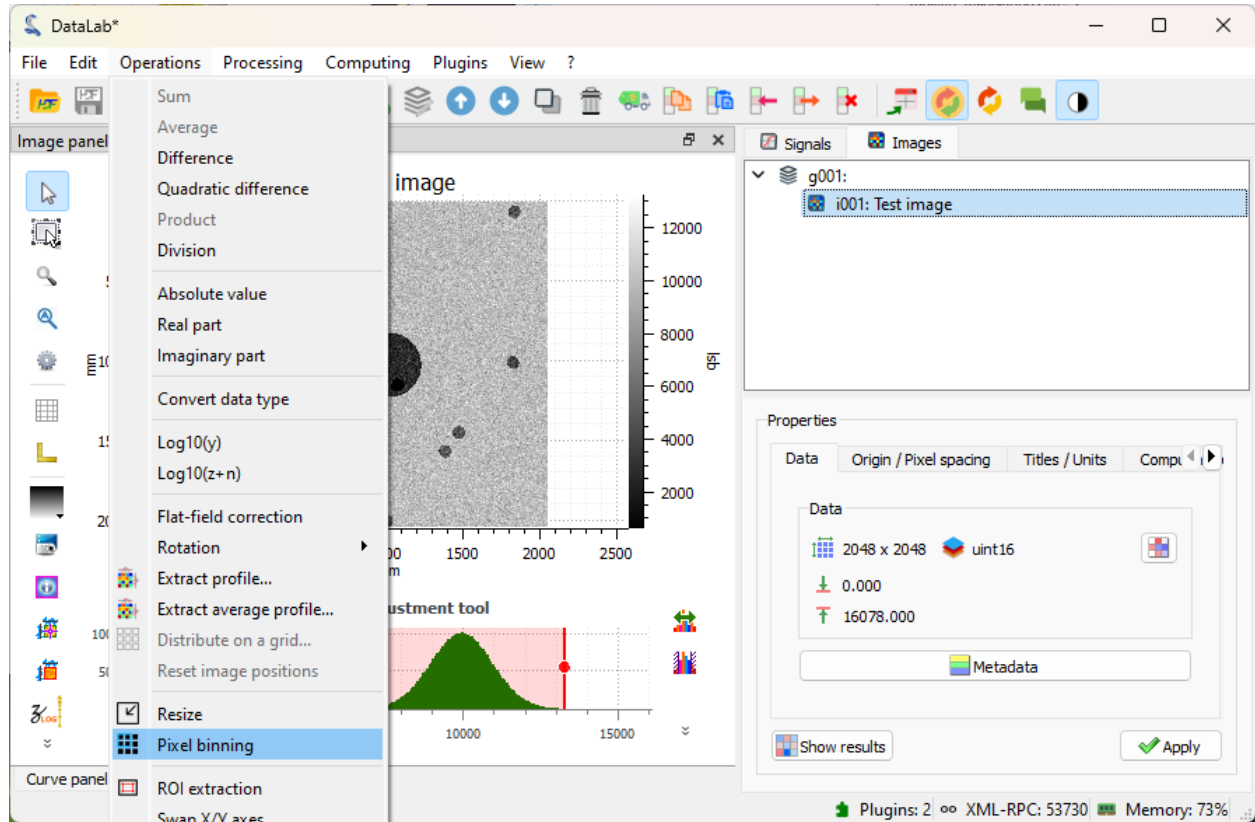
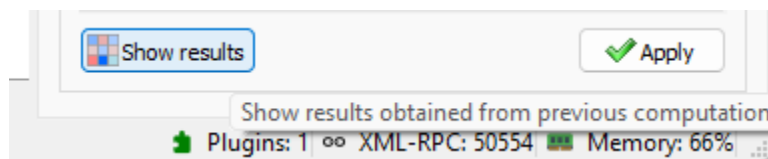


Fig. 30: Click on “Operations > Pixel binning”.

Let's apply a moving median filter to the image, to denoise it a bit more.

Now, let's detect the blobs on the image.

Note: If you want to show the analysis results again, you can select the “Show results” entry in the “Analysis” menu, or the “Show results” button, below the image list:



Finally, we can save the workspace to a file. The workspace contains all the images that were loaded in DataLab, as well as the processing results. It also contains the visualization settings (colormaps, contrast, etc.), the metadata, and the annotations. To save the workspace, click on “File > Save to HDF5 file...”, or the button in the toolbar.

If you want to load the workspace again, you can use the “File > Open HDF5 file...” (or the button in the toolbar) to load the whole workspace, or the “File > Browse HDF5 file...” (or the button in the toolbar) to load only a selection of data sets from the workspace.

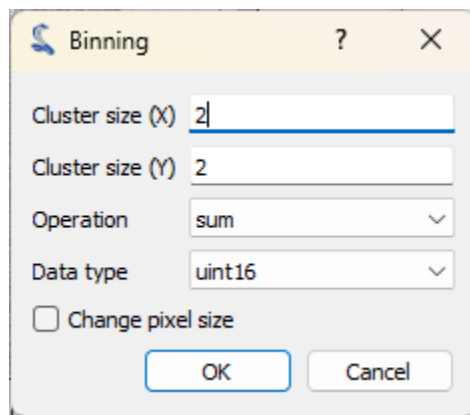


Fig. 31: The “Binning” dialog opens. Set the binning factor to 2, and click on “OK”.

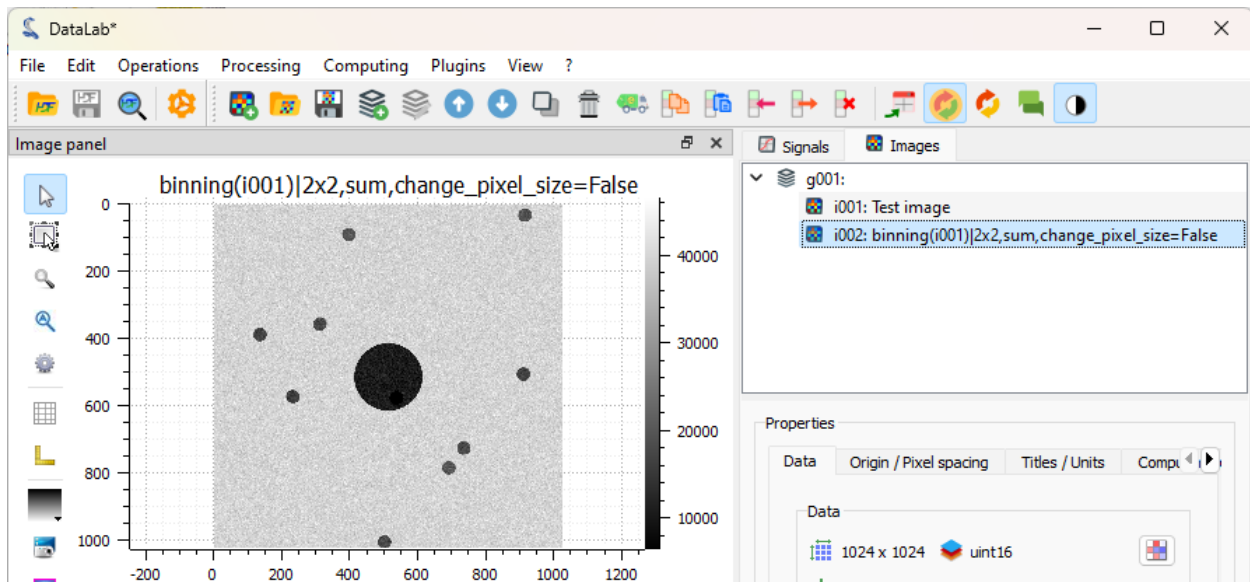


Fig. 32: The binned image is added to the “Images” panel. It is now easier to see the blobs (even if they were already quite visible on the original image: this is just an example), and the image will be faster to process.

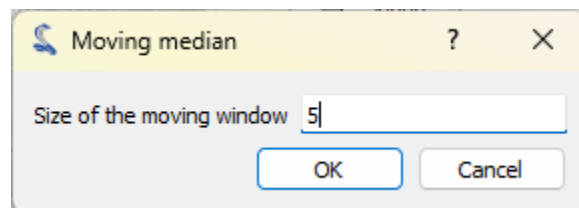


Fig. 33: Click on “Processing > Moving median” entry, and set the window size to 5.

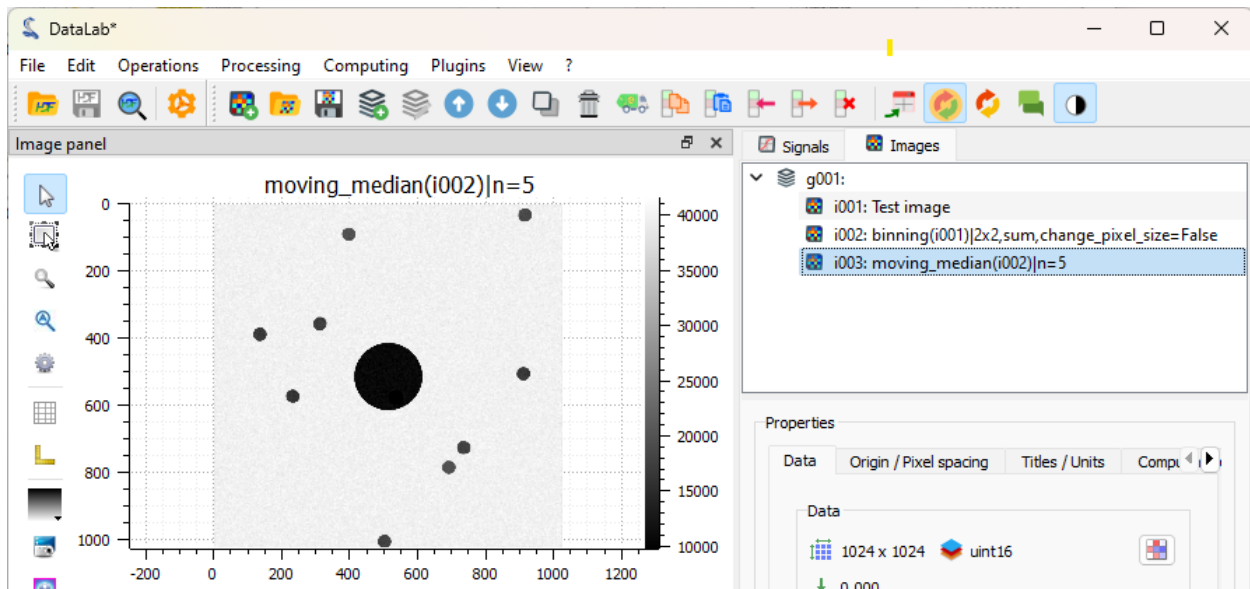


Fig. 34: The filtered image is added to the “Images” panel. Denoising is quite efficient.

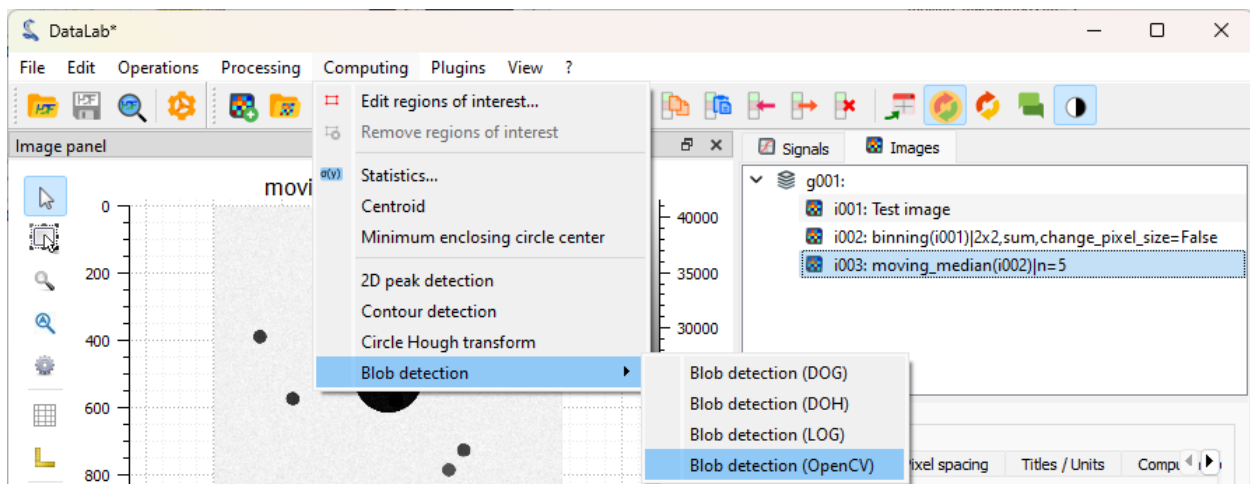


Fig. 35: Click on “Analysis > Blob detection > Blob detection (OpenCV)”.

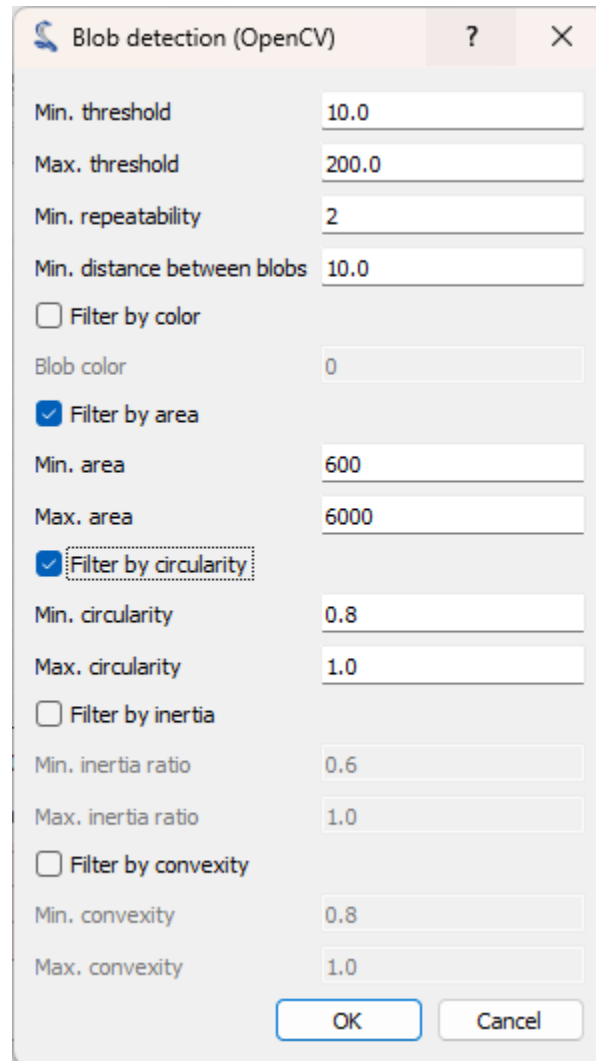
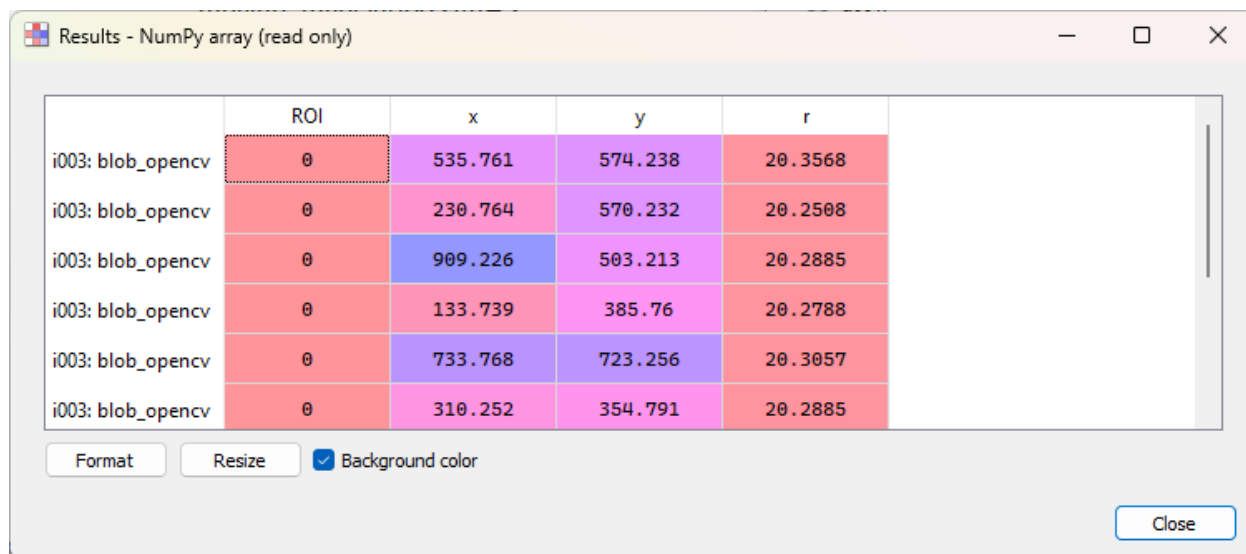


Fig. 36: The “Blob detection (OpenCV)” dialog opens. Set the parameters as shown on the screenshot, and click on “OK”.



The "Results" dialog window displays a table of detected blobs. The table has five columns: ROI, x, y, and r. The first column lists the operation used for each blob. The ROI column contains the value 0 for all blobs. The x, y, and r columns contain the coordinates and radius for each blob. The background color of the table is set to red.

	ROI	x	y	r
i003: blob_opencv	0	535.761	574.238	20.3568
i003: blob_opencv	0	230.764	570.232	20.2508
i003: blob_opencv	0	909.226	503.213	20.2885
i003: blob_opencv	0	133.739	385.76	20.2788
i003: blob_opencv	0	733.768	723.256	20.3057
i003: blob_opencv	0	310.252	354.791	20.2885

Buttons: Format, Resize, ☒ Background color, Close

Fig. 37: The “Results” dialog opens, showing the detected blobs: one line per blob, with the blob coordinates and radius.

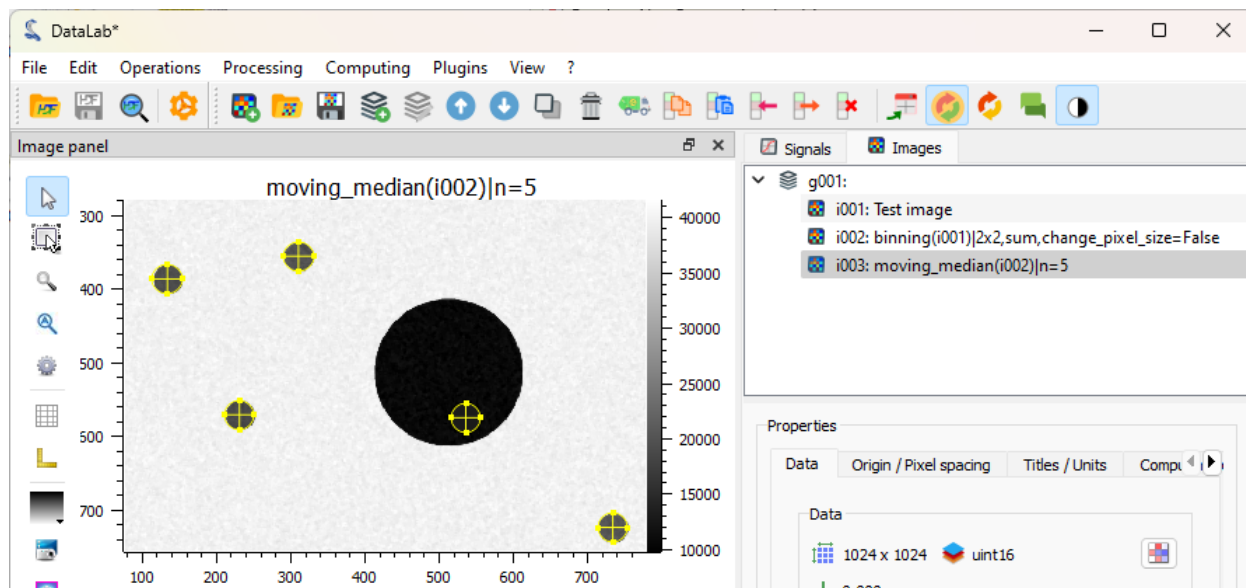


Fig. 38: The detected blobs are also added to the image metadata, and can be seen in the visualization panel on the left.

Measuring Fabry-Perot fringes

This example shows how to measure Fabry-Perot fringes using the image processing features of DataLab:

- Load an image of a Fabry-Perot interferometer
- Define a circular region of interest (ROI) around the central fringe
- Detect contours in the ROI and fit them to circles
- Show the radius of the circles
- Annotate the image
- Copy/paste the ROI to another image
- Extract the intensity profile along the X axis
- Save the workspace

First, we open DataLab and load the images:

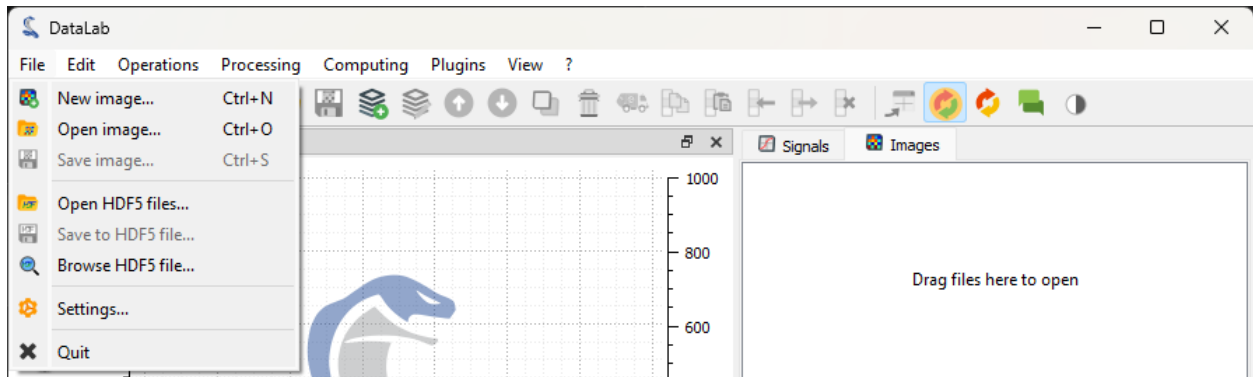


Fig. 39: Open the image files with “File > Open...”, or with the button in the toolbar, or by dragging and dropping the files into DataLab (on the panel on the right).

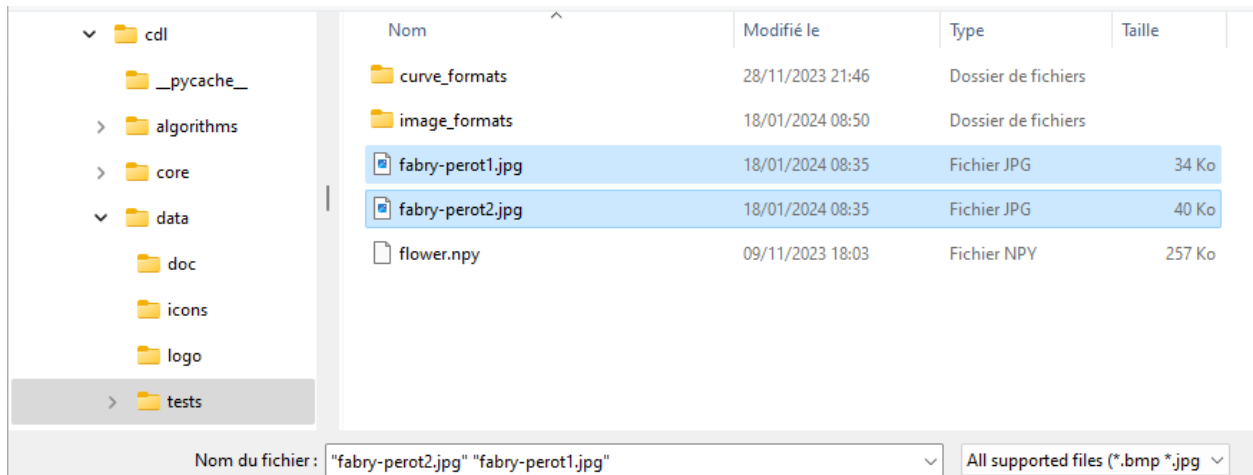


Fig. 40: Select the test images “fabry_perot1.jpg” and “fabry_perot2.jpg” and click “Open”.

The selected image is displayed in the main window. We can zoom in and out by pressing the right mouse button and dragging the mouse up and down. We can also pan the image by pressing the middle mouse button and dragging the mouse.

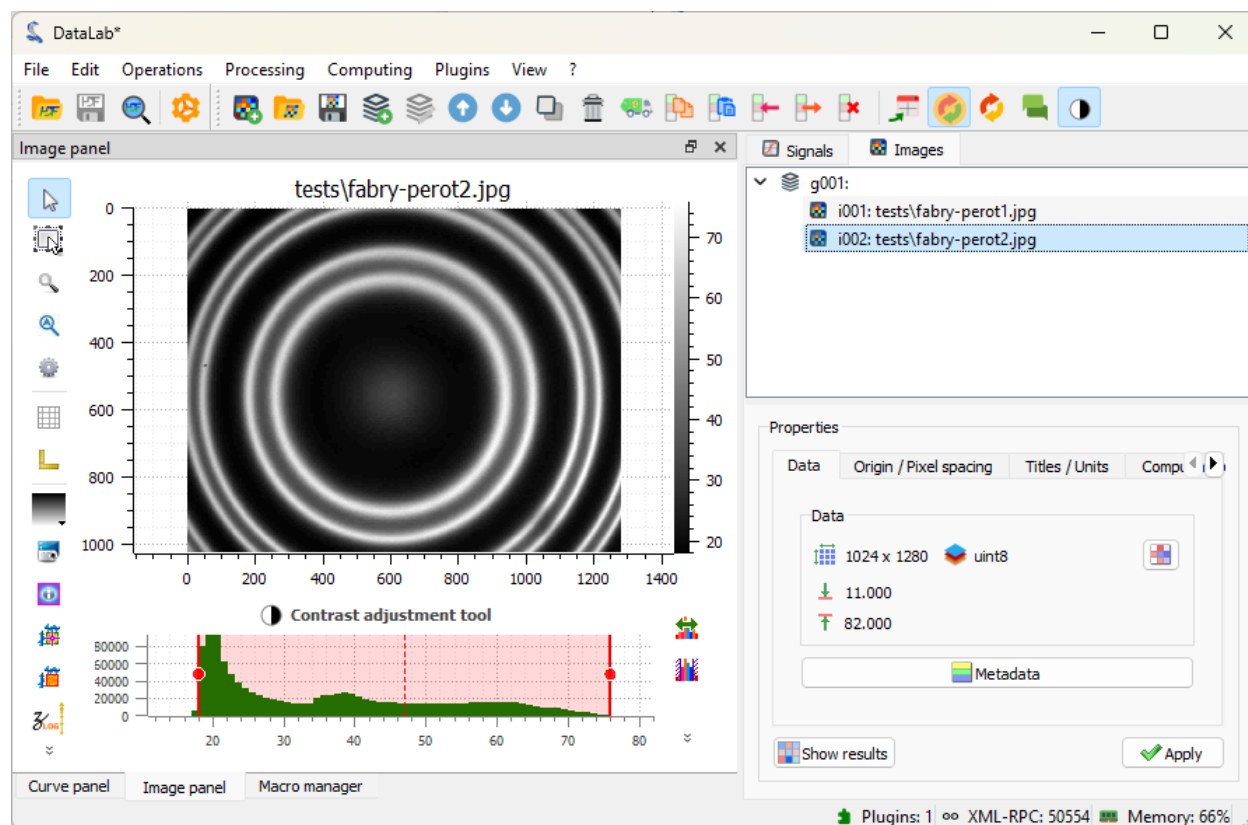


Fig. 41: Zoom in and out with the right mouse button. Pan the image with the middle mouse button.

Note: When working on application-specific images (e.g. X-ray radiography images, or optical microscopy images), it is often useful to change the colormap to a grayscale colormap. If you see a different image colormap than the one shown in the figure, you can change it by selecting the image in the visualization panel, and the selecting the colormap in the vertical toolbar on the left of the visualization panel.

Or, even better, you can change the default colormap in the DataLab settings by selecting “Edit > Settings...” in the menu, or the button in the toolbar.

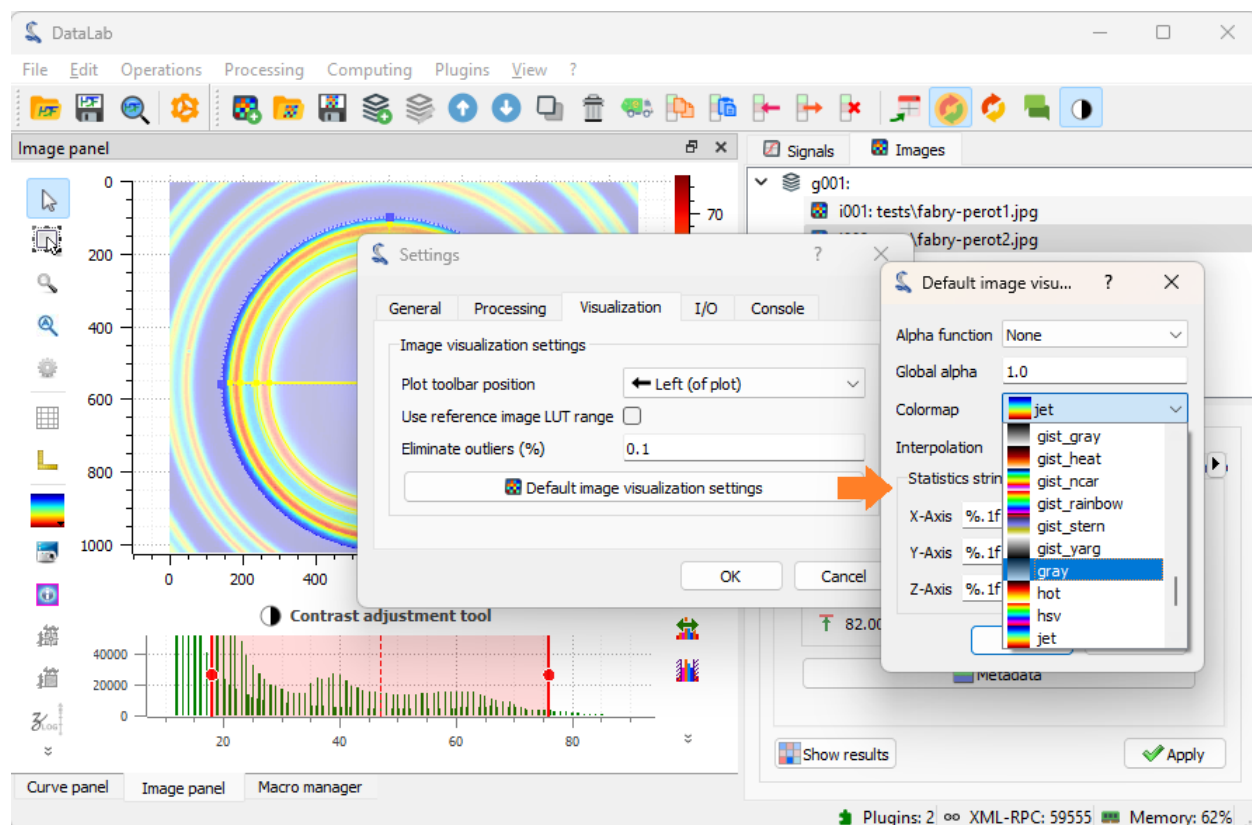
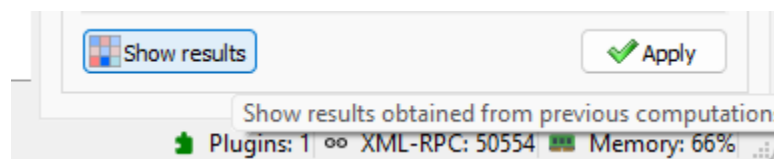


Fig. 42: Select the “Visualization” tab, and select the “gray” colormap.

Then, let’s define a circular region of interest (ROI) around the central fringe.

Now, let’s detect the contours in the ROI and fit them to circles.

Note: If you want to show the analysis results again, you can select the “Show results” entry in the “Analysis” menu, or the “Show results” button, below the image list:



The images (or signals) can also be displayed in a separate window, by clicking on the “View in a new window” entry in the “View” menu (or the button in the toolbar). This is useful to compare side by side images or signals.

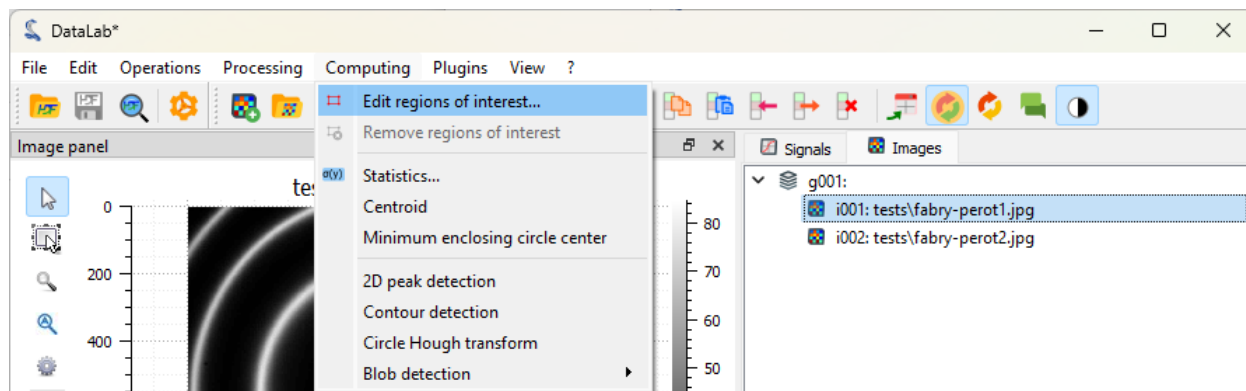


Fig. 43: Select the “Edit regions of interest” tool in the “Analysis” menu.

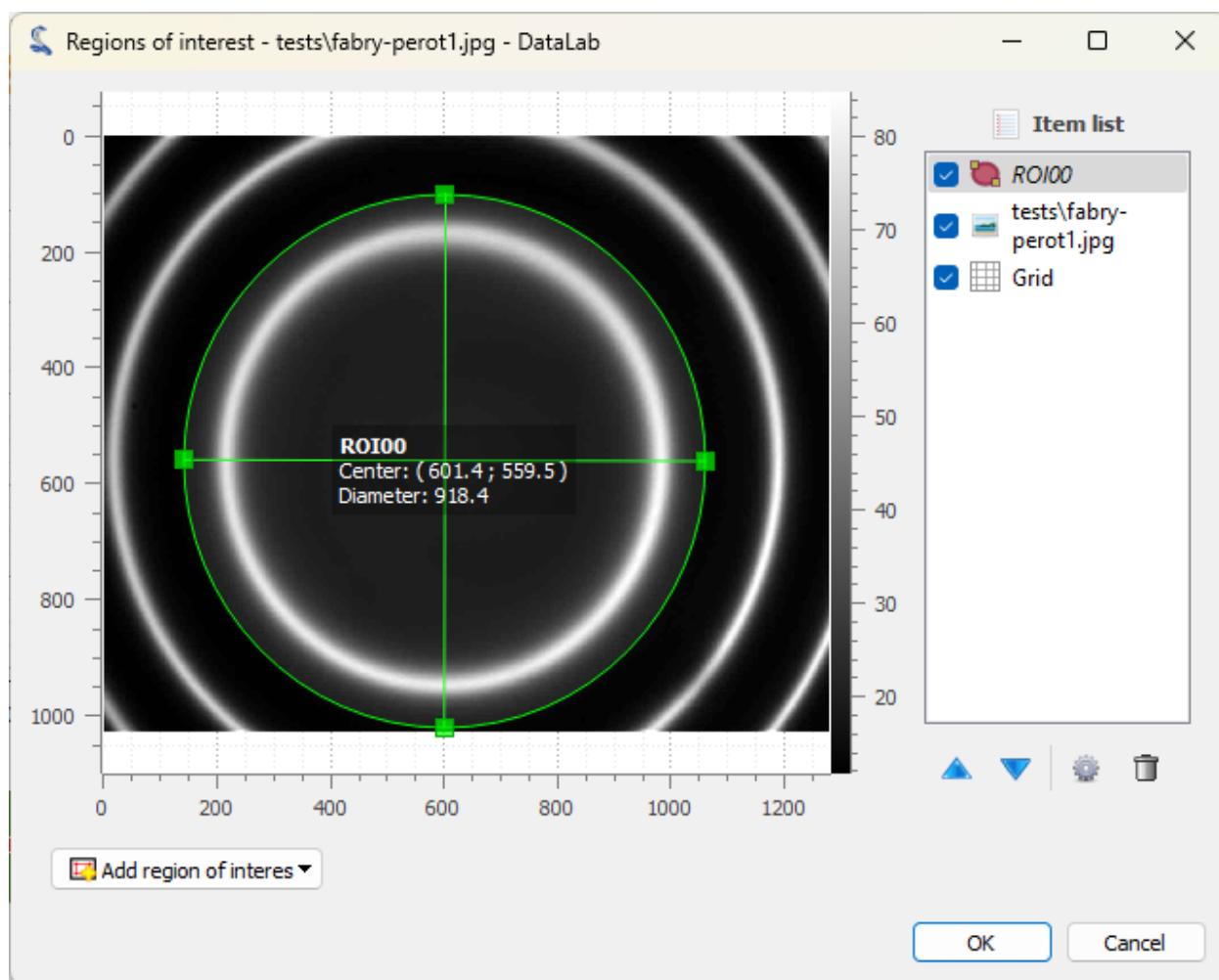


Fig. 44: The “Regions of interest” dialog opens. Click “Add ROI” and select a circular ROI. Resize the predefined ROI by dragging the handles. Note that you may change the ROI radius while keeping its center fixed by pressing the “Ctrl” key. Click “OK” to close the dialog.

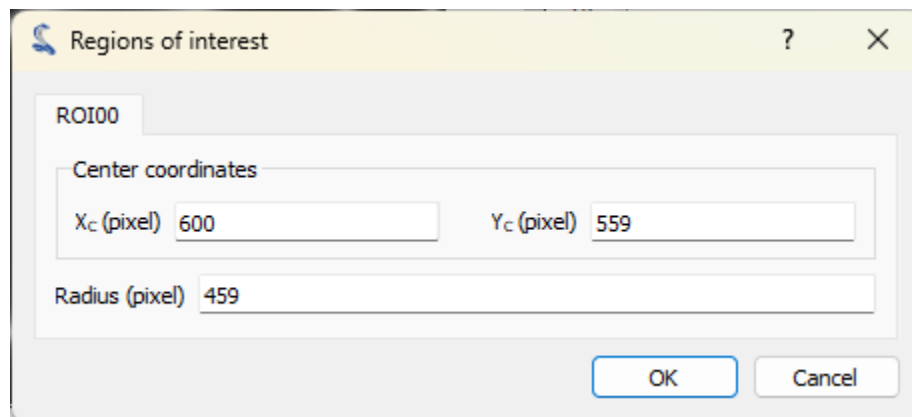


Fig. 45: Another dialog box opens, and asks you to confirm the ROI parameters. Click “OK”.

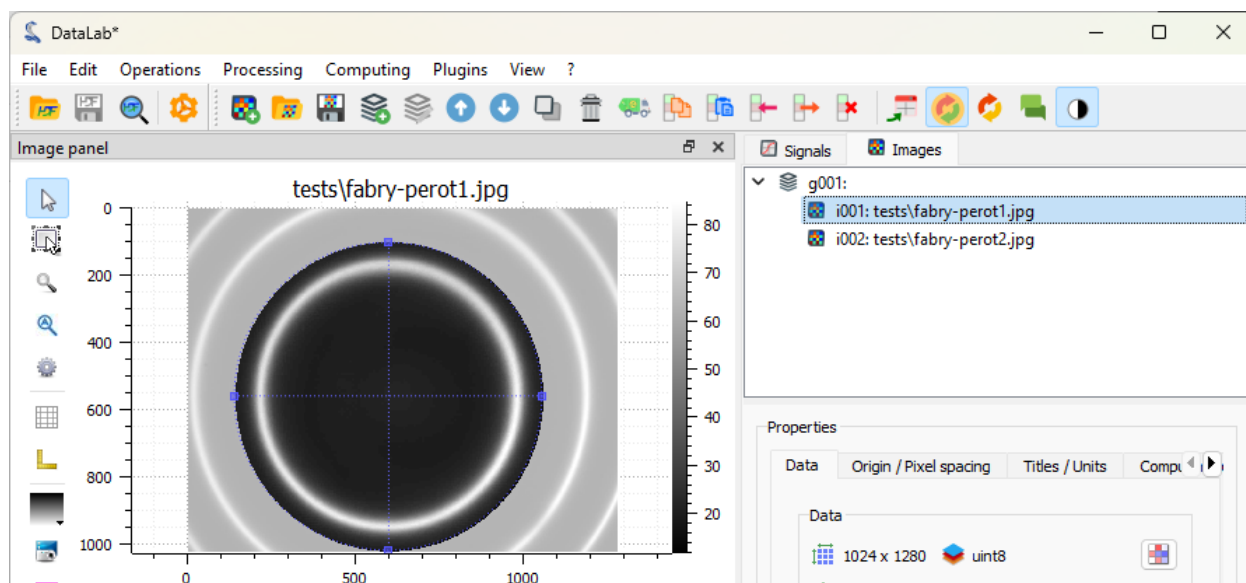


Fig. 46: The ROI is displayed on the image: masked pixels are grayed out, and the ROI boundary is displayed in blue (note that, internally, the ROI is defined by a binary mask, i.e. image data is represented as a NumPy masked array).

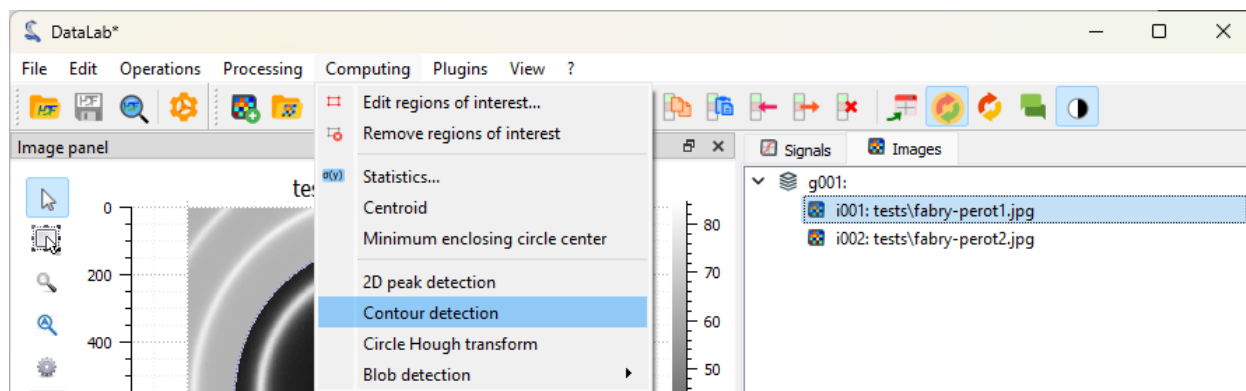


Fig. 47: Select the “Contour detection” tool in the “Analysis” menu.

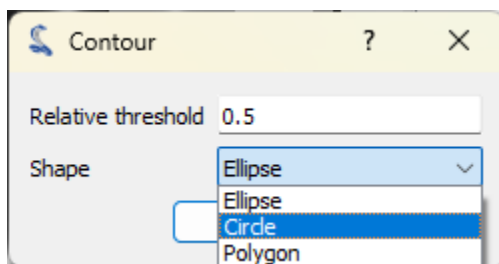


Fig. 48: The “Contour” parameters dialog opens. Select the shape “Circle” and click “OK”.

	ROI	x	y	r
contour_shape(i001)	0	599.144	554.736	403.22
contour_shape(i001)	0	595.39	556.167	367.349

Fig. 49: The “Results” dialog opens, and displays the fitted circle parameters. Click “OK”.

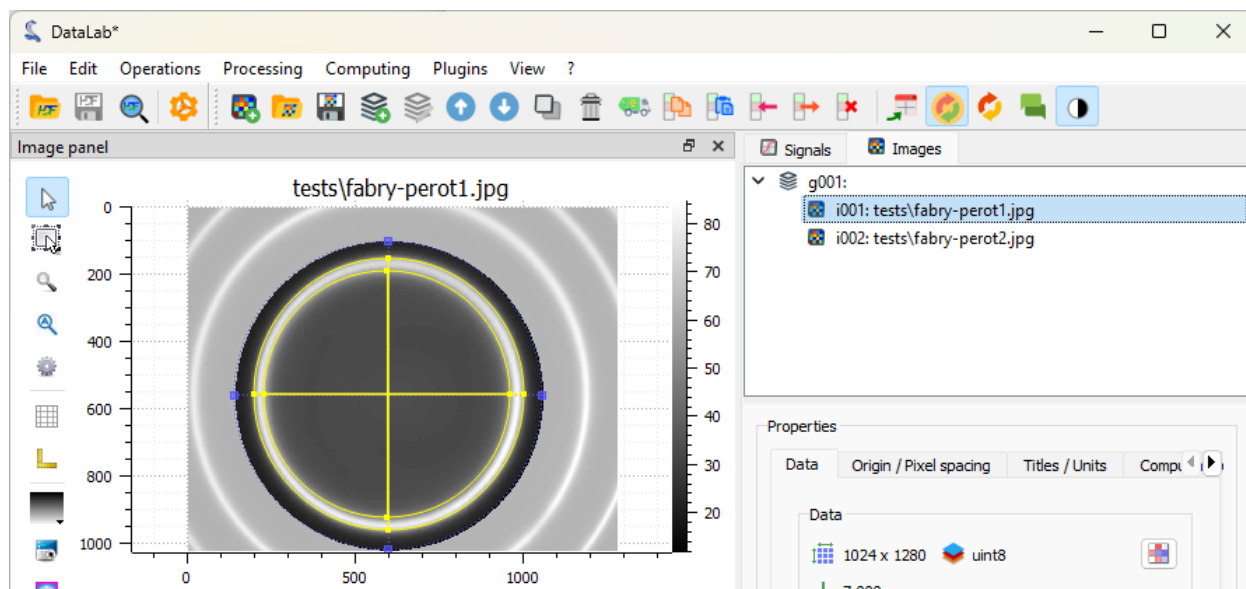


Fig. 50: The fitted circles are displayed on the image.

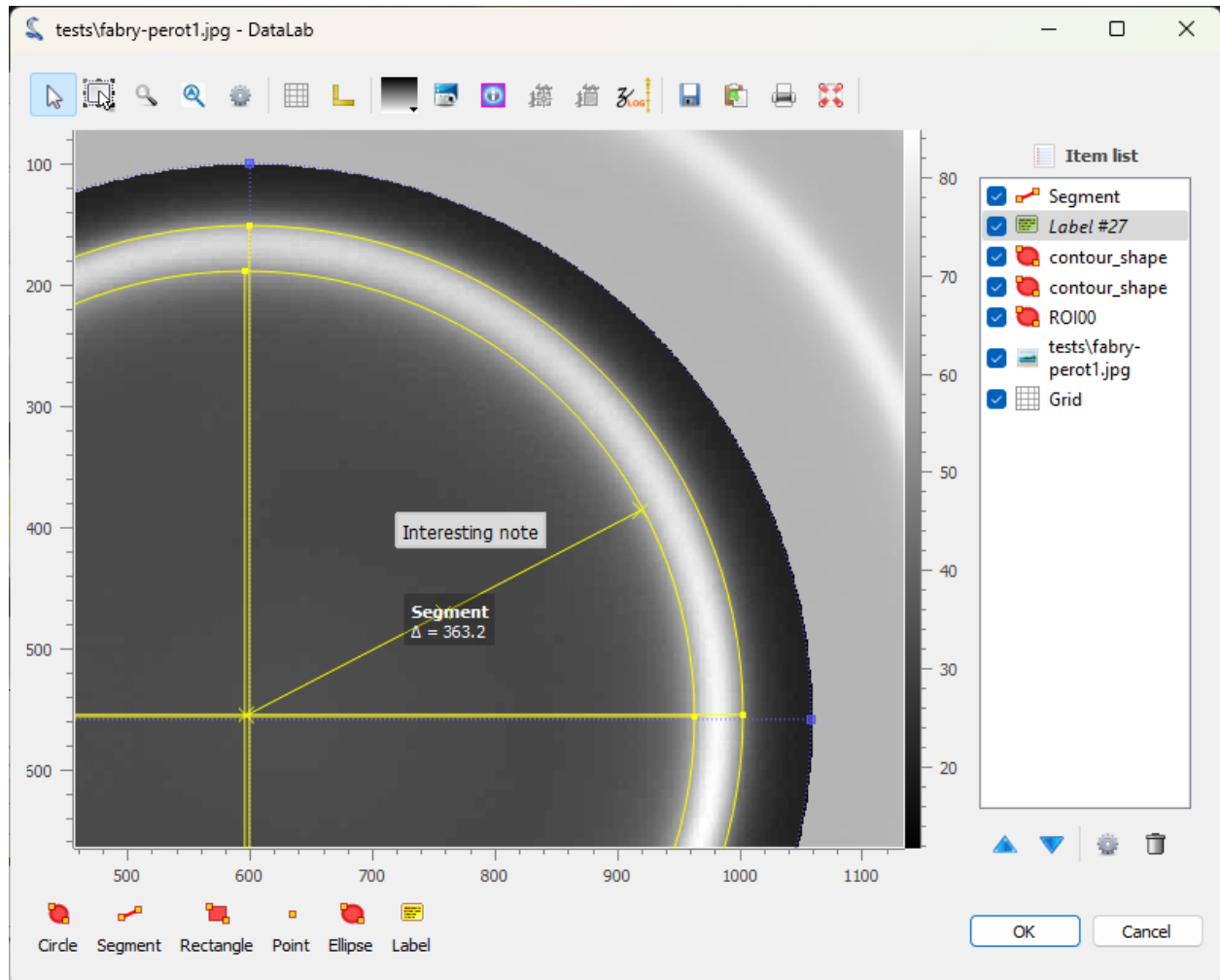


Fig. 51: The image is displayed in a separate window. The ROI and the fitted circles are also displayed. Annotations can be added to the image by clicking on the buttons at the bottom of the window. The annotations are stored in the metadata of the image, and together with the image data when the workspace is saved. Click on “OK” to close the window.

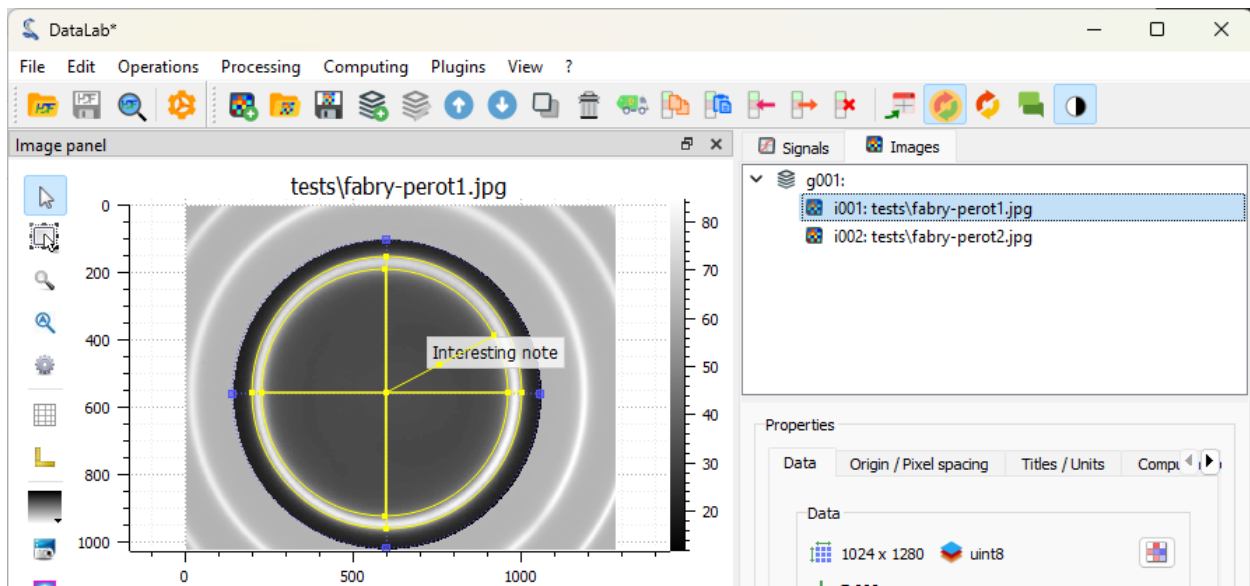


Fig. 52: The image is displayed in the main window, together with the annotations.

If you want to take a closer look at the metadata, you can open the “Metadata” dialog.

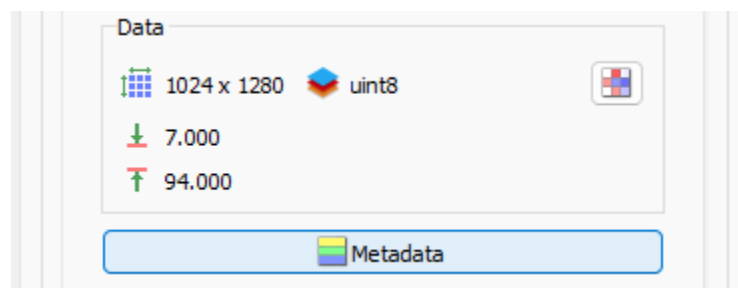



Fig. 53: The “Metadata” button is located below the image list.


Now, let’s delete the image metadata (including the annotations) to clean up the image.


If we want to define the exact same ROI on the second image, we can copy/paste the ROI from the first image to the second image, using the metadata.

To extract the intensity profile along the X axis, we have two options:

- Either select the “Line profile...” entry in the “Operations > Intensity profiles” menu.
- Or activate the “Cross section” tool  in the vertical toolbar on the left of the visualization panel.

Let’s try the first option, by selecting the “Line profile...” entry : that is the most straightforward way to extract a profile from an image, and it corresponds to the `compute_profile` method of DataLab’s API (so it can be used in a script, a plugin or a macro).

If you want to do some measurements on the profile, or add annotations, you can open the signal in a separate window, by clicking on the “View in a new window” entry in the “View” menu (or the  button in the toolbar).

Now, let’s try the second option for extracting the intensity profile along the X axis, by activating the “Cross section” tool  in the vertical toolbar on the left of the visualization panel (this tool is a [PlotPy](#) feature). Before being able to use it, we need to select the image in the visualization panel (otherwise the tool is grayed out). Then, we can click

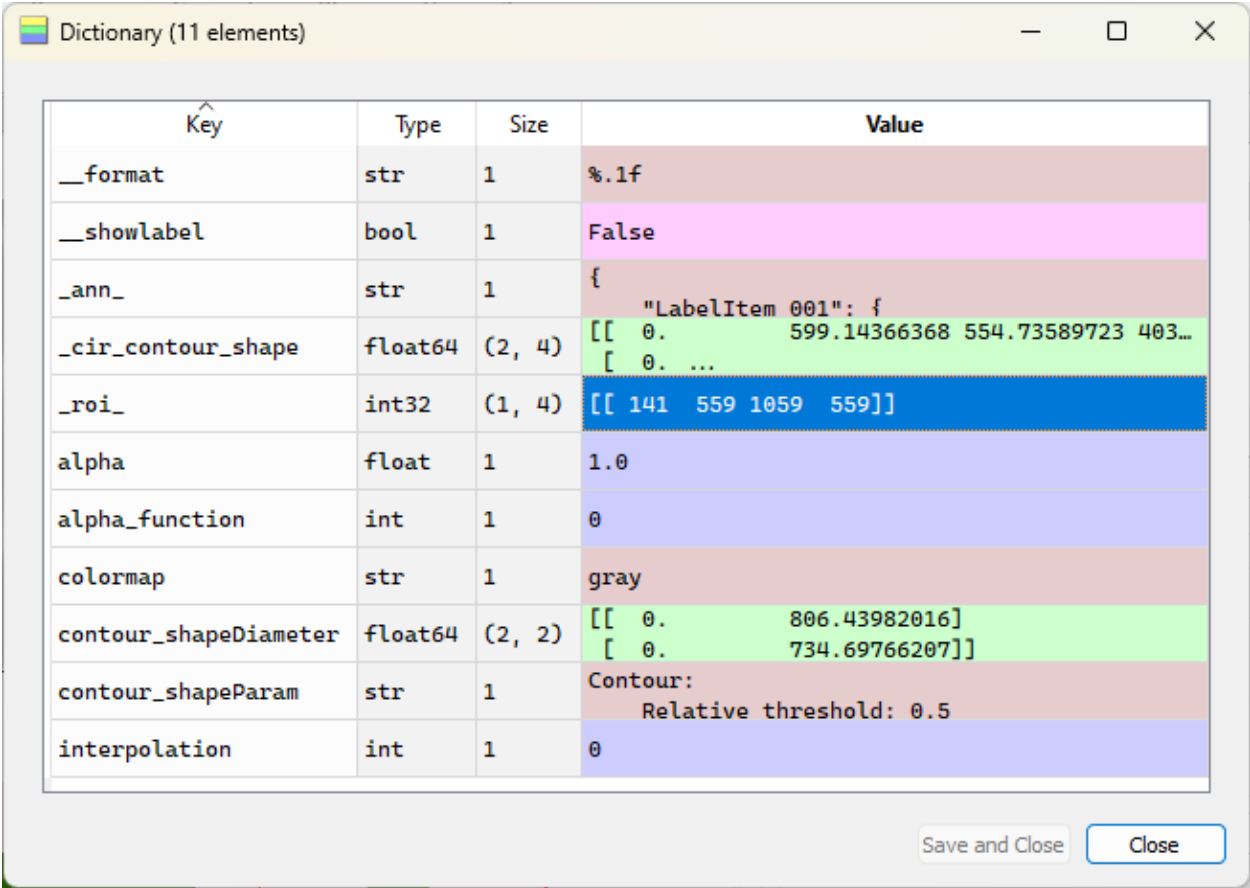


Fig. 54: The “Metadata” dialog opens. Among other information, it displays the annotations (in a JSON format), some style information (e.g. the colormap), and the ROI.

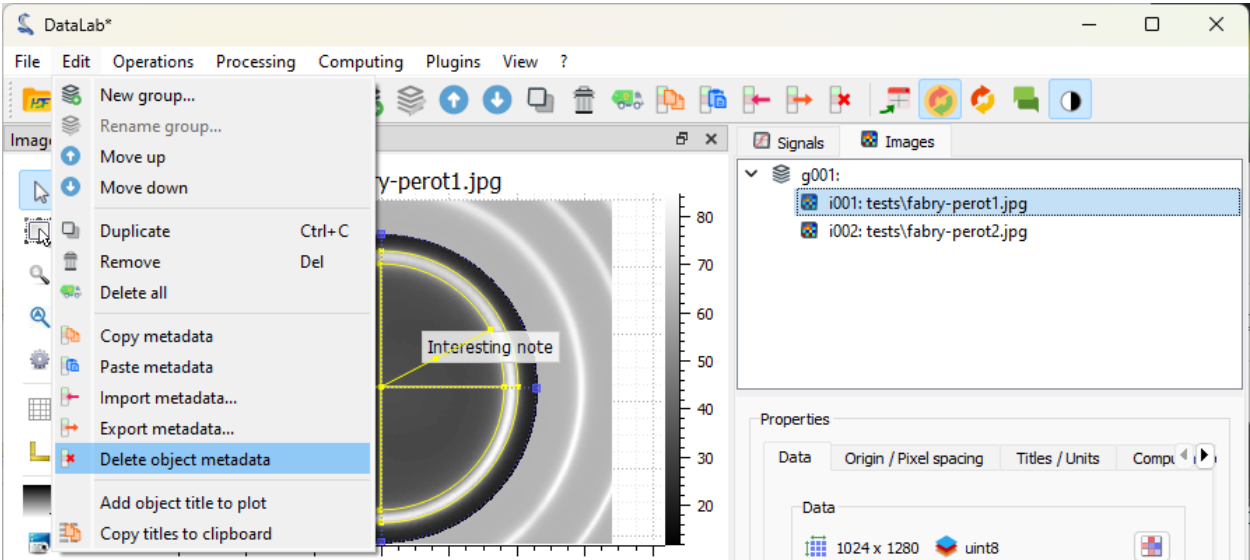


Fig. 55: Select the “Delete metadata” entry in the “Edit” menu, or the button in the toolbar.

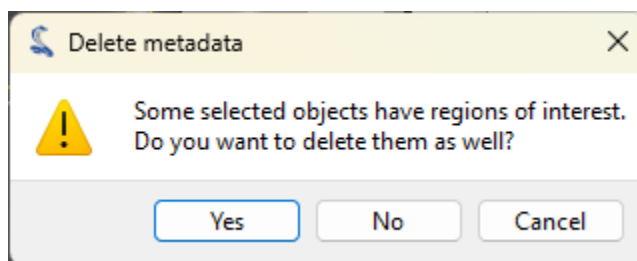


Fig. 56: The “Delete metadata” dialog opens. Click “No” to keep the ROI and delete the rest of the metadata.

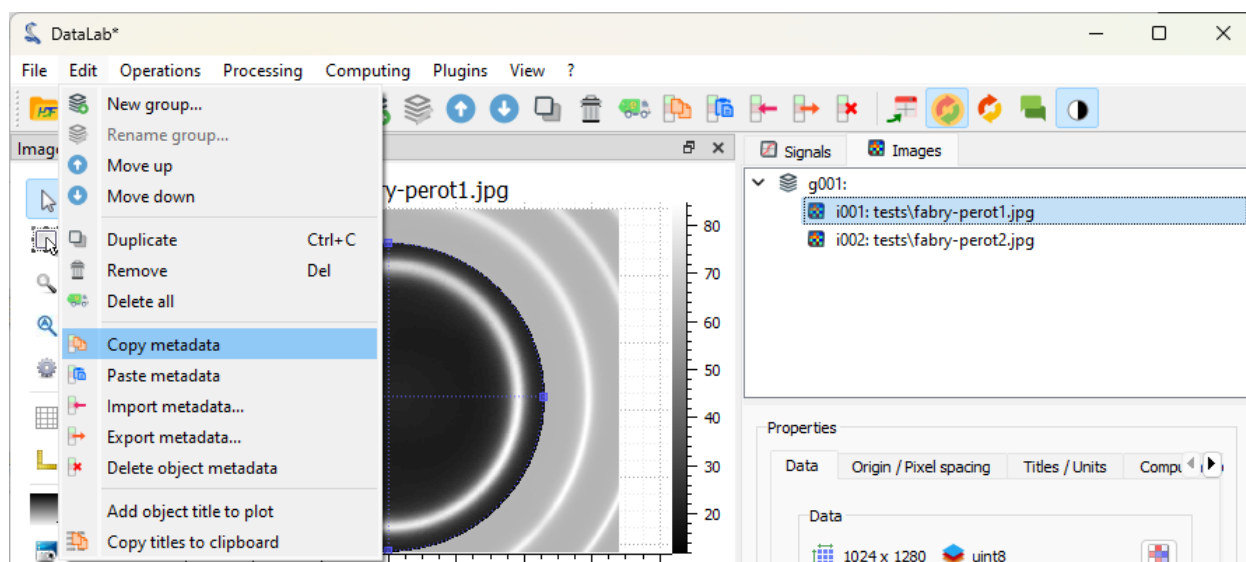


Fig. 57: Select the “Copy metadata” entry in the “Edit” menu, or the button in the toolbar.

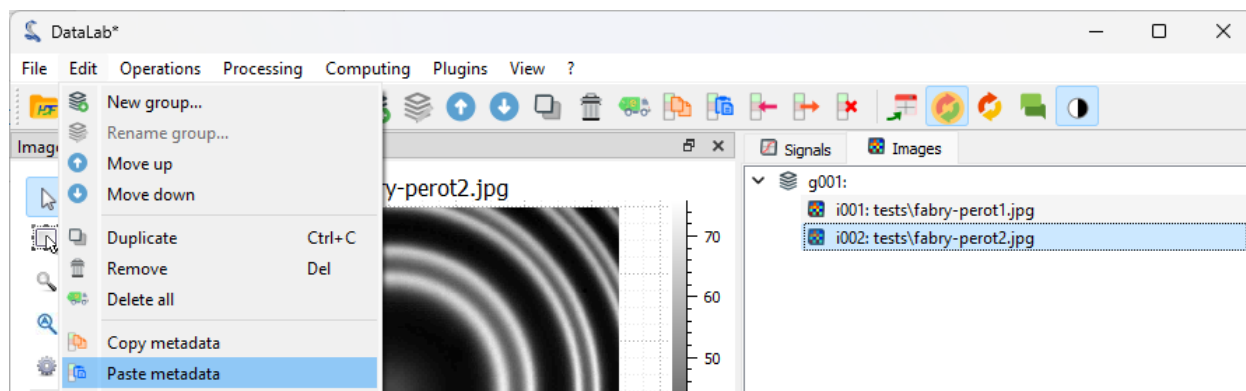


Fig. 58: Select the second image in the “Images” panel, then select the “Paste metadata” entry in the “Edit” menu, or the button in the toolbar.

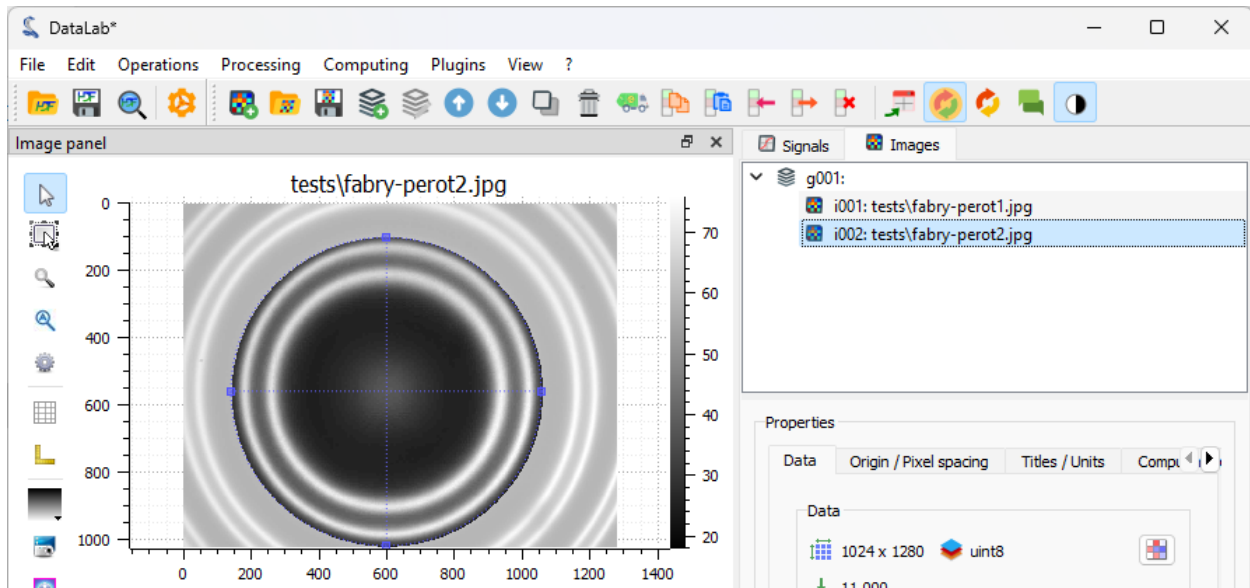


Fig. 59: The ROI is added to the second image.

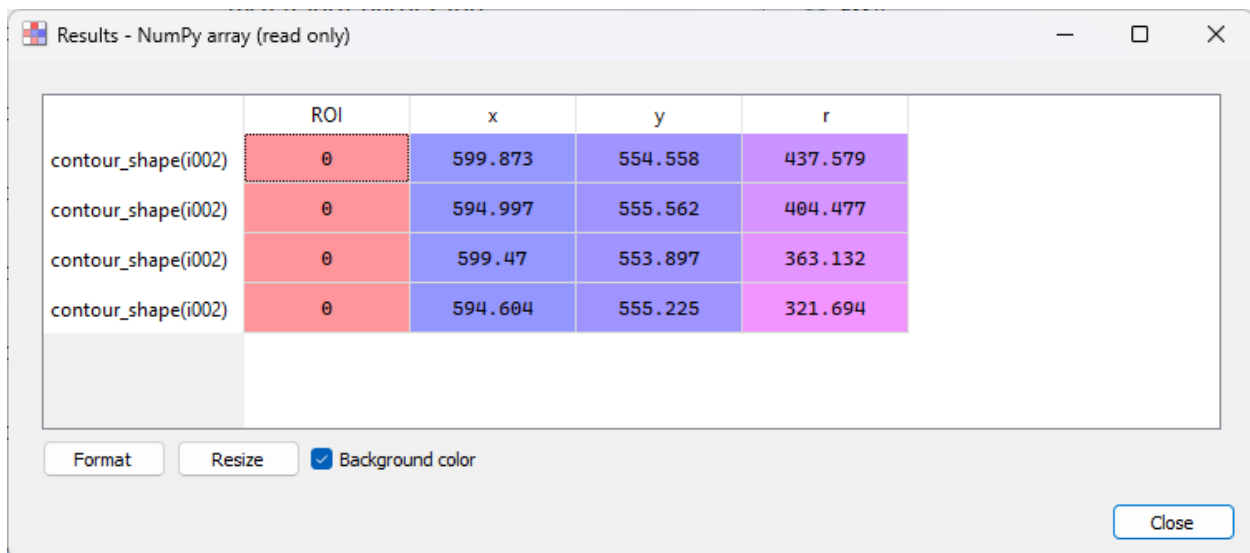


Fig. 60: Select the “Contour detection” tool in the “Analysis” menu, with the same parameters as before (shape “Circle”). On this image, there are two fringes, so four circles are fitted. The “Results” dialog opens, and displays the fitted circle parameters. Click “OK”.

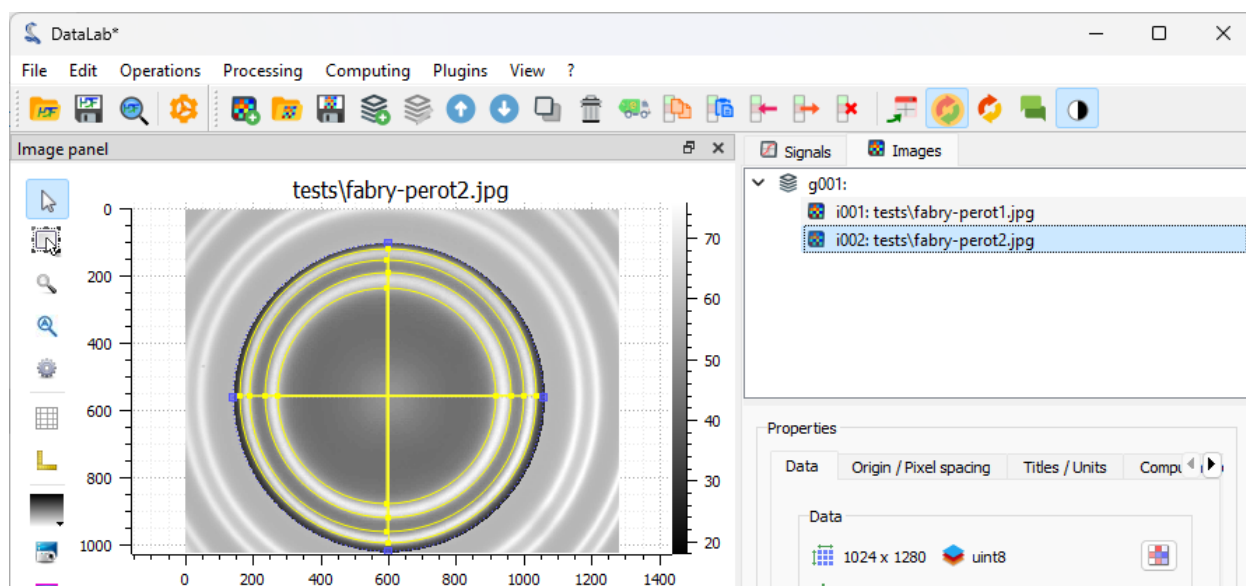


Fig. 61: The fitted circles are displayed on the image.

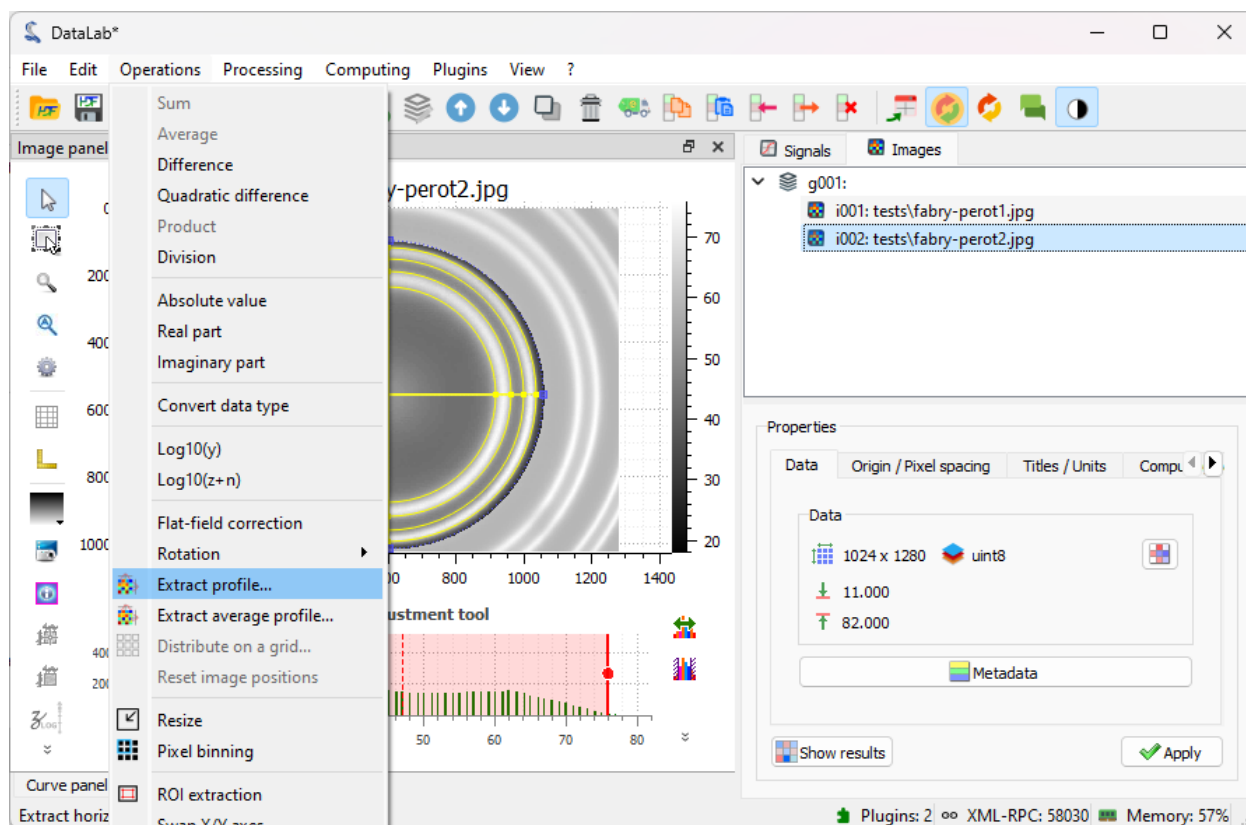


Fig. 62: Select the “Line profile...” entry in the “Operations” menu.

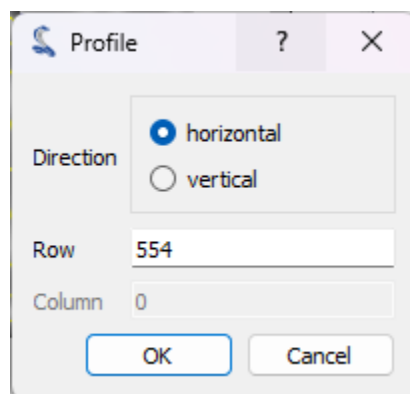


Fig. 63: The “Profile” dialog opens. Enter the row of the horizontal profile (or the column of the vertical profile) in the dialog box that opens. Click “OK”.

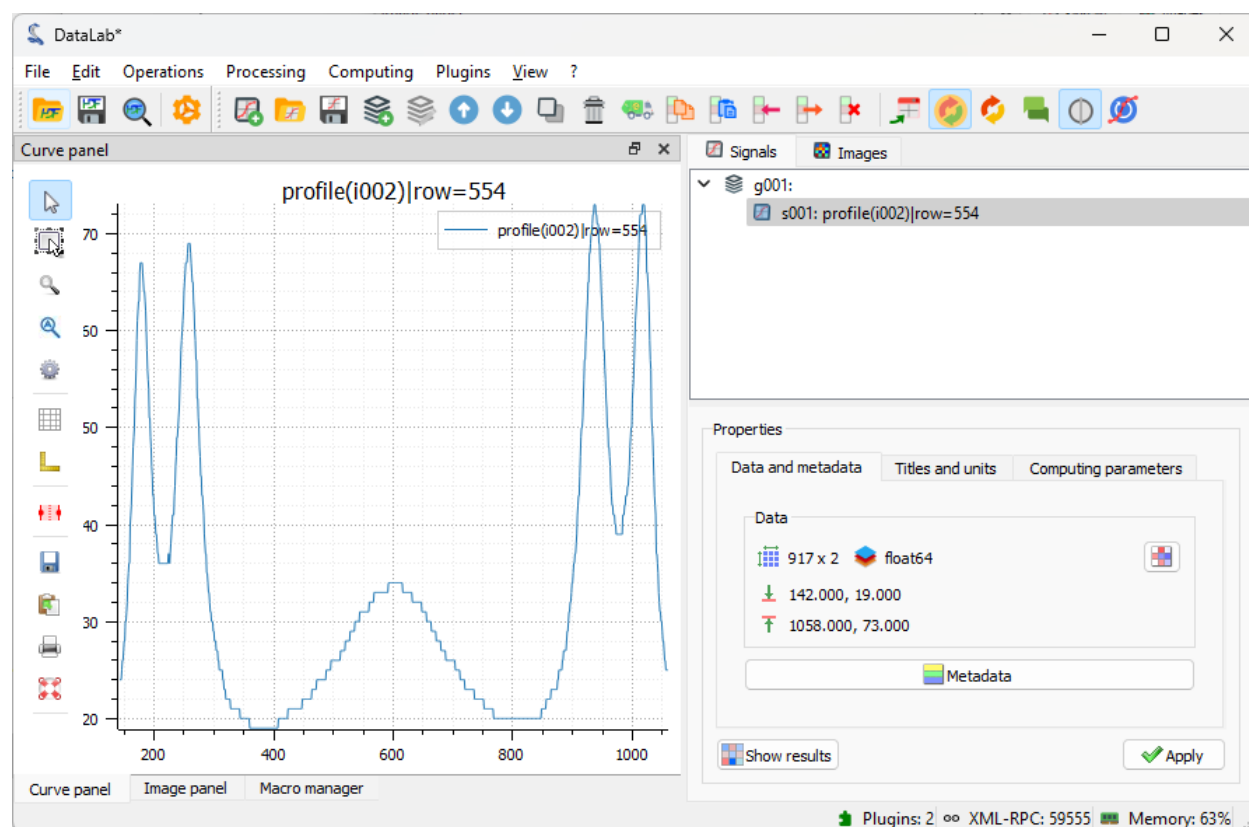


Fig. 64: The intensity profile is added to the “Signals” panel, and DataLab switches to this panel to display the profile.

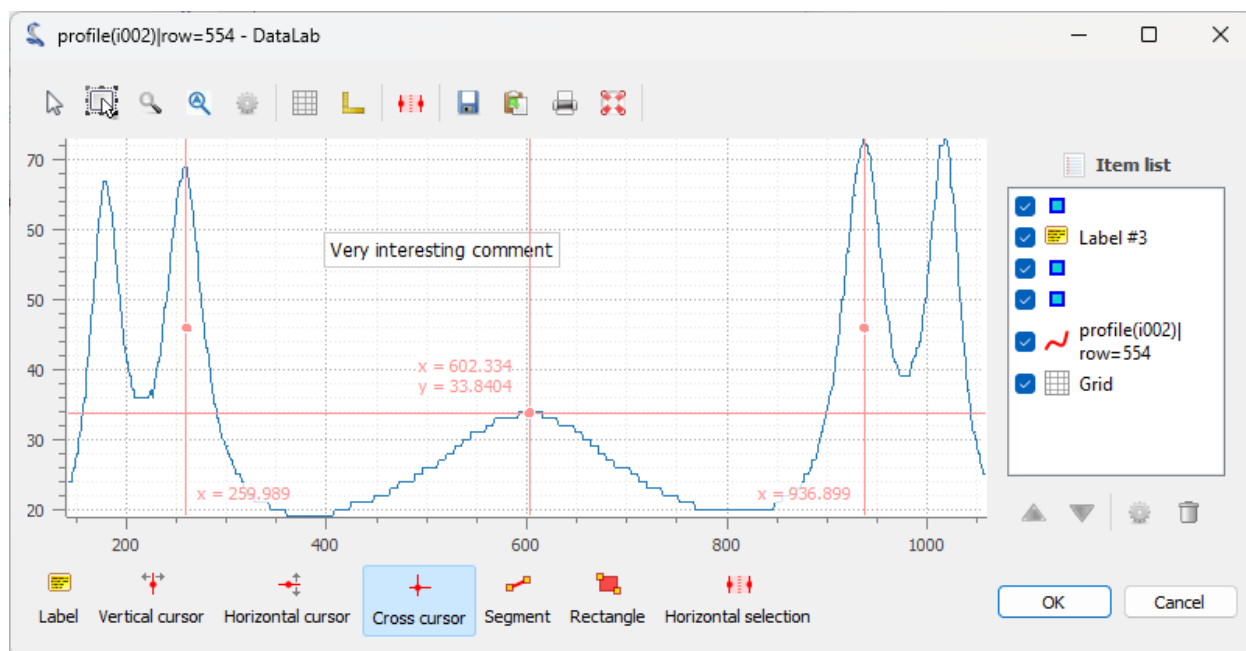


Fig. 65: The signal is displayed in a separate window. Here, we added vertical cursors and a very interesting text label. As for the images, the annotations are stored in the metadata of the signal, and together with the signal data when the workspace is saved. Click on “OK” to close the window.

on the image to display the intensity profile along the X axis. DataLab integrates a modified version of this tool, that allows to transfer the profile to the “Signals” panel for further processing.

Then, click on the “Process signal” button in the toolbar near the profile to transfer the profile to the “Signals” panel.

Finally, we can save the workspace to a file. The workspace contains all the images and signals that were loaded or processed in DataLab. It also contains the analysis results, the visualization settings (colormaps, contrast, etc.), the metadata, and the annotations.

If you want to load the workspace again, you can use the “File > Open HDF5 file...” (or the button in the toolbar) to load the whole workspace, or the “File > Browse HDF5 file...” (or the button in the toolbar) to load only a selection of data sets from the workspace.

Measuring Laser Beam Size

This example shows how to measure the size of a laser beam along the propagation axis, using using DataLab:

- Load all the images in a folder
- Apply a threshold to the images
- Extract the intensity profile along an horizontal line
- Fit the intensity profile to a Gaussian function
- Compute the full width at half maximum (FWHM) of intensity profile
- Try another method: extract the radial intensity profile
- Compute the FWHM of the radial intensity profile
- Perform the same analysis on a stack of images and on the resulting profiles



Fig. 66: Switch back to the “Images” panel, and select the image *in the visualization panel* (otherwise the “Cross section” tool is grayed out). Select the “Cross section” tool in the vertical toolbar, and click on the image to display the intensity profiles along the X and Y axes.

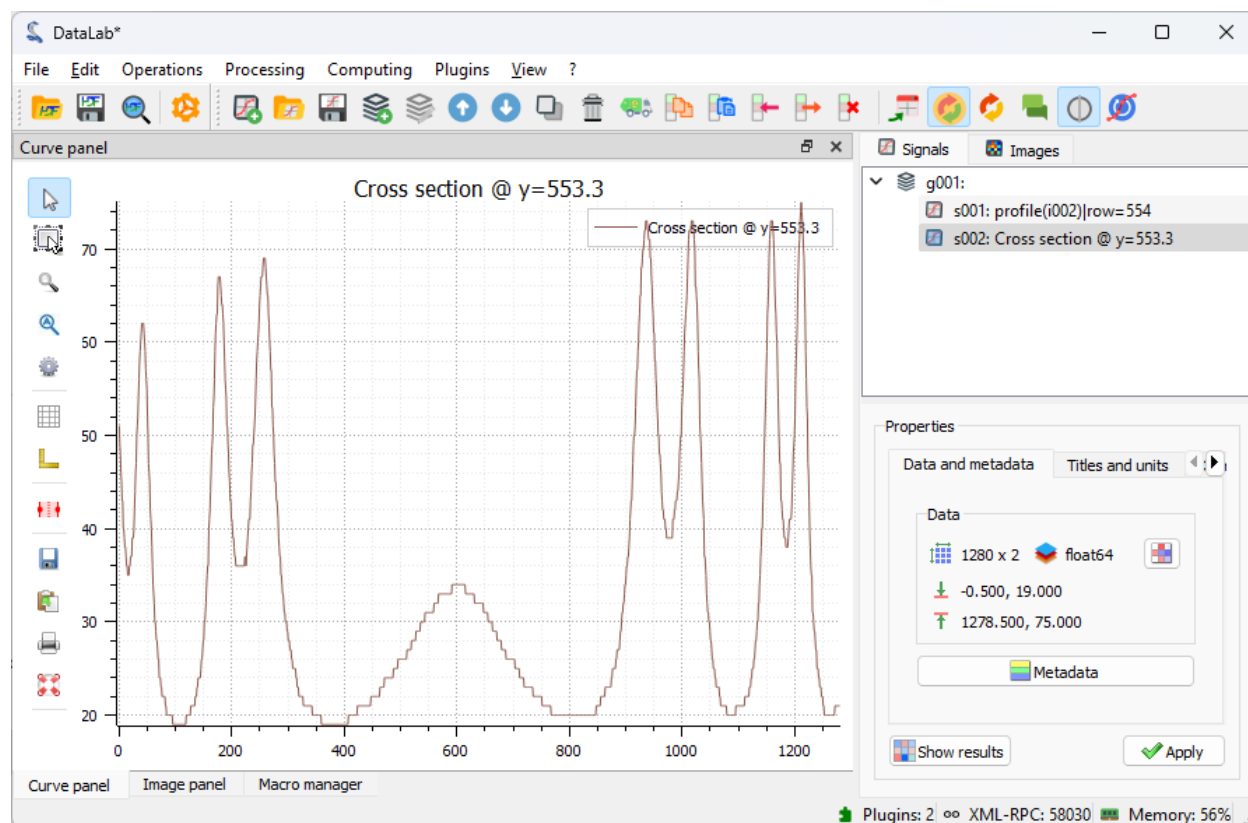


Fig. 67: The intensity profile is added to the “Signals” panel, and DataLab switches to this panel to display the profile.

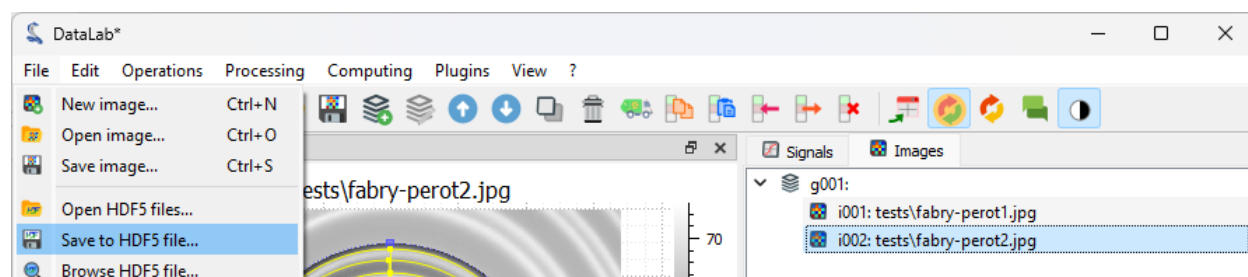


Fig. 68: Save the workspace to a file with “File > Save to HDF5 file...”, or the button in the toolbar.

- Plot the beam size as a function of the position along the propagation axis

First, we open DataLab and load the images:

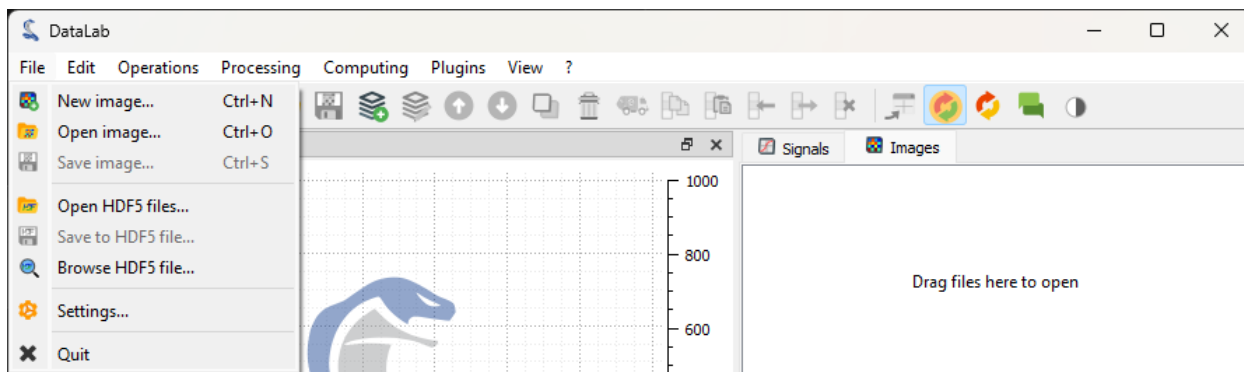


Fig. 69: Open the image files with “File > Open...”, or with the button in the toolbar, or by dragging and dropping the files into DataLab (on the panel on the right).

The selected images are loaded in the “Images” panel. The last image is displayed in the main window. On each image, we can zoom in and out by pressing the right mouse button and dragging the mouse up and down. We can also pan the image by pressing the middle mouse button and dragging the mouse.

Note: If we want to display the images side by side, we can select the “Distribute on a grid” entry in the “Operations” menu.

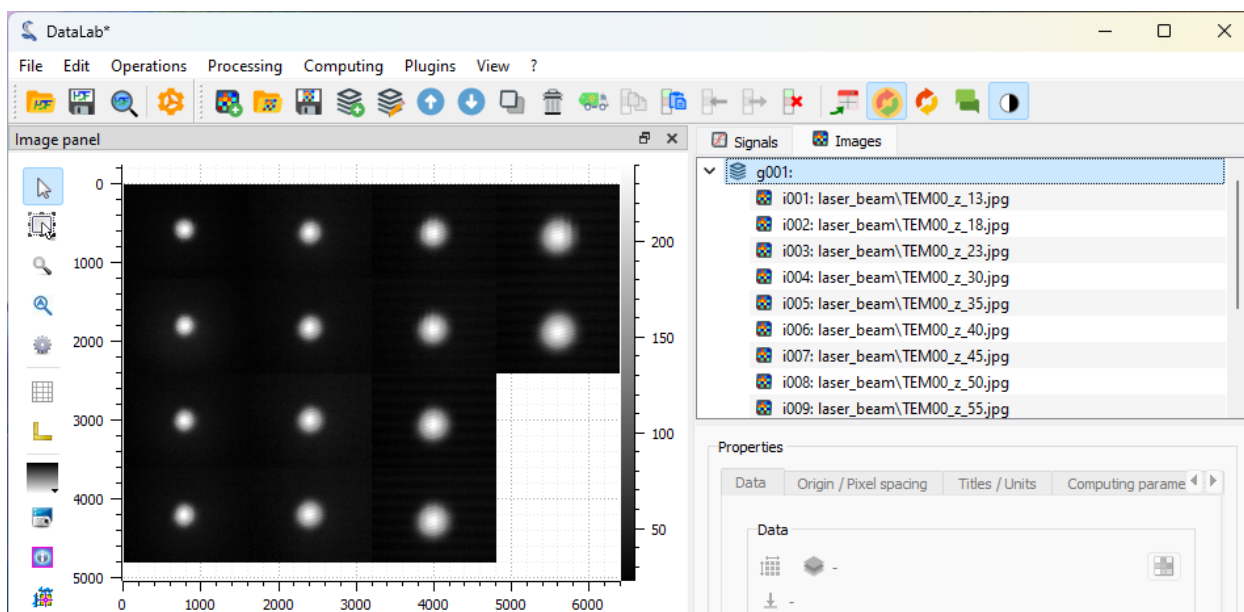


Fig. 72: Images distributed on a 4 rows grid

But, let's go back to the initial display by selecting the “Reset image positions” entry in the “Operations” menu.

If we select one of the images, we can see that there is background noise, so it might be useful to apply a threshold to the images.

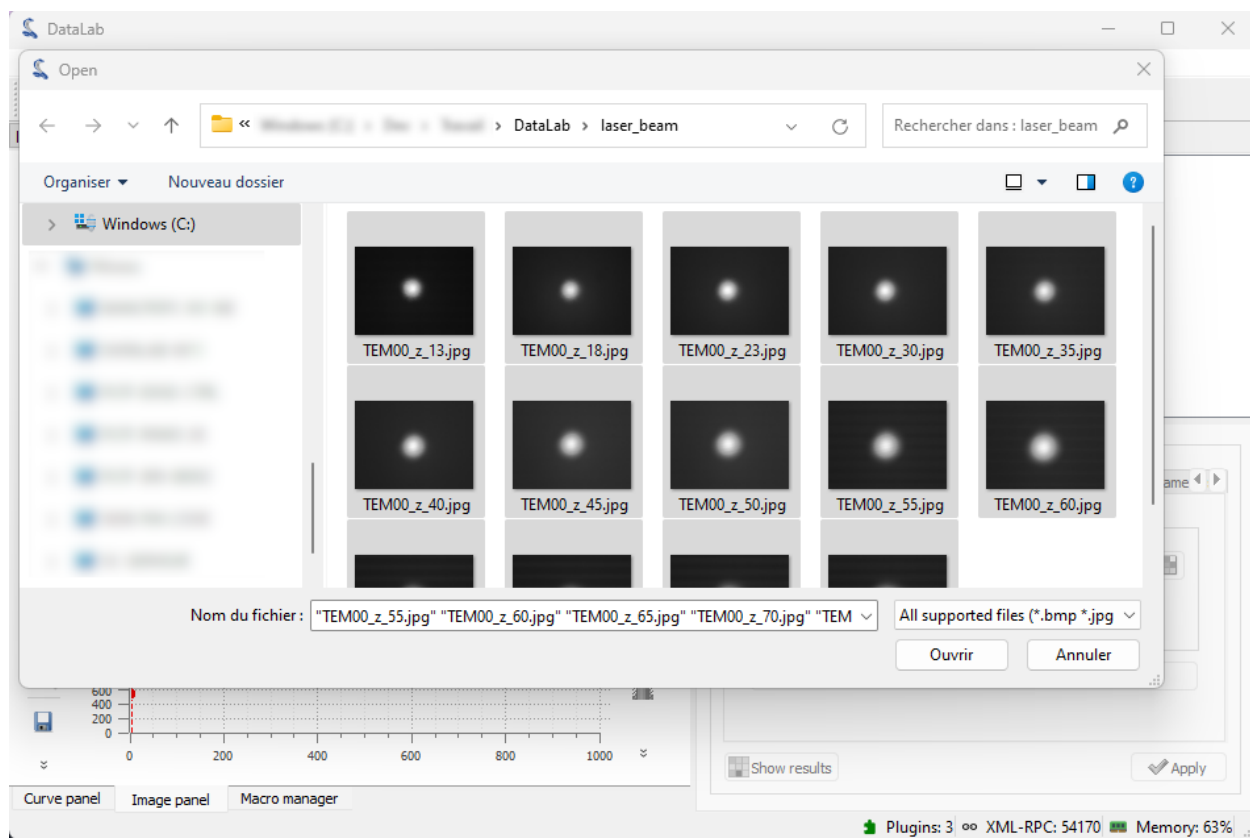


Fig. 70: Select the test images “TEM00_z_*.jpg” and click “Open”.

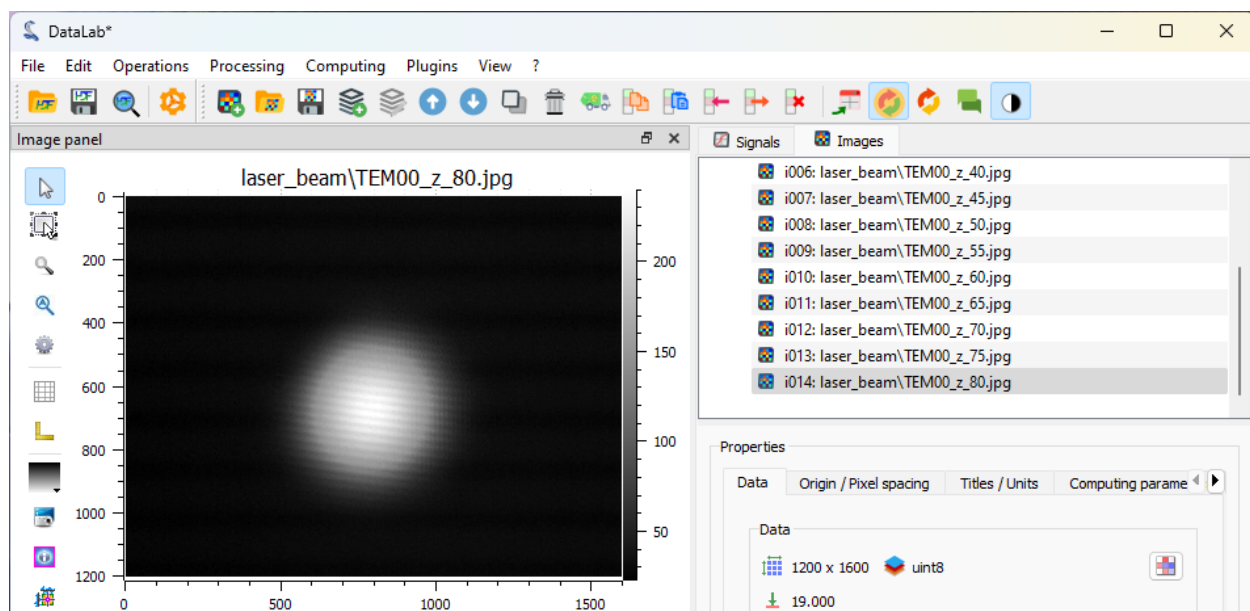


Fig. 71: Zoom in and out with the right mouse button. Pan the image with the middle mouse button.

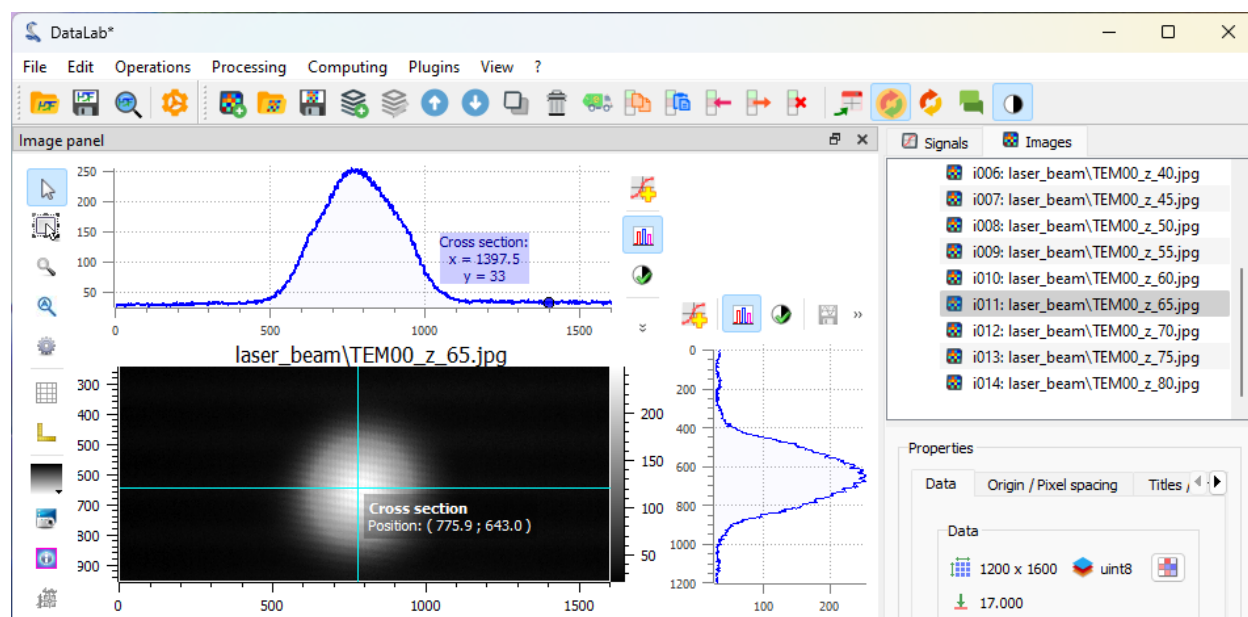



Fig. 73: Select one of the images in the “Images” panel, select the associated image in the visualization panel, and enable the “Cross section” tool  in the vertical toolbar on the left of the visualization panel (this tool is a [PlotPy](#) feature). On this figure, we can see that the background noise is around 30 lsb (to show the curve marker, we had to select the profile curve and right-click on it to display the context menu, and select “Markers > Bound to active item”).

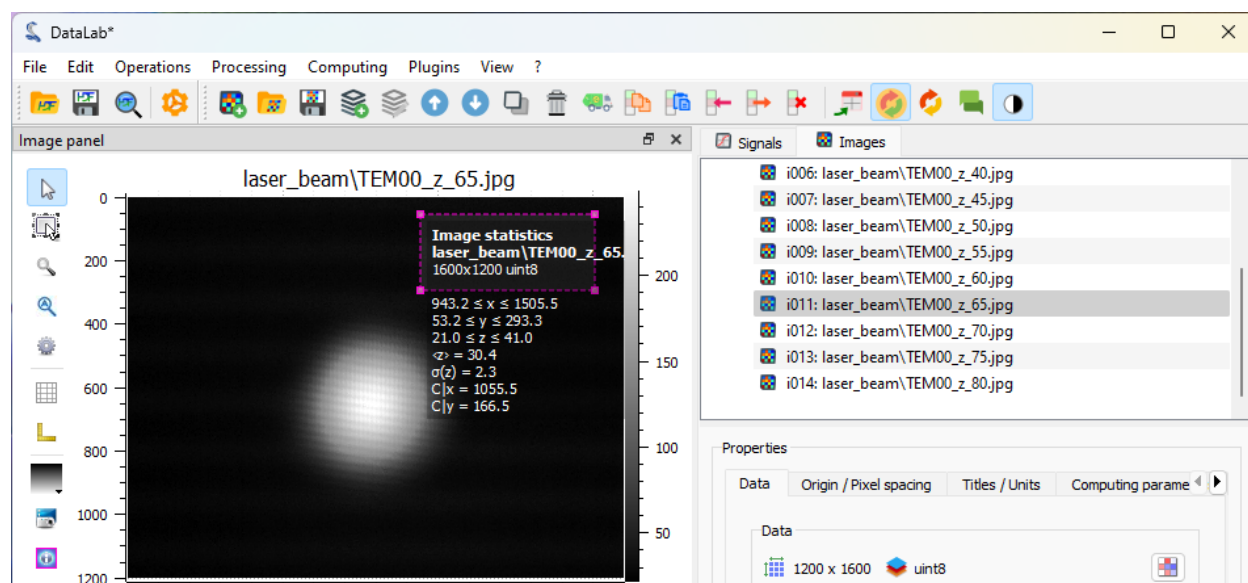



Fig. 74: Another way to measure the background noise is to use the “Image statistics” tool  in the vertical toolbar on the left of the visualization panel. It displays statistics on a the rectangular area defined by dragging the mouse on the image. This confirms that the background noise is around 30 lsb.

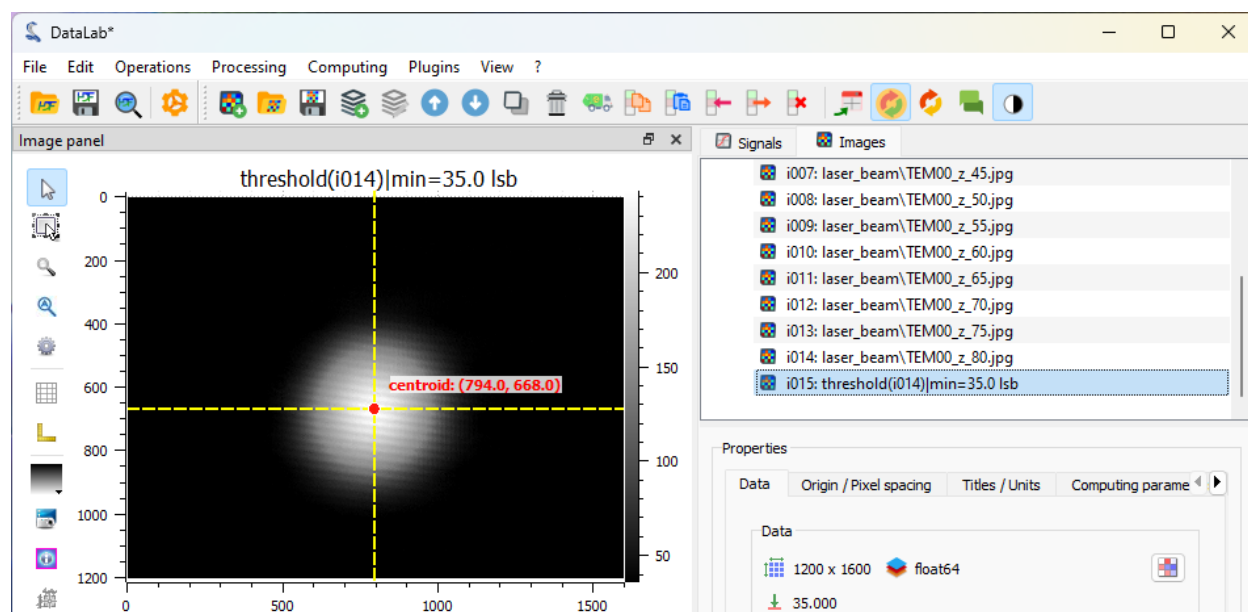


Fig. 75: After applying a threshold at 35 lsb (with “Processing > Thresholding...”), we can compute a more accurate position of the beam center using “Analysis > Centroid”.

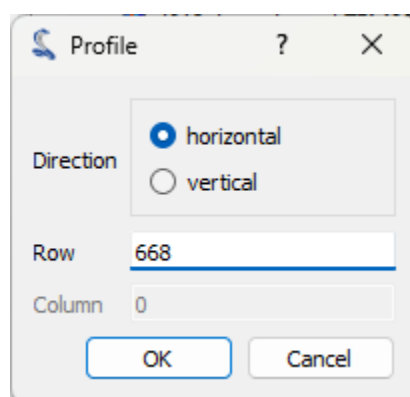


Fig. 76: Then we can extract a line profile along the horizontal axis with “Operations > Intensity profiles > Line profile”. We set the row position to the centroid position computed previously (i.e. 668).



Fig. 77: The intensity profile is displayed in the “Signals” panel. We can fit the profile to a Gaussian function with “Processing > Fitting > Gaussian fit”. Here we have selected both signals.

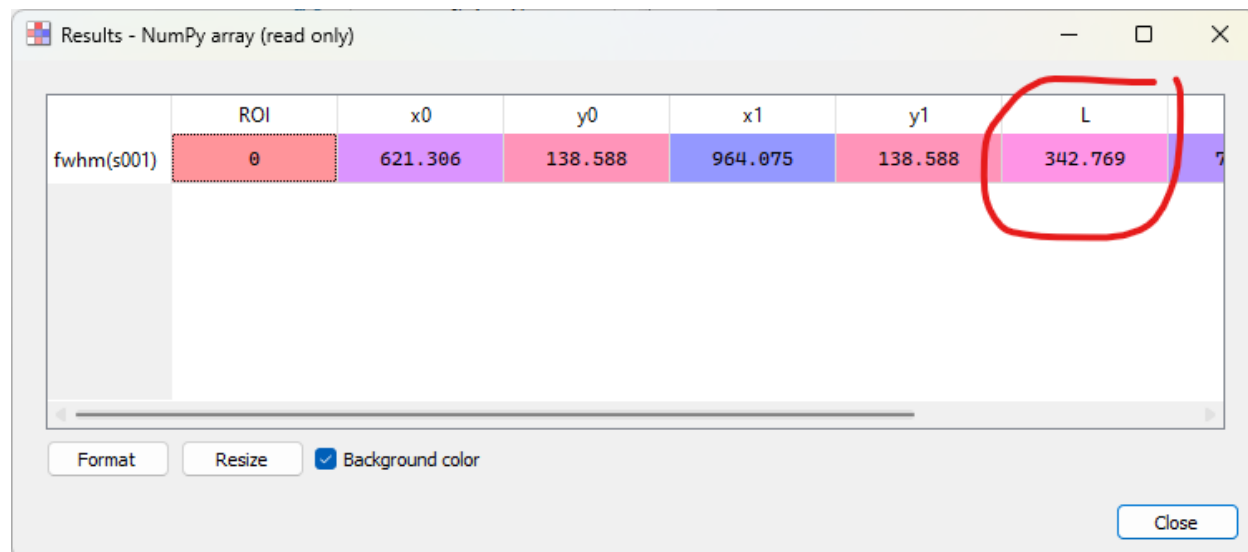


Fig. 78: If we go back to the first signal, the intensity profile, we can also directly compute the FWHM with “Analysis > Full width at half maximum”. The “Results” dialog displays a lot of information about the computation, including the FWHM value (that is the L column, “ L ” for “Length” because the result shape is a segment and FWHM is the length of the segment).

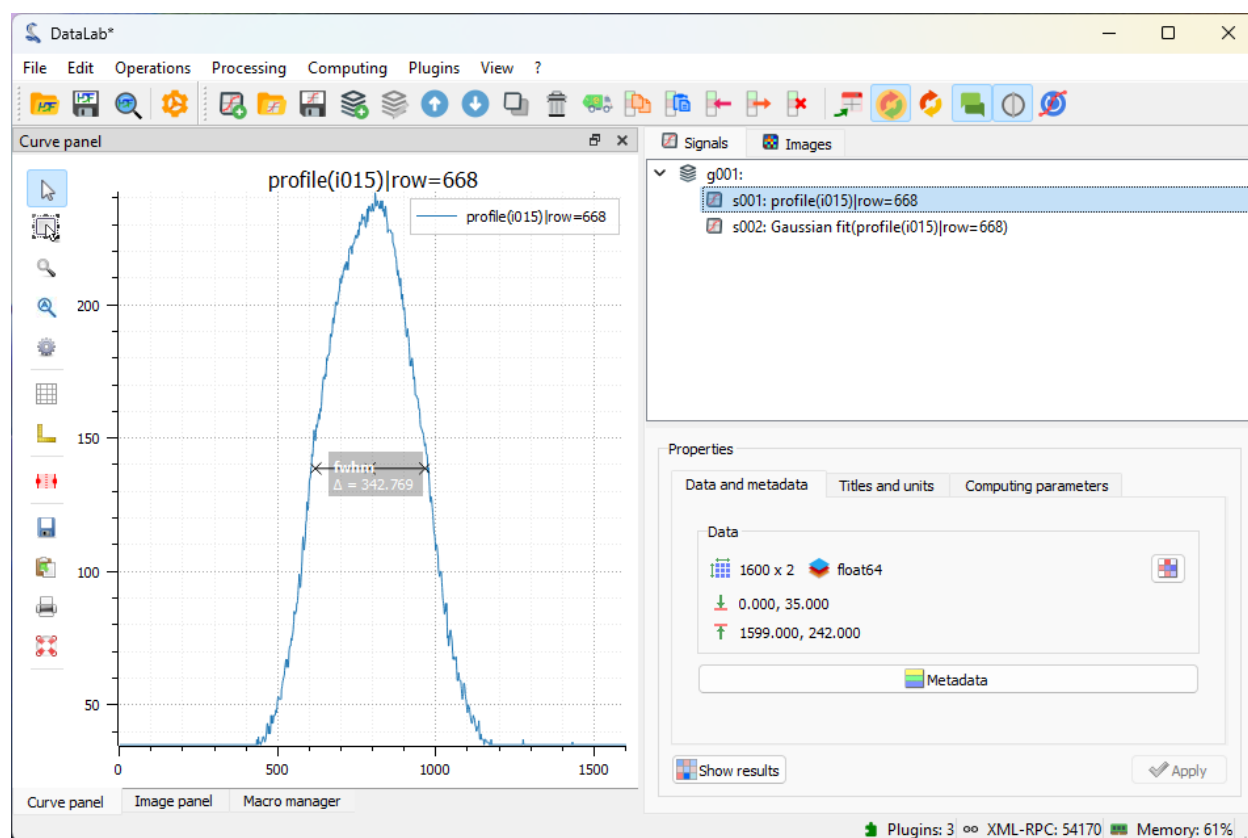


Fig. 79: The FWHM is also displayed on the curve, with an optional label (here, the title of this measurement has been displayed with “View > Show graphical object titles” or the button in the toolbar).

Now, let's try another method to measure the beam size.

From the “Images” panel, we can extract the radial intensity profile with “Operations > Intensity profiles > Radial profile”.

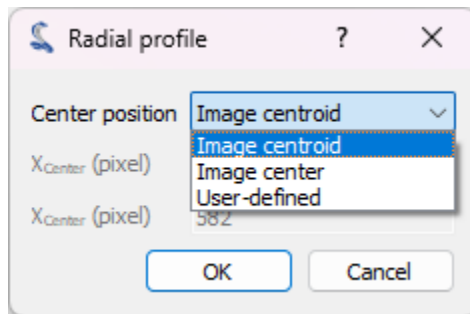


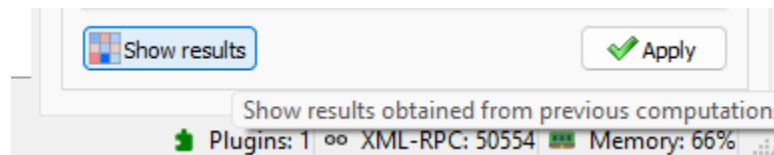
Fig. 80: The radial intensity profile may be computed around the centroid position, or around the center of the image, or around a user-defined position. Here we have selected the centroid position.

All these operations and computations that we have performed on a single image can be applied to all the images in the “Images” panel.

To do that, we begin by cleaning the “Signals” panel (with “Edit > Delete all” or the button in the toolbar). We also clean the intermediate results in the “Images” panel by selecting the images obtained during our prototyping and deleting them individually (with “Edit > Remove” or the button).

Then, we select all the images in the “Images” panel (individually, or by selecting the whole group “g001”).

Note: If you want to show the analysis results again, you can select the “Show results” entry in the “Analysis” menu, or the “Show results” button, below the image list:



Finally, we can save the workspace to a file. The workspace contains all the images and signals that were loaded or processed in DataLab. It also contains the analysis results, the visualization settings (colormaps, contrast, etc.), the metadata, and the annotations.

If you want to load the workspace again, you can use the “File > Open HDF5 file...” (or the button in the toolbar) to load the whole workspace, or the “File > Browse HDF5 file...” (or the button in the toolbar) to load only a selection of data sets from the workspace.

Prototyping a custom processing pipeline

This example shows how to prototype a custom image processing pipeline using DataLab:

- Define a custom processing function
- Create a macro-command to apply the function to an image
- Use the same code from an external IDE (e.g. Spyder) or a Jupyter notebook
- Create a plugin to integrate the function in the DataLab GUI

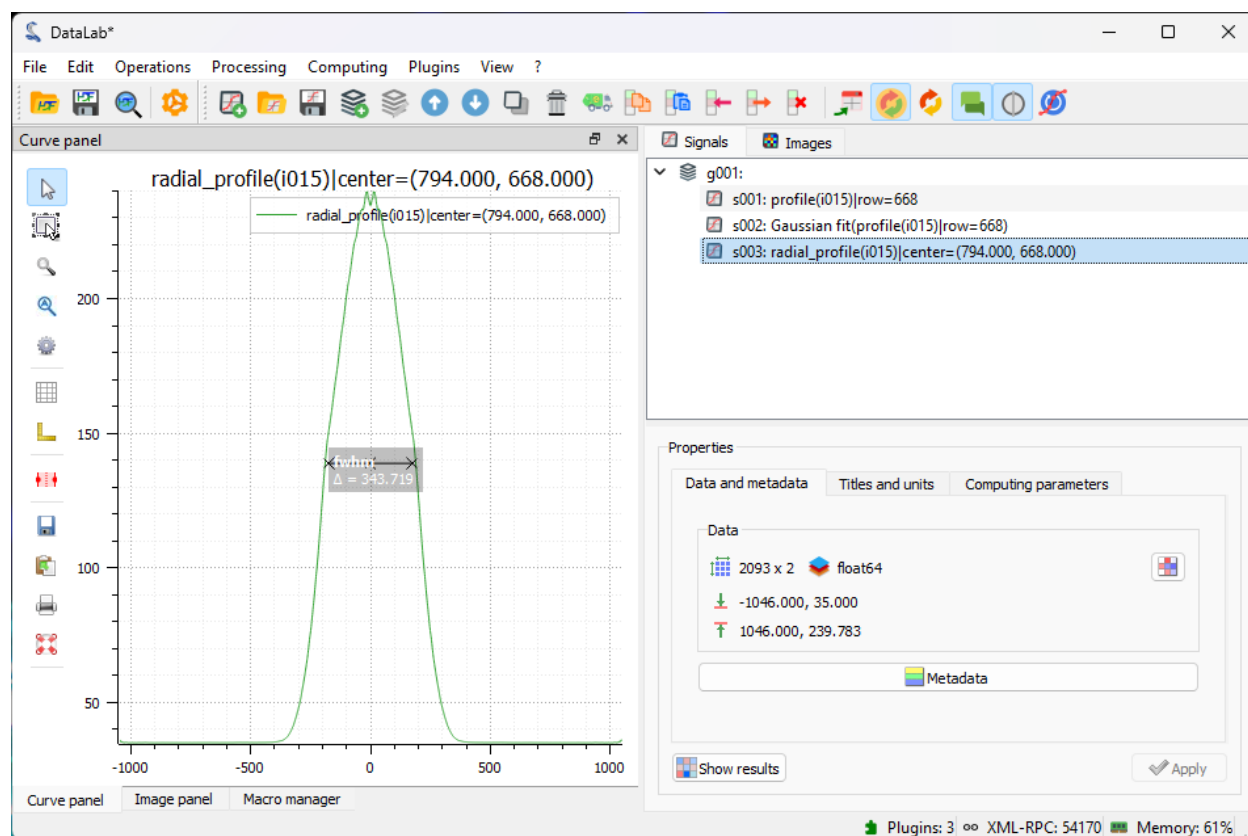


Fig. 81: The radial intensity profile is displayed in the “Signals” panel. It is smoother than the line profile, because it is computed from a larger number of pixels, thus averaging the noise.

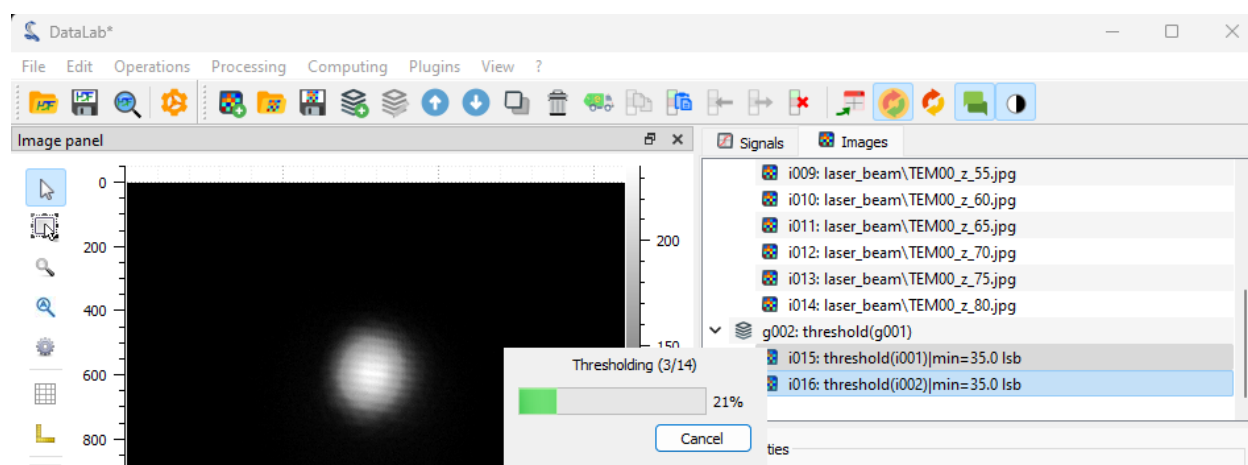


Fig. 82: We apply the threshold to all the images, and then we extract the radial intensity profile for all the images (after selecting the whole group “g002” - it should be automatically selected if you had selected “g001” before applying the threshold).

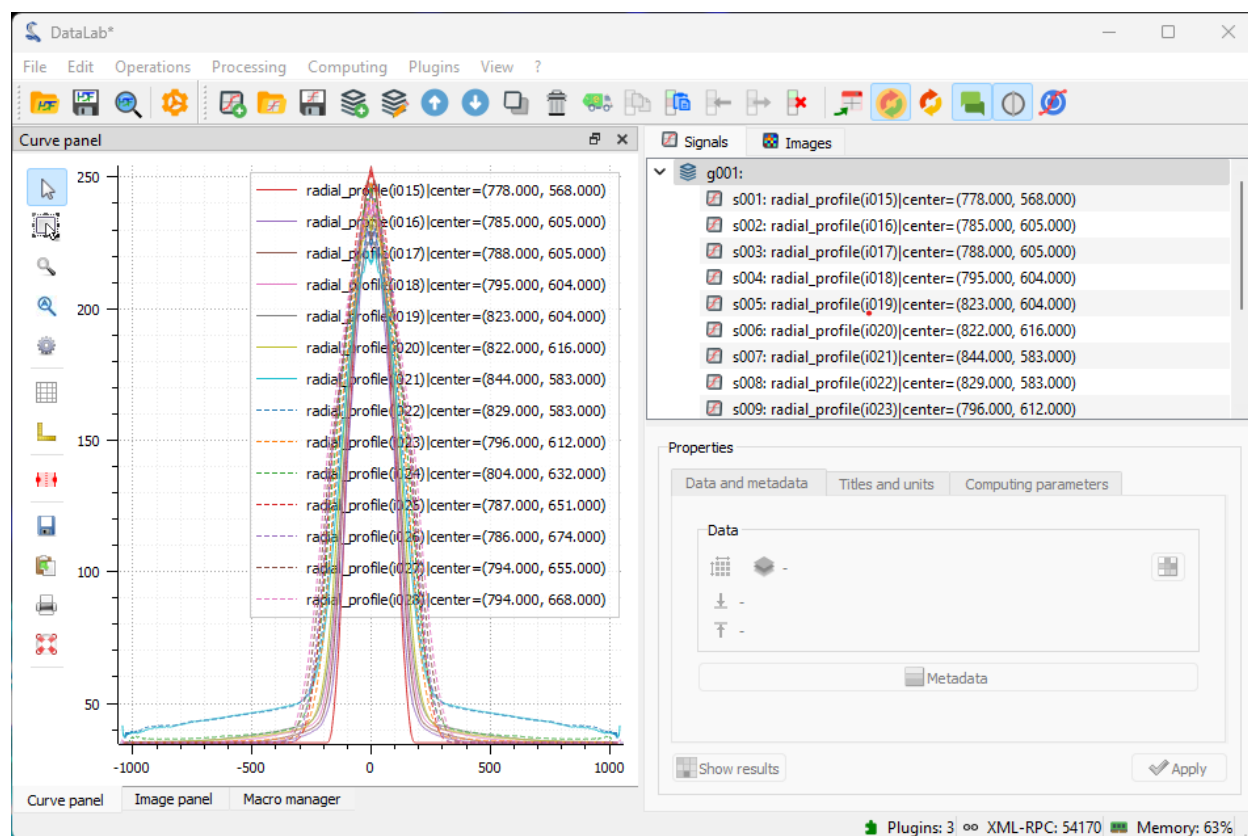


Fig. 83: The “Signals” panel now contains all the radial intensity profiles.

Results - NumPy array (read only)

	ROI	x0	y0	x1	y1	L	Xc	Yc
fwhm(s001)	0	-90.146	146.086	90.1454	146.086	180.291	-0.000307247	146.086
fwhm(s002)	0	-97.5273	134.95	97.5273	134.95	195.055	-2.84217e-14	134.95
fwhm(s003)	0	-102.844	144.563	102.845	144.563	205.689	0.000226296	144.563
fwhm(s004)	0	-108.246	140.839	108.246	140.839	216.492	-1.66472e-05	140.839
fwhm(s005)	0	-114.898	134.226	114.898	134.226	229.796	-1.0366e-05	134.226
fwhm(s006)	0	-120.149	138.229	120.147	138.229	240.295	-0.000828078	138.229
fwhm(s007)	0	-132.471	134.219	132.471	134.219	264.942	2.84217e-14	134.219
fwhm(s008)	0	-136.738	138.216	136.737	138.216	273.475	-0.000167016	138.216
fwhm(s009)	0	-136.727	139.425	136.727	139.425	273.454	-0.000201918	139.425

Format Resize ☒ Background color Close

Fig. 84: We can compute the FWHM of all the radial intensity profiles: the “Results” dialog displays the FWHM values for all the profiles.

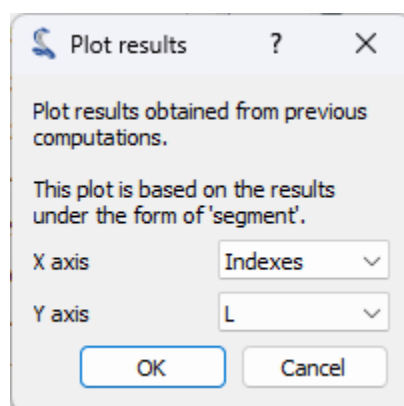


Fig. 85: Finally, we can plot the beam size as a function of the position along the propagation axis. To do that, we use the “Plot results” feature in the “Analysis” menu. This feature allows to plot result data sets by choosing the x and y axes among the result columns. Here, we choose the to plot the FWHM values (L) as a function of the image index (*Indices*).

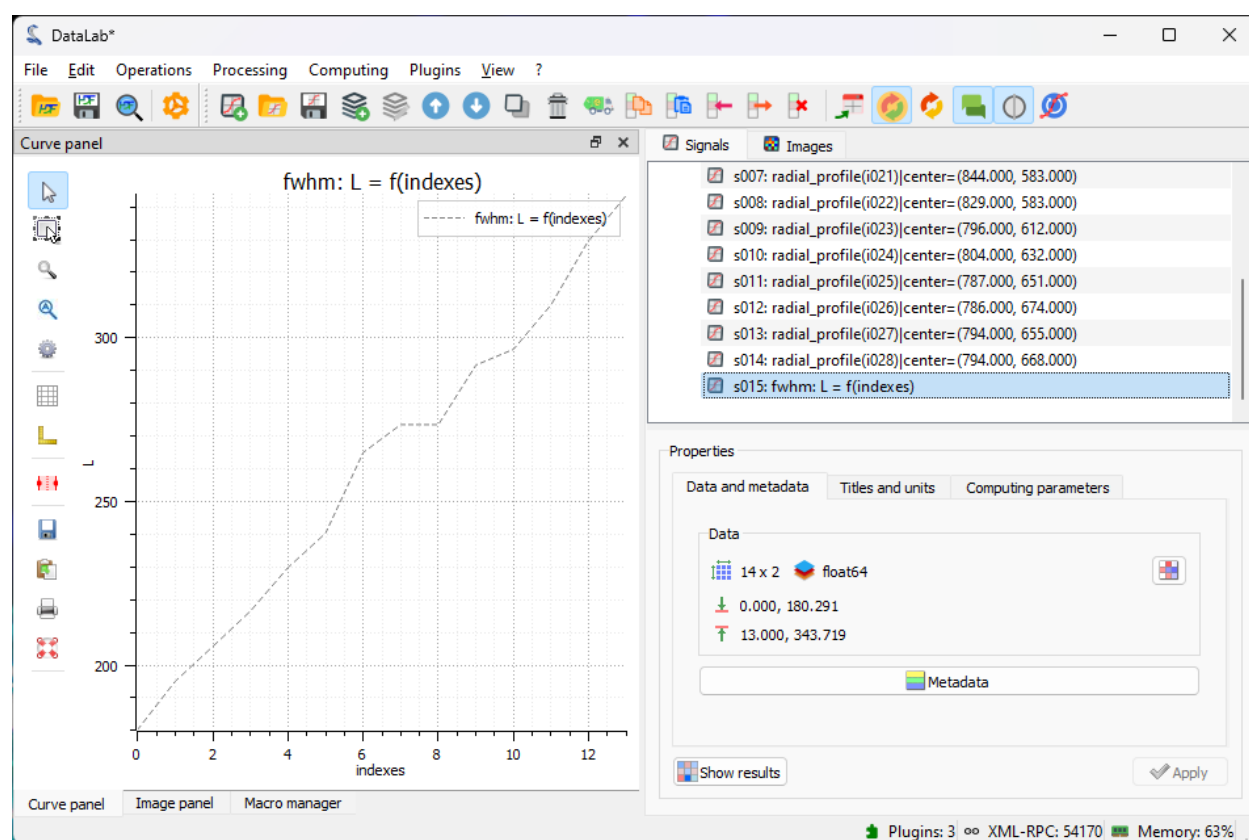


Fig. 86: The plot is displayed in the “Signals” panel and shows that the beam size increases with the position along the propagation axis (the position is here in arbitrary units, the image index).

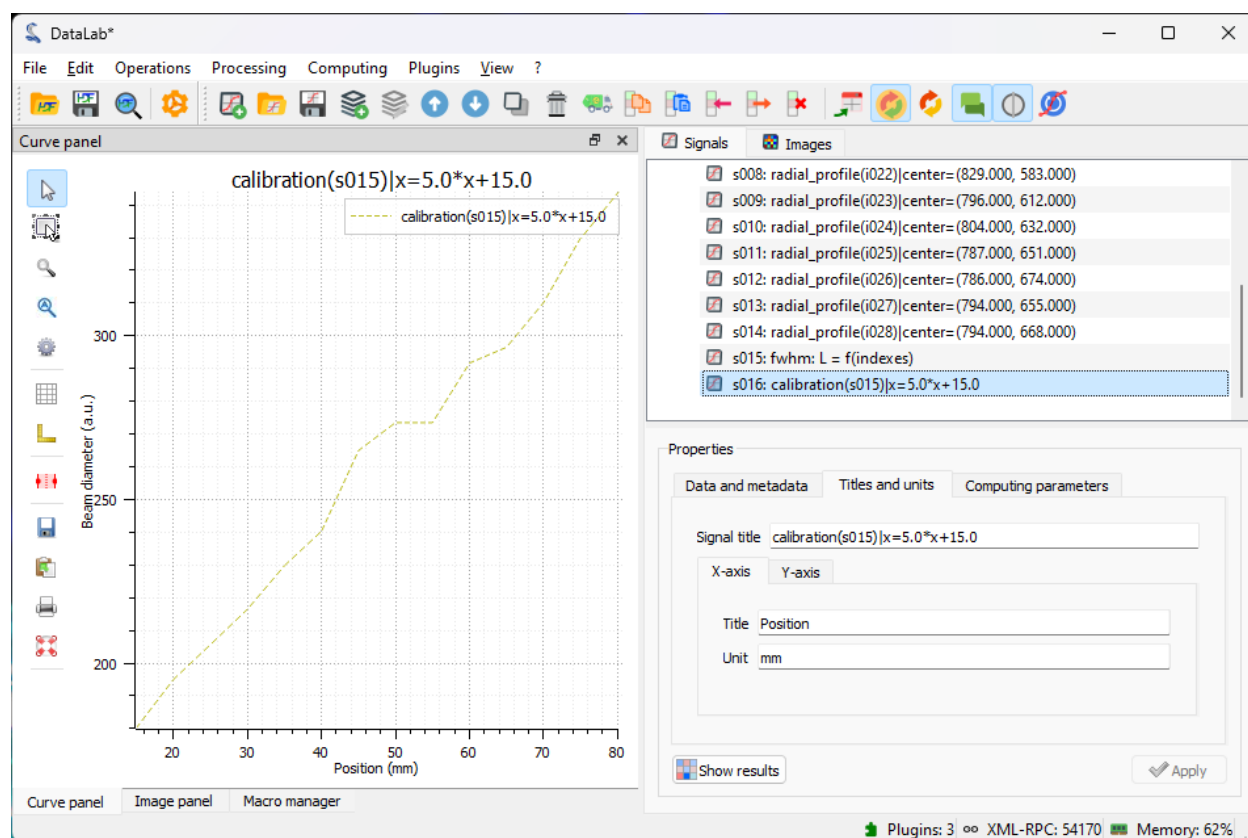


Fig. 87: We can also calibrate the X and Y axis using “Processing > Linear calibration”. Here we have set the X axis to the position in mm (and entered the title and unit in the “Properties” group box).

Define a custom processing function

For illustrating the extensibility of DataLab, we will use a simple image processing function that is not available in the standard DataLab distribution, and that represents a typical use case for prototyping a custom processing pipeline.

The function that we will work on is a denoising filter that combines the ideas of averaging and edge detection. This filter will average the pixel values in the neighborhood, but with a twist: it will give less weight to pixels that are significantly different from the central pixel, assuming they might be part of an edge or noise.

Here is the code of the `weighted_average_denoise` function:

```
def weighted_average_denoise(data: np.ndarray) -> np.ndarray:
    """Apply a custom denoising filter to an image.

    This filter averages the pixels in a 5x5 neighborhood, but gives less weight
    to pixels that significantly differ from the central pixel.
    """

    def filter_func(values: np.ndarray) -> float:
        """Filter function"""
        central_pixel = values[len(values) // 2]
        differences = np.abs(values - central_pixel)
        weights = np.exp(-differences / np.mean(differences))
        return np.average(values, weights=weights)

    return spi.generic_filter(data, filter_func, size=5)
```

For testing our processing function, we will use a generated image from a DataLab plugin example (*plugins/examples/cdl_example_imageproc.py*). Before starting, make sure that the plugin is installed in DataLab (see the first steps of the tutorial *Detecting blobs on an image*).

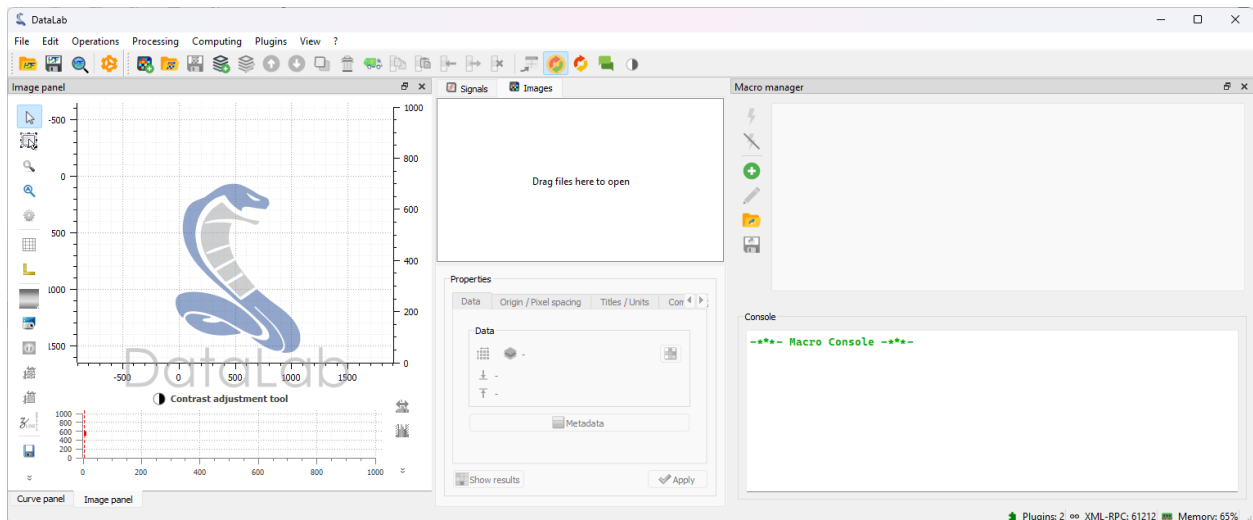


Fig. 88: To begin, we reorganize the window layout of DataLab to have the “Image Panel” on the left and the “Macro Panel” on the right.

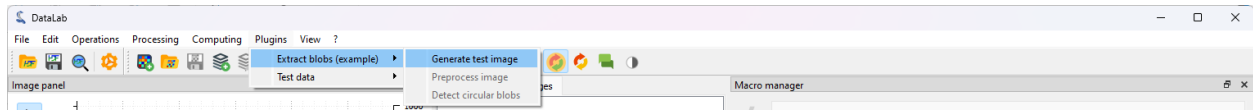


Fig. 89: We generate a new image using the “Plugins > Extract blobs (example) > Generate test image” menu.

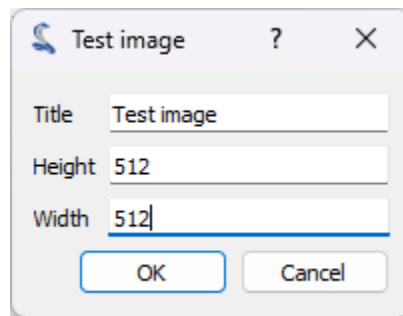


Fig. 90: We select a limited size for the image (e.g. 512x512 pixels) because our algorithm is quite slow, and click on “OK”.

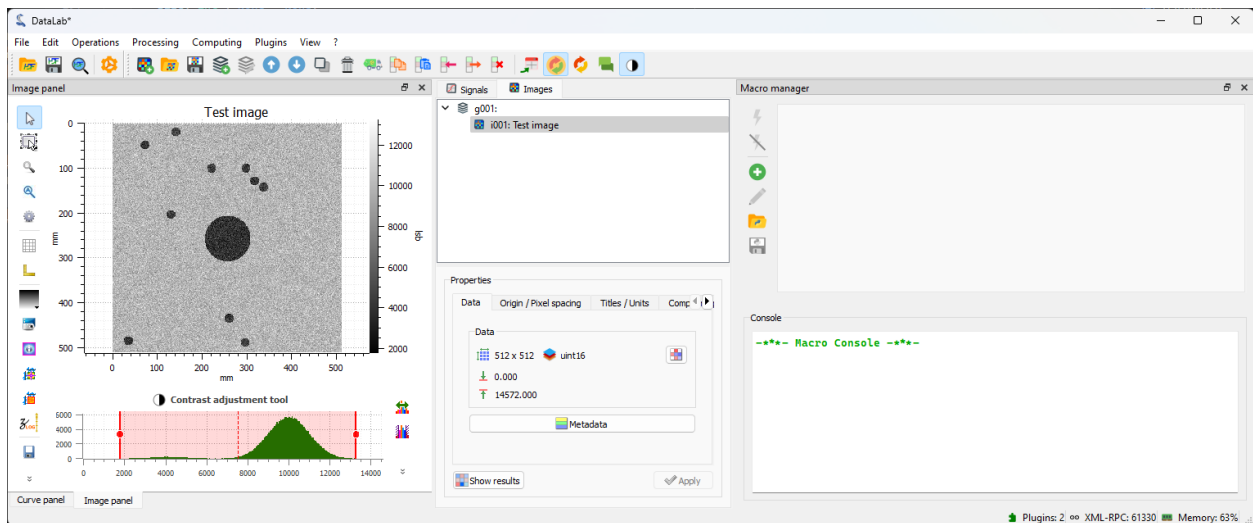


Fig. 91: We can now see the generated image in the “Image Panel”.

Create a macro-command

Let's get back to our custom function. We can create a new macro-command that will apply the function to the current image. To do so, we open the "Macro Panel" and click on the "New macro" button.

DataLab creates a new macro-command which is not empty: it contains a sample code that shows how to create a new image and add it to the "Image Panel". We can remove this code and replace it with our own code:

```
# Import the necessary modules
import numpy as np
import scipy.ndimage as spi
from cdl.proxy import RemoteProxy

# Define our custom processing function
def weighted_average_denoise(values: np.ndarray) -> float:
    """Apply a custom denoising filter to an image.

    This filter averages the pixels in a 5x5 neighborhood, but gives less weight
    to pixels that significantly differ from the central pixel.
    """
    central_pixel = values[len(values) // 2]
    differences = np.abs(values - central_pixel)
    weights = np.exp(-differences / np.mean(differences))
    return np.average(values, weights=weights)

# Initialize the proxy to DataLab
proxy = RemoteProxy()

# Switch to the "Image Panel" and get the current image
proxy.set_current_panel("image")
image = proxy.get_object()
if image is None:
    # We raise an explicit error if there is no image to process
    raise RuntimeError("No image to process!")

# Get a copy of the image data, and apply the function to it
data = np.array(image.data, copy=True)
data = spi.generic_filter(data, weighted_average_denoise, size=5)

# Add new image to the panel
proxy.add_image("My custom filtered data", data)
```

In DataLab, macro-commands are simply Python scripts:

- Macros are part of DataLab's **workspace**, which means that they are saved and restored when exporting and importing to/from an HDF5 file.
- Macros are executed in a separate process, so we need to import the necessary modules and initialize the proxy to DataLab. The proxy is a special object that allows to communicate with DataLab.
- As a consequence, **when defining a plugin or when controlling DataLab from an external IDE, we can use exactly the same code as in the macro-command**. This is a very important point, because it means that we can prototype our processing pipeline in DataLab, and then use the same code in a plugin or in an external IDE to develop it further.

Note: The macro-command is executed in DataLab’s Python environment, so we can use the modules that are available in DataLab. However, we can also use our own modules, as long as they are installed in DataLab’s Python environment or in a Python distribution that is compatible with DataLab’s Python environment.

If your custom modules are not installed in DataLab’s Python environment, and if they are compatible with DataLab’s Python version, you can prepend the `sys.path` with the path to the Python distribution that contains your modules:

```
import sys
sys.path.insert(0, "/path/to/my/python/distribution")
```

This will allow you to import your modules in the macro-command and mix them with the modules that are available in DataLab.

Warning: If you use this method, make sure that your modules are compatible with DataLab’s Python version. Otherwise, you will get errors when importing them.

Now, let’s execute the macro-command by clicking on the “Run macro” button:

- The macro-command is executed in a separate process, so we can continue to work in DataLab while the macro-command is running. And, if the macro-command takes too long to execute, we can stop it by clicking on the “Stop macro” button.
- During the execution of the macro-command, we can see the progress in the “Macro Panel” window: the process standard output is displayed in the “Console” below the macro editor. We can see the following messages:
 - `---[...]-[# ==> Running 'Untitled 01' macro...]:` the macro-command starts
 - `Connecting to DataLab XML-RPC server...OK [...]:` the proxy is connected to DataLab
 - `---[...]-[# <== 'Untitled 01' macro has finished]:` the macro-command ends

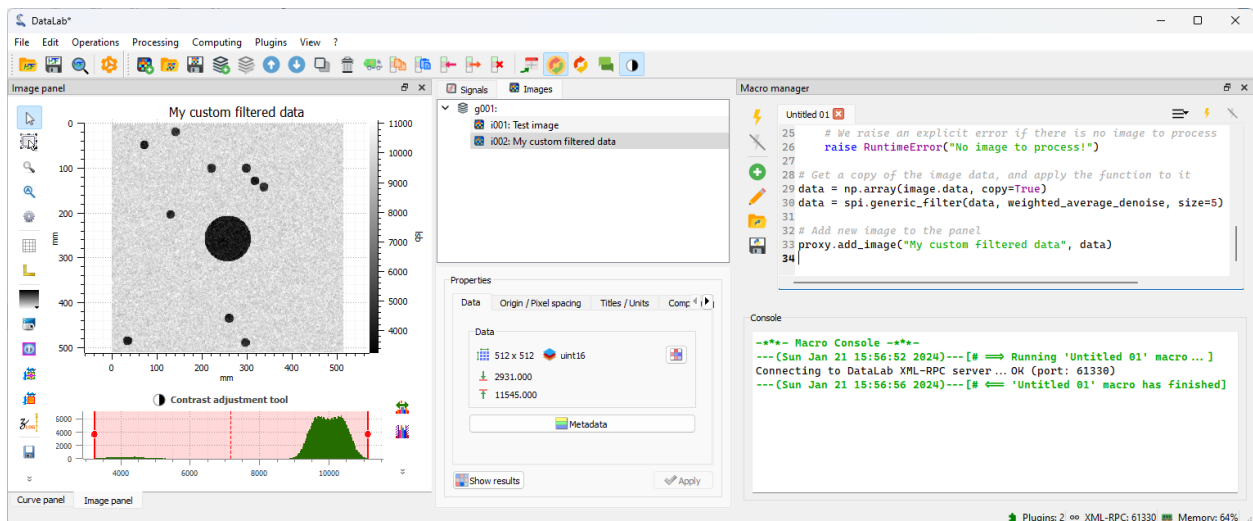


Fig. 92: When the macro-command has finished, we can see the new image in the “Image Panel”. Our filter has been applied to the image, and we can see that the noise has been reduced.

Prototyping with an external IDE

Now that we have a working prototype of our processing pipeline, we can use the same code in an external IDE to develop it further.

For example, we can use the Spyder IDE to debug our code. To do so, we need to install Spyder but not necessarily in DataLab's Python environment (in the case of the stand-alone version of DataLab, it wouldn't be possible anyway).

The only requirement is to install a DataLab client in Spyder's Python environment:

- If you use the stand-alone version of DataLab or if you want or need to keep DataLab and Spyder in separate Python environments, you can install the [DataLab Simple Client](#) (`cdl-client`) using the `pip` package manager:

```
pip install cdl-client
```

Or you may also install the [DataLab Python package](#) (`cdl`) which includes the client (but also other modules, so we don't recommend this method if you don't need all DataLab's features in this Python environment):

```
pip install cdl
```

- If you use the DataLab Python package, you may run Spyder in the same Python environment as DataLab, so you don't need to install the client: it is already available in the main DataLab package (the `cdl` package).

Once the client is installed, we can start Spyder and create a new Python script:

```

1  # -*- coding: utf-8 -*-
2  """
3  Example of remote control of DataLab current session,
4  from a Python script running outside DataLab (e.g. in Spyder)
5
6  Created on Fri May 12 12:28:56 2023
7
8  @author: p.raybaut
9  """
10
11 # %% Importing necessary modules
12
13 import numpy as np
14 import scipy.ndimage as spi
15 from cdlclient import SimpleRemoteProxy
16
17 # %% Connecting to DataLab current session
18
19 proxy = SimpleRemoteProxy()
20 proxy.connect()
21
22 # %% Executing commands in DataLab (...)
23
24
25 # Define our custom processing function
26 def weighted_average_denoise(data: np.ndarray) -> np.ndarray:
27     """Apply a custom denoising filter to an image.
28
29     This filter averages the pixels in a 5x5 neighborhood, but gives less weight
30     to pixels that significantly differ from the central pixel.
```

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```

31 """
32
33 def filter_func(values: np.ndarray) -> float:
34     """Filter function"""
35     central_pixel = values[len(values) // 2]
36     differences = np.abs(values - central_pixel)
37     weights = np.exp(-differences / np.mean(differences))
38     return np.average(values, weights=weights)
39
40     return spi.generic_filter(data, filter_func, size=5)
41
42
43 # Switch to the "Image Panel" and get the current image
44 proxy.set_current_panel("image")
45 image = proxy.get_object()
46 if image is None:
47     # We raise an explicit error if there is no image to process
48     raise RuntimeError("No image to process!")
49
50 # Get a copy of the image data, and apply the function to it
51 data = np.array(image.data, copy=True)
52 data = weighted_average_denoise(data)
53
54 # Add new image to the panel
55 proxy.add_image("Filtered using Spyder", data)

```

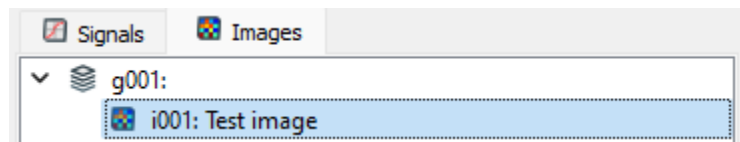


Fig. 93: We go back to DataLab and select the first image in the “Image Panel”.

Prototyping with a Jupyter notebook

We can also use a Jupyter notebook to prototype our processing pipeline. To do so, we need to install Jupyter but not necessarily in DataLab’s Python environment (in the case of the stand-alone version of DataLab, it wouldn’t be possible anyway).

The only requirement is to install a DataLab client in Jupyter’s Python environment (see the previous section for more details: that is exactly the same procedure as for Spyder or any other IDE like Visual Studio Code, for example).

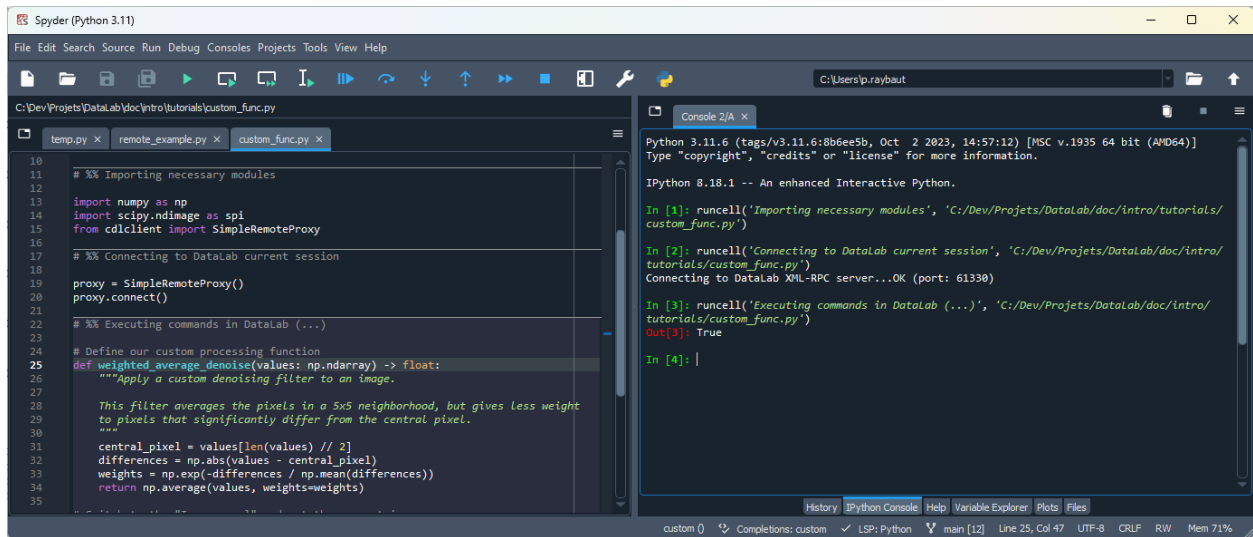


Fig. 94: Then, we execute the script in Spyder, step-by-step (using the defined cells), and we can see the result in DataLab.

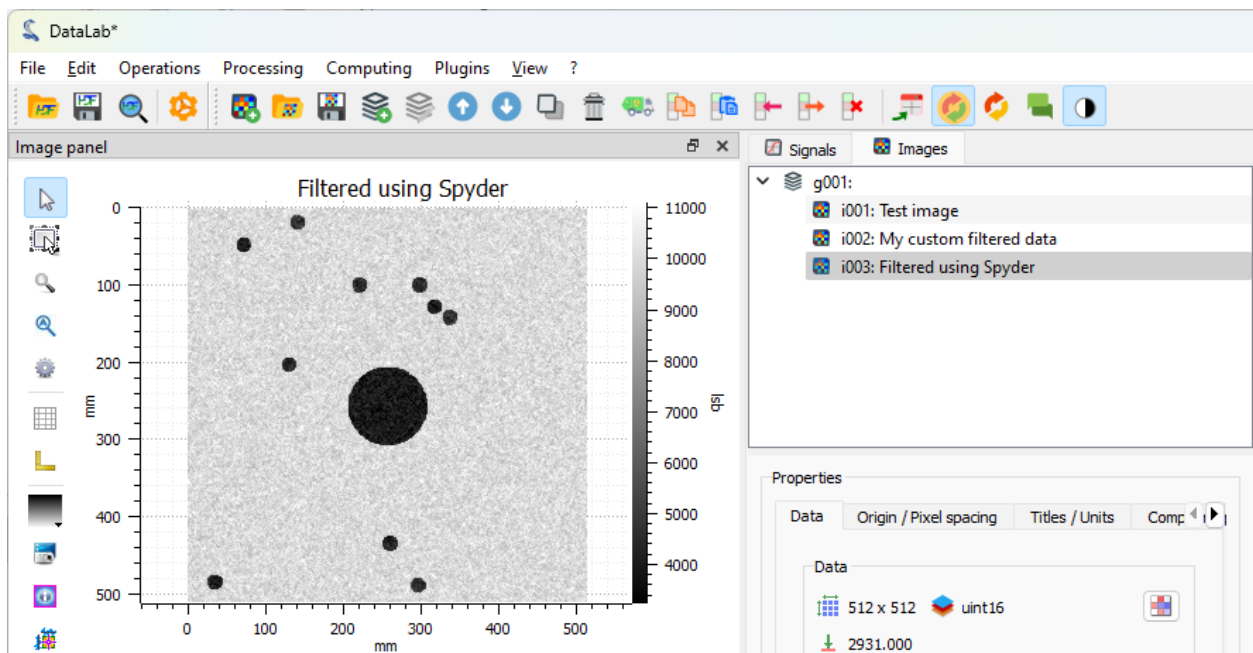


Fig. 95: We can see in DataLab that a new image has been added to the “Image Panel”. This image is the result of the execution of the script in Spyder. Here we have used the script without any modification, but we could have modified it to test new ideas, and then use the modified script in DataLab.

DataLab custom function example

This is part of the DataLab's custom function tutorial which aims at illustrating the extensibility of DataLab (macros, plugins, and control from an external IDE or a Jupyter notebook).

The only requirement is to install the *DataLab Simple Client* package (using `pip install cdlclient`, for example).

```
[2]: import numpy as np
import scipy.ndimage as spi
from cdlclient import SimpleRemoteProxy

# Define our custom processing function
def weighted_average_denoise(values: np.ndarray) -> float:
    """Apply a custom denoising filter to an image.

    This filter averages the pixels in a 5x5 neighborhood, but gives less weight
    to pixels that significantly differ from the central pixel.
    """
    central_pixel = values[len(values) // 2]
    differences = np.abs(values - central_pixel)
    weights = np.exp(-differences / np.mean(differences))
    return np.average(values, weights=weights)
```

Connecting to DataLab current session:

```
[3]: proxy = SimpleRemoteProxy()
proxy.connect()

Connecting to DataLab XML-RPC server...OK (port: 61330)
```

Switch to the "Image panel" and get the current image

```
[5]: proxy.set_current_panel("image")
image = proxy.get_object()
if image is None:
    # We raise an explicit error if there is no image to process
    raise RuntimeError("No image to process!")
```

Get a copy of the image data, apply the function to it, and add new image to the panel

```
[6]: data = np.array(image.data, copy=True)
data = spi.generic_filter(data, weighted_average_denoise, size=5)
proxy.add_image("Filtered using a Jupyter notebook", data)
```

Fig. 96: Once the client is installed, we can start Jupyter and create a new notebook.

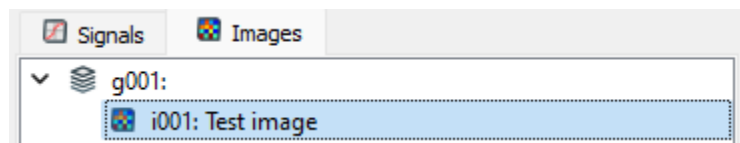


Fig. 97: We go back to DataLab and select the first image in the "Image Panel".

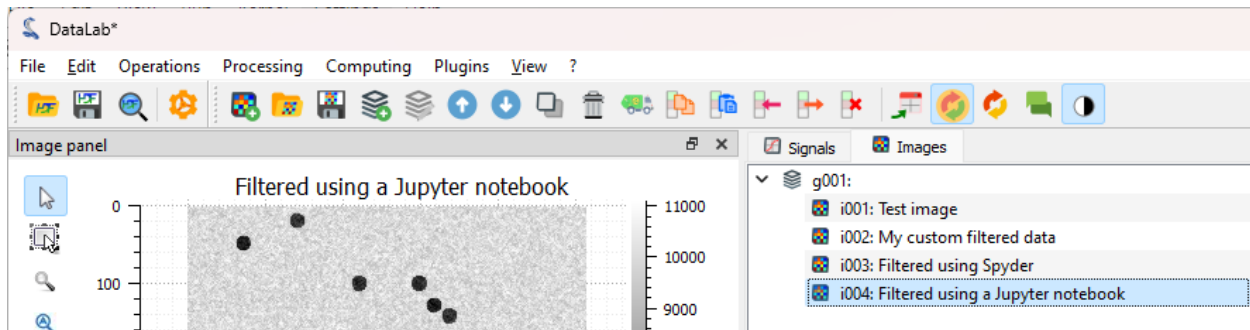


Fig. 98: Then, we execute the notebook in Jupyter, step-by-step (using the defined cells), and we can see the result in DataLab. Once again, we can see in DataLab that a new image has been added to the "Image Panel". This image is the result of the execution of the notebook in Jupyter. As for the script in Spyder, we could have modified the notebook to test new ideas, and then use the modified notebook in DataLab.

Creating a plugin

Now that we have a working prototype of our processing pipeline, we can create a plugin to integrate it in DataLab's GUI. To do so, we need to create a new Python module that will contain the plugin code. We can use the same code as in the macro-command, but we need to make some changes.

See also:

The plugin system is described in the *Plugins* section.

Apart from integrating the feature to DataLab's GUI which is more convenient for the user, the advantage of creating a plugin is that we can take benefit of the DataLab infrastructure, if we encapsulate our processing function in a certain way (see below):

- Our function will be executed in a separate process, so we can interrupt it if it takes too long to execute.
- Warnings and errors will be handled by DataLab, so we don't need to handle them ourselves.

The most significant change is that we need to define a function that will be operating on DataLab's native image objects (*cdl.obj.ImageObj*), instead of operating on NumPy arrays. So we need to find a way to call our custom function *weighted_average_denoise* with a *cdl.obj.ImageObj* as input and output. To avoid writing a lot of boilerplate code, we can use the function wrapper provided by DataLab: *cdl.computation.image.Wrap11Func*.

Besides we need to define a class that describes our plugin, which must inherit from *cdl.plugins.PluginBase* and name the Python script that contains the plugin code with a name that starts with *cdl_* (e.g. *cdl_custom_func.py*), so that DataLab can discover it at startup.

Moreover, inside the plugin code, we want to add an entry in the "Plugins" menu, so that the user can access our plugin from the GUI.

Here is the plugin code:

```

1  # -*- coding: utf-8 -*-
2
3  """
4  Custom denoising filter plugin
5  =====
6
7  This is a simple example of a DataLab image processing plugin.
8
9  It is part of the DataLab custom function tutorial.
10
11  .. note::
12
13     This plugin is not installed by default. To install it, copy this file to
14     your DataLab plugins directory (see `DataLab documentation
15     <https://datalab-platform.com/en/features/general/plugins.html>`).
16  """
17
18  import numpy as np
19  import scipy.ndimage as spi
20
21  import cdl.computation.image as cpi
22  import cdl.obj
23  import cdl.param
24  import cdl.plugins
25

```

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```

26
27 def weighted_average_denoise(data: np.ndarray) -> np.ndarray:
28     """Apply a custom denoising filter to an image.
29
30     This filter averages the pixels in a 5x5 neighborhood, but gives less weight
31 to pixels that significantly differ from the central pixel.
32     """
33
34     def filter_func(values: np.ndarray) -> float:
35         """Filter function"""
36         central_pixel = values[len(values) // 2]
37         differences = np.abs(values - central_pixel)
38         weights = np.exp(-differences / np.mean(differences))
39         return np.average(values, weights=weights)
40
41     return spi.generic_filter(data, filter_func, size=5)
42
43
44 class CustomFilters(cdl.plugins.PluginBase):
45     """DataLab Custom Filters Plugin"""
46
47     PLUGIN_INFO = cdl.plugins.PluginInfo(
48         name="My custom filters",
49         version="1.0.0",
50         description="This is an example plugin",
51     )
52
53     def create_actions(self) -> None:
54         """Create actions"""
55         acth = self.imagepanel.acthandler
56         proc = self.imagepanel.processor
57         with acth.new_menu(self.PLUGIN_INFO.name):
58             for name, func in (("Weighted average denoise", weighted_average_denoise),):
59                 # Wrap function to handle `ImageObj` objects instead of NumPy arrays
60                 wrapped_func = cpi.Wrap11Func(func)
61                 acth.new_action(
62                     name, triggered=lambda: proc.compute_11(wrapped_func, title=name)
63                 )

```

To test it, we have to add the plugin script to one of the plugin directories that are discovered by DataLab at startup (see the *Plugins* section for more details, or the *Detecting blobs on an image* for an example).

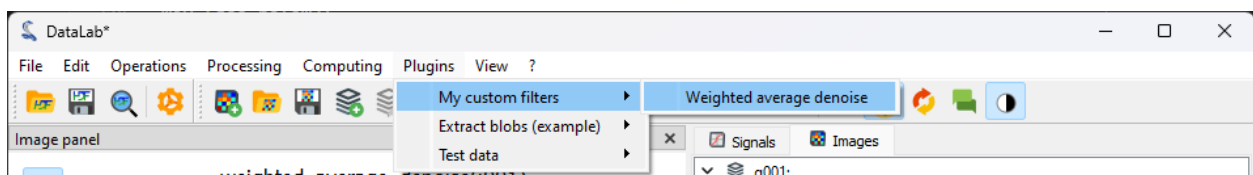


Fig. 99: We restart DataLab and we can see that the plugin has been loaded.

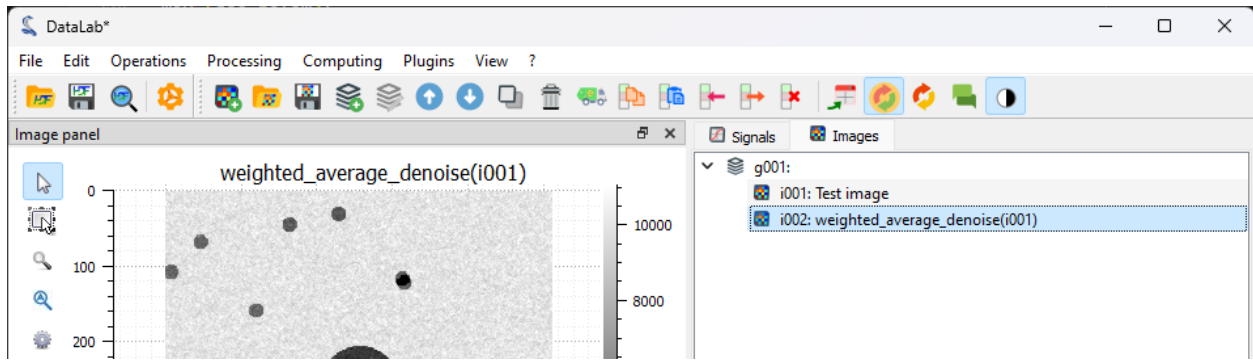
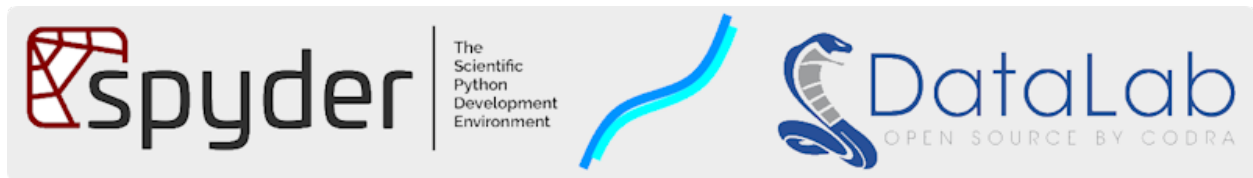


Fig. 100: We generate again our test image using (see the first steps of the tutorial), and we process it using the plugin: “Plugins > My custom filters > Weighted average denoise”.

DataLab and Spyder: a perfect match

This tutorial shows how to use [Spyder](#) to work with DataLab through an example, using fake algorithms and data that represent an hypothetical research/technical work. The goal is to illustrate how to use DataLab to test your algorithms with some data, and how to debug them if necessary.

The example is quite simple, but it illustrates the basic concepts of working with DataLab and [Spyder](#).



Note: DataLab and [Spyder](#) are **complementary** tools. While [Spyder](#) is a powerful development environment with interactive scientific computing capabilities, DataLab is a versatile data analysis tool that may be used to perform a wide range of tasks, from simple data visualization to complex data analysis and processing. In other words, [Spyder](#) is a **development** tool, while DataLab is a **data analysis** tool. You can use [Spyder](#) to develop algorithms and then use DataLab to analyze data with those algorithms.

Basic concepts

In the context of your research or technical work, we assume that you are developing a software to process data (signals or images): this software may either be a stand-alone application or a library that you will use in other applications, or even a simple script that you will run from the command line. In any case, you will need to follow a development process that will include the following steps:

0. Prototype the algorithm in a development environment, such as [Spyder](#).
1. Develop the algorithm in a development environment, such as [Spyder](#).
2. Test the algorithm with some data.
3. Debug the algorithm if necessary.
4. Repeat steps 2 and 3 until the algorithm works as expected.
5. Use the algorithm in your application.

Note: DataLab can help you with step 0 because it provides all the processing primitives that you need to prototype your algorithm: you can load data, visualize it, and perform basic processing operations. We won't cover this step in the following paragraphs because the DataLab documentation already provides a lot of information about it.

In this tutorial, we will see how to use DataLab to perform steps 2 and 3. We assume that you already have prototyped (preferably in DataLab!) and developed your algorithm in [Spyder](#). Now, you want to test it with some data, but without quitting [Spyder](#) because you may need to do some changes to your algorithm and re-test it. Besides, your workflow is already set up in [Spyder](#) and you don't want to change it.

Note: In this tutorial, we assume that you have already installed DataLab and that you have started it. If you haven't done it yet, please refer to the [Installation](#) section of the documentation.

Besides, we assume that you have already installed [Spyder](#) and that you have started it. If you haven't done it yet, please refer to the [Spyder](#) documentation. **Note that you don't need to install DataLab in the same environment as Spyder:** that's the whole point of DataLab, it is a stand-alone application that can be used from any environment. For this tutorial, you only need to install the DataLab Simple Client (`pip install cdlclient`) in the same environment as [Spyder](#).

Testing your algorithm with DataLab

Let's assume that you have developed algorithms in the `my_work` module of your project. You have already prototyped them in DataLab, and you have developed them in [Spyder](#) by writing functions that take some data as input and return some processed data as output. Now, you want to test these algorithms with some data.

To test these algorithms, you have written two functions in the `my_work` module:

- `test_my_1d_algorithm`: this function returns some 1D data that will allow you to validate your first algorithm which works on 1D data.
- `test_my_2d_algorithm`: this function returns some 2D data that will allow you to validate your second algorithm which works on 2D data.

You can now use DataLab to visualize the data returned by these functions directly from [Spyder](#):

- First, you need to start both DataLab and [Spyder](#).
- Remember that DataLab is a stand-alone application that can be used from any environment, so you don't need to install it in the same environment as [Spyder](#) because the connection between these two applications is done through a communication protocol.

Here is how to do it:

```
# %% Connecting to DataLab current session

from cdlclient import SimpleRemoteProxy

proxy = SimpleRemoteProxy()
proxy.connect()

# %% Visualizing 1D data from my work

from my_work import test_my_1d_algorithm
```

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```

x, y = test_my_1d_algorithm() # Here is all my research/technical work!
proxy.add_signal("My 1D result data", x, y) # Let's visualize it in DataLab
proxy.compute_wiener() # Denoise the signal using the Wiener filter

# %% Visualizing 2D data from my work

from my_work import test_my_2d_algorithm

z = test_my_2d_algorithm()[1] # Here is all my research/technical work!
proxy.add_image("My 2D result data", z) # Let's visualize it in DataLab

```

If we execute the first two cells, we will see the following output in the Spyder console:

```

Python 3.11.5 (tags/v3.11.5:cce6ba9, Aug 24 2023, 14:38:34) [MSC v.1936 64 bit (AMD64)]
Type "copyright", "credits" or "license" for more information.

```

```

IPython 8.15.0 -- An enhanced Interactive Python.

```

```

In [1]: runcell('Connecting to DataLab current session', 'my_work_test_with_cdl.py')
Connecting to DataLab XML-RPC server...OK (port: 54577)

```

```

In [2]: runcell('Visualizing 1D data from my work', 'my_work_test_with_cdl.py')
Out[2]: True

```

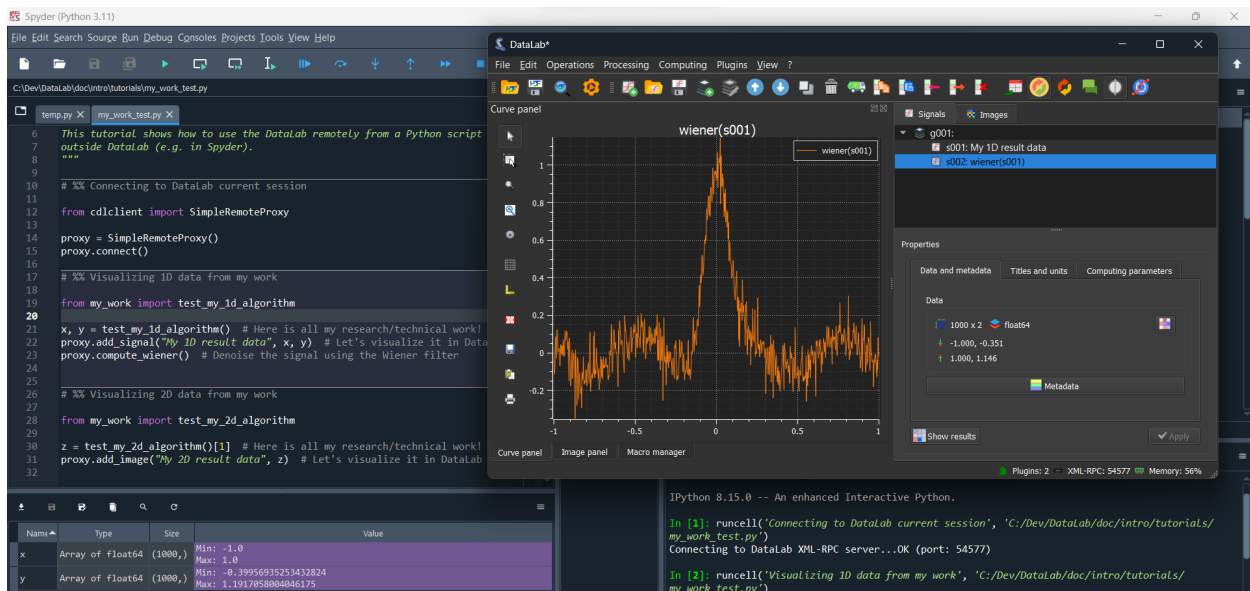


Fig. 101: On this screenshot, we can see the result of evaluating the first two cells: the first cell connects to DataLab, and the second cell visualizes the 1D data returned by the `test_my_1d_algorithm` function.

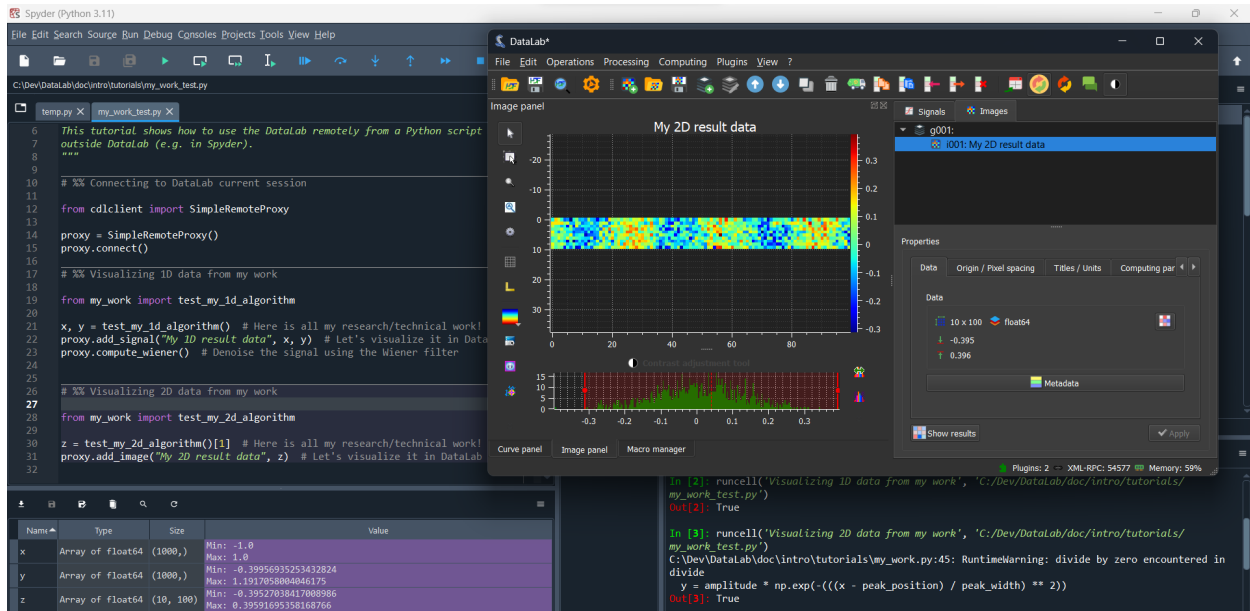


Fig. 102: On this screenshot, we can see the result of evaluating the third cell: the `test_my_2d_algorithm` function returns a 2D array, and we can visualize it directly in DataLab.

Debugging your algorithm with DataLab

Now that you have tested your algorithms with some data, you may want to debug them if necessary. To do so, you can combine the [Spyder](#) debugging capabilities with DataLab.

Here is the code of the fake algorithm that we want to debug, in which we have introduced an optional `debug_with_datalab` parameter that - if set to `True` - will create a proxy object allowing to visualize the data step-by-step in DataLab:

```

def generate_2d_data(
    num_lines: int = 10,
    noise_std: float = 0.1,
    x_min: float = -1,
    x_max: float = 1,
    num_points: int = 100,
    debug_with_datalab: bool = False,
) -> tuple[np.ndarray, np.ndarray]:
    """Generate 2D data that can be used in the tutorials to represent some results.

    Args:
        num_lines: Number of lines in the generated data, by default 10.
        noise_std: Standard deviation of the noise, by default 0.1.
        x_min: Minimum value of the x axis, by default -1.
        x_max: Maximum value of the x axis, by default 1.
        num_points: Number of points in the generated data, by default 100.
        debug_with_datalab: Whether to use the DataLab to debug the function,
            by default False.

    Returns:
        Generated data (x, y; where y is a 2D array and x is a 1D array).

```

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```

"""
proxy = None
if debug_with_datalab:
    proxy = SimpleRemoteProxy()
    proxy.connect()
z = np.zeros((num_lines, num_points))
for i in range(num_lines):
    amplitude = 0.1 * i**2
    peak_position = 0.5 * i**2
    peak_width = 0.1 * i**2
    x, y = generate_1d_data(
        amplitude,
        peak_position,
        peak_width,
        relaxation_oscillations=True,
        noise=True,
        noise_std=noise_std,
        x_min=x_min,
        x_max=x_max,
        num_points=num_points,
    )
    z[i] = y
    if proxy is not None:
        proxy.add_signal(f"Line {i}", x, y)
return x, z

```

The corresponding `test_my_2d_algorithm` function also has an optional `debug_with_datalab` parameter that is simply passed to the `generate_2d_data` function.

Now, we can use [Spyder](#) to debug the `test_my_2d_algorithm` function:

```

# %% Debugging my work with DataLab

from my_work import generate_2d_data

x, z = generate_2d_data(debug_with_datalab=True)

```

In this simple example, the algorithm is just iterating 10 times and generating a 1D array at each iteration. Each 1D array is then stacked in a 2D array that is returned by the `generate_2d_data` function. With the `debug_with_datalab` parameter set to `True`, we can visualize each 1D array in DataLab: that way, we can check that the algorithm is working as expected.

Note: If we had executed the script using [Spyder](#) debugger and set a breakpoint in the `generate_2d_data` function, we would have seen the generated 1D arrays in DataLab at each iteration: since DataLab is executed in a separate process, we would have been able to manipulate the data in DataLab while the algorithm is paused in [Spyder](#).

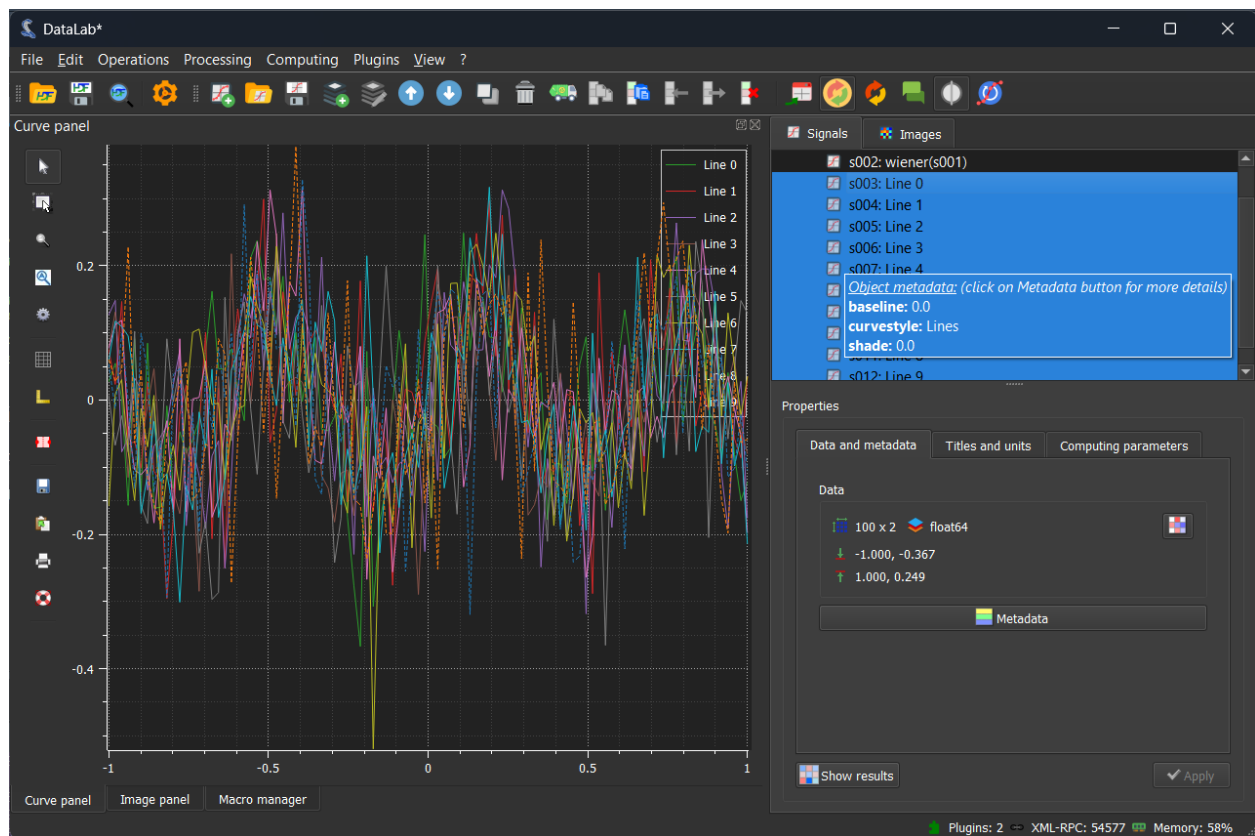


Fig. 103: On this screenshot, we can see the result of evaluating the first cell: the `test_my_2d_algorithm` function is called with the `debug_with_dataLAB` parameter set to `True`: 10 1D arrays are generated and visualized in DataLab.

FEATURES

The following sections describe the features of DataLab, the open-source scientific data analysis and visualization platform.

First, the **validation** section explains why and how DataLab is validated - that is another singular and fundamental feature of DataLab.

Then, the **general features** section describes the general features of DataLab, which concern both the signal and image processing panels.

The **signal processing** and **image processing** sections describe the features specific to the signal and image processing panels, respectively.

Note: Before jumping into the details of other parts of the documentation, it is recommended to start with the [Workspace](#) page, which describes the basic concepts of DataLab.

See also:

For a synthetic overview of the features of DataLab, please refer to the [Key features](#) page.

2.1 Validation

DataLab is a platform for scientific data analysis and visualization. It may be used in a variety of scientific disciplines, including biology, physics, and astronomy. The common ground for all these disciplines is the need to validate the results of computational analysis against ground-truth data. This is a critical step in the scientific method, and it is essential for reproducibility and trust in the results. This is what we call **technical validation**.

DataLab is also used in industrial applications, where the validation of the results is essential for guaranteeing the quality of the process but a wider range of validation is required to ensure that a maximum of use cases are covered from a functional point of view. This is what we call **functional validation**.

Thus, DataLab validation may be categorized into two types:

- **Technical validation:** ensures that the results of computational analysis are accurate and reliable.
- **Functional validation:** checks that the software behaves as expected in a variety of use cases (classic automated unit test suite).

2.1.1 Technical Validation

DataLab technical validation is based on two key concepts: **ground-truth data** and **analytical validation**.

Ground-truth data

Ground-truth data is data that is known to be correct. It is used to validate the results of computational analysis.

In DataLab, ground-truth data may be obtained from a variety of sources, including:

- Experimental data
- Simulated data
- Synthetic data
- Data from a trusted source

Analytical validation

Analytical validation is the process of comparing the results of computational analysis to ground-truth data. This is done to ensure that the results are accurate and reliable.

In DataLab, analytical validation is implemented using a variety of techniques, including:

- Cross-validation with an analytical model (from a trusted source, e.g. [SciPy](#) or [NumPy](#))
- Statistical analysis
- Visual inspection
- Expert review

Scope

The scope of technical validation in DataLab includes all compute functions that operate on DataLab's signal and image objects (i.e. `cdl.obj.SignalObj` and `cdl.obj.ImageObj`).

This includes functions for (all functions are named `compute_<function_name>`):

- Signal processing (`cdl.computation.signal`)
- Image processing (`cdl.computation.image`)

Implementation

The tests are implemented using the [pytest](#) framework.

When writing a new technical validation test, the following rules should be followed regarding the test function:

- The test function should be named:
 - `test_signal_<function_name>` for signal compute functions
 - `test_image_<function_name>` for image compute functions

Note: The `signal` or `image` prefix is used to indicate the type of object that the function operates on. It may be omitted if the function operates exclusively on one type of object (e.g. `test_adjust_gamma` is the test function for the `compute_adjust_gamma` function, which operates on images).

- The test function should be marked with the `@pytest.mark.validation` decorator.

Following those rules ensures that:

- The tests are easily identified as technical validation tests.
- The tests can be executed separately using the command line interface (see [Run technical validation tests](#)).
- The tests are automatically discovered for synthesizing the validation status of the compute functions (see [Validation Status of DataLab](#)).

Executing tests

In DataLab, technical validation tests are disseminated in the test suite of the project, but they can also be executed separately using the command line interface.

See also:

See paragraph [Run technical validation tests](#) for more information on how to run technical validation tests.

2.1.2 Functional validation

Strategy

DataLab functional validation is based a classic test strategy, with a strong emphasis on automated testing. Apart from one or two manual tests (e.g. load test), all tests are automated (more than 99% of the tests are automated).

Writing tests follows the TDD (Test-Driven Development) principle:

- When *a new feature is developed*, the developer writes the tests first. The tests are then executed to ensure that they fail. The developer then implements the feature, and the tests are executed again to ensure that they pass.
- When *a bug is reported*, the developer writes a test that reproduces the bug. The test is executed to ensure that it fails. The developer then fixes the bug, and the test is executed again to ensure that it passes.

Depending on the abstraction level, unit tests and/or application tests are written. When writing both types of tests, the developer starts with the unit tests and then writes the application tests.

Types of tests

The functional validation of DataLab is based on two main types of tests:

- **Unit tests** (test scripts named `*_unit_test.py`): Test individual functions or methods. All unit tests are automated.
- **Application tests** (test scripts named `*_app_test.py`): Test the interaction between components (integration tests), or the application as a whole. All application tests are automated.

Implementation

The tests are implemented using the `pytest` framework. Many existing tests may be derived from to create new tests.

Executing tests

To execute the tests, the developer uses the command line interface. See section *Run complete test suite* for more information on how to run functional validation tests.

2.1.3 Validation Status of DataLab

Functional validation

In DataLab, functional validation is based on a classic test strategy (see *Functional validation*).

Test coverage is around 90%, with more than 200 tests.

Technical validation

This paragraph provides the validation status of compute functions in DataLab (this is what we call technical validation, see *Technical Validation*).

Note: This is a work in progress: the tables below are updated continuously as new functions are validated or test code is adapted (the tables are generated from the test code). Some functions are already validated but do not appear in the list below yet, while others are still in the validation process.

Warning: The validation status must not be confused with the test coverage. The validation status indicates whether the function has been validated against ground-truth data or analytical models. The test coverage indicates the percentage of the code that is executed by the test suite, but it does not necessarily take into account the correctness of the results (DataLab's test coverage is around 90%).

Table 1: Validation Statistics

Category	Signal	Image	Total
Number of compute functions	62	95	157
Number of validated compute functions	50	83	133
Percentage of validated compute functions	80%	87%	84%

Signal Compute Functions

The table below shows the validation status of signal compute functions in DataLab. It is automatically generated from the source code.

Table 2: Validation status of signal compute functions

Compute function	Description	Test function
<code>compute_abs</code>	Compute absolute value with <code>numpy.absolute</code>	<code>test_signal_abs</code>
<code>compute_addition</code>	Add dst and src signals and return dst signal modified in place	<code>test_signal_addition</code>
<code>compute_addition_constant</code>	Add dst and a constant value and return a the new result signal object	<code>test_signal_addition_constant</code>
<code>compute_allan_deviation</code>	Compute Allan deviation with <code>cdl.algorithms.signal.allan_deviation()</code>	<code>test_signal_allan_deviation</code>
<code>compute_allan_variance</code>	Compute Allan variance with <code>cdl.algorithms.signal.allan_variance()</code>	<code>test_signal_allan_variance</code>
<code>compute_arithmetic</code>	Perform arithmetic operation on two signals	<code>test_signal_arithmetic</code>
<code>compute_astype</code>	Convert data type with <code>numpy.astype()</code>	<code>test_signal_astype</code>
<code>compute_bandwidth_3db</code>	Compute bandwidth at -3 dB with <code>cdl.algorithms.signal.bandwidth()</code>	<code>test_signal_bandwidth_3db</code>
<code>compute_calibration</code>	Compute linear calibration	<code>test_signal_calibration</code>
<code>compute_cartesian2polar</code>	Convert cartesian coordinates to polar coordinates	<code>test_signal_cartesian2polar</code>
<code>compute_clip</code>	Compute maximum data clipping with <code>numpy.clip()</code>	<code>test_signal_clip</code>
<code>compute_contrast</code>	Compute contrast with <code>cdl.algorithms.signal.contrast()</code>	<code>test_signal_contrast</code>
<code>compute_convolution</code>	Compute convolution of two signals	<code>test_signal_convolution</code>
<code>compute_derivative</code>	Compute derivative with <code>numpy.gradient()</code>	<code>test_signal_derivative</code>
<code>compute_detrending</code>	Detrend data with <code>scipy.signal.detrend()</code>	N/A
<code>compute_difference</code>	Compute difference between two signals	<code>test_signal_difference</code>
<code>compute_difference_constant</code>	Subtract a constant value from a signal	<code>test_signal_difference_constant</code>
<code>compute_division</code>	Compute division between two signals	<code>test_signal_division</code>
<code>compute_division_constant</code>	Divide a signal by a constant value	<code>test_signal_division_constant</code>
<code>compute_dynamic_parameters</code>	Compute Dynamic parameters	<code>test_dynamic_parameters</code>
<code>compute_exp</code>	Compute exponential with <code>numpy.exp</code>	<code>test_signal_exp</code>
<code>compute_fft</code>	Compute FFT with <code>cdl.algorithms.signal.fft1d()</code>	<code>test_signal_fft</code>
<code>compute_filter</code>	Compute frequency filter (low-pass, high-pass, band-pass, band-stop)	N/A
<code>compute_fwle2</code>	Compute FW at $1/e^2$ with <code>cdl.algorithms.signal.fwle2()</code>	<code>test_signal_fwle2</code>
<code>compute_fwhm</code>	Compute FWHM with <code>cdl.algorithms.signal.fwhm()</code>	<code>test_signal_fwhm</code>
<code>compute_gaussian_filter</code>	Compute gaussian filter with <code>scipy.ndimage.gaussian_filter()</code>	<code>test_signal_gaussian_filter</code>
<code>compute_hadamard_variance</code>	Compute Hadamard variance	N/A

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Table 2 – continued from previous page

Compute function	Description	Test function
<code>compute_histogram</code>	Compute histogram with <code>numpy.histogram()</code>	N/A
<code>compute_ifft</code>	Compute iFFT with <code>cdl.algorithms.signal.ifft1d()</code>	<code>test_signal_ifft</code>
<code>compute_im</code>	Compute imaginary part with <code>numpy.imag()</code>	<code>test_signal_im</code>
<code>compute_integral</code>	Compute integral with <code>scipy.integrate.cumulative_trapezoid()</code>	<code>test_signal_integral</code>
<code>compute_interpolation</code>	Interpolate data with <code>cdl.algorithms.signal.interpolate()</code>	N/A
<code>compute_inverse</code>	Compute inverse with <code>numpy.invert</code>	<code>test_signal_inverse</code>
<code>compute_log10</code>	Compute Log10 with <code>numpy.log10</code>	<code>test_signal_log10</code>
<code>compute_magnitude_spectrum</code>	Compute magnitude spectrum	<code>test_signal_magnitude_spectrum</code>
<code>compute_modified_allan_var</code>	Compute Modified Allan variance	N/A
<code>compute_moving_average</code>	Compute moving average with <code>scipy.ndimage.uniform_filter()</code>	<code>test_signal_moving_average</code>
<code>compute_moving_median</code>	Compute moving median with <code>scipy.ndimage.median_filter()</code>	<code>test_signal_moving_median</code>
<code>compute_normalize</code>	Normalize data with <code>cdl.algorithms.signal.normalize()</code>	<code>test_signal_normalize</code>
<code>compute_offset_correction</code>	Correct offset: subtract the mean value of the signal in the specified range	<code>test_signal_offset_correction</code>
<code>compute_overlapping_allan</code>	Compute Overlapping Allan variance	N/A
<code>compute_peak_detection</code>	Peak detection with <code>cdl.algorithms.signal.peak_indices()</code>	N/A
<code>compute_phase_spectrum</code>	Compute phase spectrum	<code>test_signal_phase_spectrum</code>
<code>compute_polar2cartesian</code>	Convert polar coordinates to cartesian coordinates	<code>test_signal_polar2cartesian</code>
<code>compute_power</code>	Compute power with <code>numpy.power</code>	<code>test_signal_power</code>
<code>compute_product</code>	Multiply dst and src signals and return dst signal modified in place	<code>test_signal_product</code>
<code>compute_product_constant</code>	Multiply dst by a constant value and return the new result signal object	<code>test_signal_product_constant</code>
<code>compute_psd</code>	Compute power spectral density	<code>test_signal_psd</code>
<code>compute_quadratic_differer</code>	Compute quadratic difference between two signals	<code>test_signal_quadratic_difference</code>
<code>compute_re</code>	Compute real part with <code>numpy.real()</code>	<code>test_signal_re</code>
<code>compute_resampling</code>	Resample data with <code>cdl.algorithms.signal.interpolate()</code>	N/A
<code>compute_reverse_x</code>	Reverse x-axis	<code>test_signal_reverse_x</code>
<code>compute_sampling_rate_peri</code>	Compute sampling rate and period	<code>test_signal_sampling_rate_period</code>
<code>compute_sqrt</code>	Compute square root with <code>numpy.sqrt</code>	<code>test_signal_sqrt</code>
<code>compute_stats</code>	Compute statistics on a signal	<code>test_signal_stats_unit</code>
<code>compute_swap_axes</code>	Swap axes	<code>test_signal_swap_axes</code>
<code>compute_time_deviation</code>	Compute Time Deviation (TDEV)	N/A
<code>compute_total_variance</code>	Compute Total variance	N/A
<code>compute_wiener</code>	Compute Wiener filter with <code>scipy.signal.wiener()</code>	<code>test_signal_wiener</code>
<code>compute_windowing</code>	Compute windowing (available methods: hamming, hanning, bartlett, blackman)	N/A

continues on next page

Table 2 – continued from previous page

Compute function	Description	Test function
<code>compute_x_at_minmax</code>		<code>test_signal_x_at_minmax</code>
<code>compute_x_at_y</code>		<code>test_signal_x_at_y</code>

Image Compute Functions

The table below shows the validation status of image compute functions in DataLab. It is automatically generated from the source code.

Table 3: Validation status of image compute functions

Compute function	Description	Test function
<code>compute_abs</code>	Compute absolute value with <code>numpy.absolute</code>	<code>test_image_abs</code>
<code>compute_addition</code>	Add dst and src images and return dst image modified in place	<code>test_image_addition</code>
<code>compute_addition_constant</code>	Add dst and a constant value and return the new result image object	<code>test_image_addition_constant</code>
<code>compute_arithmetic</code>	Compute arithmetic operation on two images	<code>test_image_arithmetic</code>
<code>compute_astype</code>	Convert image data type with <code>cdl.algorithms.datatypes.clip_astype()</code>	<code>test_image_astype</code>
<code>compute_average_profile</code>	Compute horizontal or vertical average profile	<code>test_average_profile</code>
<code>compute_binning</code>	Binning function on data with <code>cdl.algorithms.image.binning()</code>	<code>test_binning</code>
<code>compute_butterworth</code>	Compute Butterworth filter with <code>skimage.filters.butterworth()</code>	<code>test_butterworth</code>
<code>compute_calibration</code>	Compute linear calibration	<code>test_image_calibration</code>
<code>compute_centroid</code>	Compute centroid	<code>test_image_centroid</code>
<code>compute_clip</code>	Apply clipping with <code>numpy.clip()</code>	<code>test_image_clip</code>
<code>compute_difference</code>	Compute difference between two images	<code>test_image_difference</code>
<code>compute_difference_constant</code>	Subtract a constant value from an image and return the new result image object	<code>test_image_difference_constant</code>
<code>compute_division</code>	Compute division between two images	<code>test_image_division</code>
<code>compute_division_constant</code>	Divide an image by a constant value and return the new result image object	<code>test_image_division_constant</code>
<code>compute_enclosing_circle</code>	Compute minimum enclosing circle	N/A
<code>compute_exp</code>	Compute exponential with <code>numpy.exp</code>	<code>test_image_exp</code>
<code>compute_fft</code>	Compute FFT with <code>cdl.algorithms.image.fft2d()</code>	<code>test_image_fft</code>
<code>compute_flatfield</code>	Compute flat field correction with <code>cdl.algorithms.image.flatfield()</code>	N/A
<code>compute_fliph</code>	Flip data horizontally with <code>numpy.fliplr()</code>	<code>test_image_fliph</code>
<code>compute_flipv</code>	Flip data vertically with <code>numpy.flipud()</code>	<code>test_image_flipv</code>
<code>compute_gaussian_filter</code>	Compute gaussian filter with <code>scipy.ndimage.gaussian_filter()</code>	<code>test_image_gaussian_filter</code>

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Table 3 – continued from previous page

Compute function	Description	Test function
<code>compute_histogram</code>	Compute histogram of the image data, with <code>numpy.histogram()</code>	N/A
<code>compute_hough_circle_peaks</code>	Compute Hough circles	N/A
<code>compute_iff</code>	Compute inverse FFT with <code>cdl.algorithms.image.iff2d()</code>	<code>test_image_iff</code>
<code>compute_im</code>	Compute imaginary part with <code>numpy.imag()</code>	<code>test_image_im</code>
<code>compute_inverse</code>	Compute the inverse of an image and return the new result image object	<code>test_image_inverse</code>
<code>compute_line_profile</code>	Compute horizontal or vertical profile	<code>test_line_profile</code>
<code>compute_log10</code>	Compute log10 with <code>numpy.log10</code>	<code>test_image_log10</code>
<code>compute_logp1</code>	Compute log10(z+n) with <code>numpy.log10</code>	<code>test_image_logp1</code>
<code>compute_magnitude_spectrum</code>	Compute magnitude spectrum	<code>test_image_magnitude_spectrum</code>
<code>compute_moving_average</code>	Compute moving average with <code>scipy.ndimage.uniform_filter()</code>	<code>test_image_moving_average</code>
<code>compute_moving_median</code>	Compute moving median with <code>scipy.ndimage.median_filter()</code>	<code>test_image_moving_median</code>
<code>compute_normalize</code>		<code>test_image_normalize</code>
<code>compute_offset_correction</code>	Apply offset correction	<code>test_image_offset_correction</code>
<code>compute_phase_spectrum</code>	Compute phase spectrum	<code>test_image_phase_spectrum</code>
<code>compute_product</code>	Multiply dst and src images and return dst image modified in place	<code>test_image_product</code>
<code>compute_product_constant</code>	Multiply dst by a constant value and return the new result image object	<code>test_image_product_constant</code>
<code>compute_psd</code>	Compute power spectral density	<code>test_image_psd</code>
<code>compute_quadratic_differer</code>	Compute quadratic difference between two images	<code>test_image_quadratic_difference</code>
<code>compute_radial_profile</code>	Compute radial profile around the centroid	N/A
<code>compute_re</code>	Compute real part with <code>numpy.real()</code>	<code>test_image_re</code>
<code>compute_resize</code>	Zooming function with <code>scipy.ndimage.zoom()</code>	N/A
<code>compute_rotate</code>	Rotate data with <code>scipy.ndimage.rotate()</code>	<code>test_image_rotate</code>
<code>compute_rotate270</code>	Rotate data 270° with <code>numpy.rot90()</code>	<code>test_image_rotate270</code>
<code>compute_rotate90</code>	Rotate data 90° with <code>numpy.rot90()</code>	<code>test_image_rotate90</code>
<code>compute_segment_profile</code>	Compute segment profile	<code>test_segment_profile</code>
<code>compute_stats</code>	Compute statistics on an image	<code>test_image_stats_unit</code>
<code>compute_swap_axes</code>	Swap image axes with <code>numpy.transpose()</code>	<code>test_image_swap_axes</code>
<code>compute_wiener</code>	Compute Wiener filter with <code>scipy.signal.wiener()</code>	<code>test_image_wiener</code>
<code>compute_blob_dog</code>	Compute blobs using Difference of Gaussian method	N/A
<code>compute_blob_doh</code>	Compute blobs using Determinant of Hessian method	N/A
<code>compute_blob_log</code>	Compute blobs using Laplacian of Gaussian method	N/A
<code>compute_blob_opencv</code>	Compute blobs using OpenCV	N/A
<code>compute_contour_shape</code>	Compute contour shape fit	N/A
<code>compute_peak_detection</code>	Compute 2D peak detection	N/A

continues on next page

Table 3 – continued from previous page

Compute function	Description	Test function
<code>compute_canny</code>	Compute Canny filter with <code>skimage.feature.canny()</code>	<code>test_canny</code>
<code>compute_farid</code>	Compute Farid filter with <code>skimage.filters.farid()</code>	<code>test_farid</code>
<code>compute_farid_h</code>	Compute horizontal Farid filter with <code>skimage.filters.farid_h()</code>	<code>test_farid_h</code>
<code>compute_farid_v</code>	Compute vertical Farid filter with <code>skimage.filters.farid_v()</code>	<code>test_farid_v</code>
<code>compute_laplace</code>	Compute Laplace filter with <code>skimage.filters.laplace()</code>	<code>test_laplace</code>
<code>compute_prewitt</code>	Compute Prewitt filter with <code>skimage.filters.prewitt()</code>	<code>test_prewitt</code>
<code>compute_prewitt_h</code>	Compute horizontal Prewitt filter with <code>skimage.filters.prewitt_h()</code>	<code>test_prewitt_h</code>
<code>compute_prewitt_v</code>	Compute vertical Prewitt filter with <code>skimage.filters.prewitt_v()</code>	<code>test_prewitt_v</code>
<code>compute_roberts</code>	Compute Roberts filter with <code>skimage.filters.roberts()</code>	<code>test_roberts</code>
<code>compute_scharr</code>	Compute Scharr filter with <code>skimage.filters.scharr()</code>	<code>test_scharr</code>
<code>compute_scharr_h</code>	Compute horizontal Scharr filter with <code>skimage.filters.scharr_h()</code>	<code>test_scharr_h</code>
<code>compute_scharr_v</code>	Compute vertical Scharr filter with <code>skimage.filters.scharr_v()</code>	<code>test_scharr_v</code>
<code>compute_sobel</code>	Compute Sobel filter with <code>skimage.filters.sobel()</code>	<code>test_sobel</code>
<code>compute_sobel_h</code>	Compute horizontal Sobel filter with <code>skimage.filters.sobel_h()</code>	<code>test_sobel_h</code>
<code>compute_sobel_v</code>	Compute vertical Sobel filter with <code>skimage.filters.sobel_v()</code>	<code>test_sobel_v</code>
<code>compute_adjust_gamma</code>	Gamma correction with <code>skimage.exposure.adjust_gamma()</code>	<code>test_adjust_gamma</code>
<code>compute_adjust_log</code>	Compute log correction with <code>skimage.exposure.adjust_log()</code>	<code>test_adjust_log</code>
<code>compute_adjust_sigmoid</code>	Compute sigmoid correction with <code>skimage.exposure.adjust_sigmoid()</code>	<code>test_adjust_sigmoid</code>
<code>compute_equalize_adapthist</code>	Adaptive histogram equalization	<code>test_equalize_adapthist</code>
<code>compute_equalize_hist</code>	Histogram equalization with <code>skimage.exposure.equalize_hist()</code>	<code>test_equalize_hist</code>
<code>compute_rescale_intensity</code>	Rescale image intensity levels	<code>test_rescale_intensity</code>
<code>compute_black_tophat</code>	Compute Black Top-Hat with <code>skimage.morphology.black_tophat()</code>	<code>test_black_tophat</code>
<code>compute_closing</code>	Compute morphological closing with <code>skimage.morphology.closing()</code>	<code>test_closing</code>
<code>compute_dilation</code>	Compute Dilation with <code>skimage.morphology.dilation()</code>	<code>test_dilation</code>
<code>compute_erosion</code>	Compute Erosion with <code>skimage.morphology.erosion()</code>	<code>test_erosion</code>
<code>compute_opening</code>	Compute morphological opening with <code>skimage.morphology.opening()</code>	<code>test_opening</code>

continues on next page

Table 3 – continued from previous page

Compute function	Description	Test function
<code>compute_white_tophat</code>	Compute White Top-Hat with <code>skimage.morphology.white_tophat()</code>	<code>test_white_tophat</code>
<code>compute_denoise_bilateral</code>	Compute bilateral filter denoising	<code>test_denoise_bilateral</code>
<code>compute_denoise_tophat</code>	Denoise using White Top-Hat	<code>test_denoise_tophat</code>
<code>compute_denoise_tv</code>	Compute Total Variation denoising	<code>test_denoise_tv</code>
<code>compute_denoise_wavelet</code>	Compute Wavelet denoising	<code>test_denoise_wavelet</code>
<code>compute_threshold</code>	Compute the threshold, using one of the available algorithms	<code>test_threshold</code>
<code>compute_threshold_isodata</code>	Compute the threshold using the Isodata algorithm with default parameters	<code>test_threshold_isodata</code>
<code>compute_threshold_li</code>	Compute the threshold using the Li algorithm with default parameters	<code>test_threshold_li</code>
<code>compute_threshold_mean</code>	Compute the threshold using the Mean algorithm	<code>test_threshold_mean</code>
<code>compute_threshold_minimum</code>	Compute the threshold using the Minimum algorithm with default parameters	<code>test_threshold_minimum</code>
<code>compute_threshold_otsu</code>	Compute the threshold using the Otsu algorithm with default parameters	<code>test_threshold_otsu</code>
<code>compute_threshold_triangle</code>	Compute the threshold using the Triangle algorithm with default parameters	<code>test_threshold_triangle</code>
<code>compute_threshold_yen</code>	Compute the threshold using the Yen algorithm with default parameters	<code>test_threshold_yen</code>

2.2 General features

This section describes the general features of DataLab, which concern both the signal and image processing panels.

2.2.1 Workspace

Basic concepts

Working with DataLab is very easy. The user interface is intuitive and self-explanatory. The main window is divided into two main areas:

- The left area shows the list of data sets which are currently loaded in DataLab, distributed over two tabs: **Signals** and **Images**. The user can switch between the two tabs by clicking on the corresponding tab: this switches the main window to the corresponding panel, as well as the menu and toolbar contents. Below the list of data sets, a **Properties** view shows information about the currently selected data set.
- The right area shows the visualization of the currently selected data set. The visualization is updated automatically when the user selects a new data set in the list of data sets.

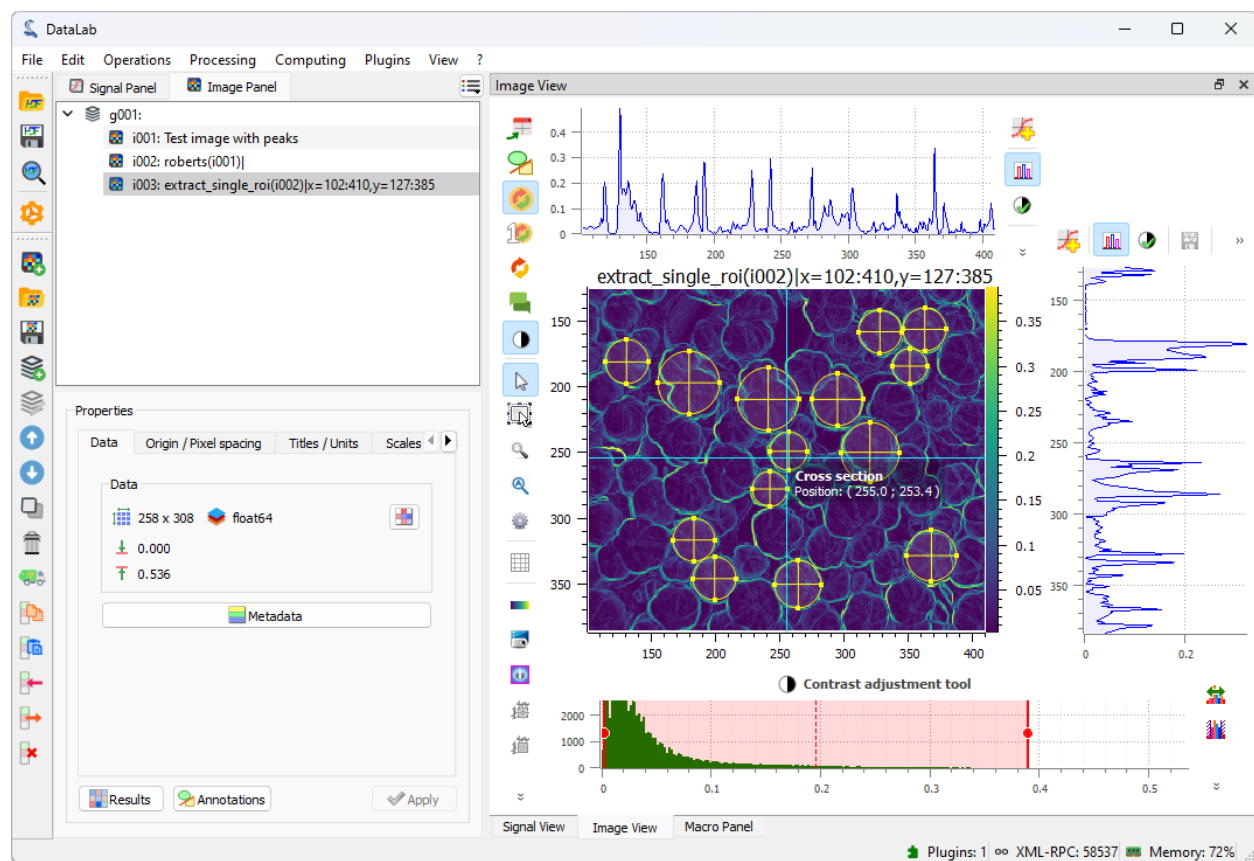


Fig. 1: DataLab main window

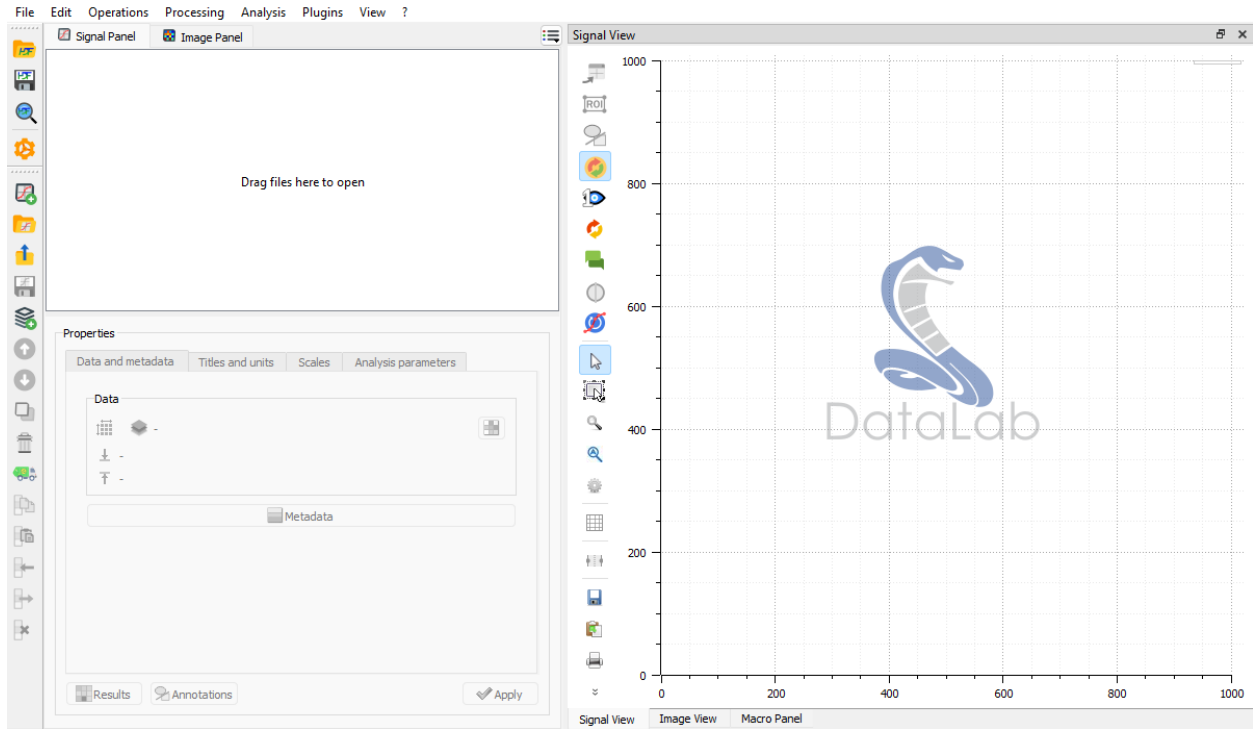


Fig. 2: DataLab main window, at startup.

Internal data model and workspace

DataLab has its own internal data model, in which data sets are organized around a tree structure. Each panel in the main window corresponds to a branch of the tree. Each data set shown in the panels corresponds to a leaf of the tree. Inside the data set, the data is organized in an object-oriented way, with a set of attributes and methods. The data model is described in more details in the API section (see [cdl.obj](#)).

For each data set (1D signal or 2D image), not only the data itself is stored, but also a set of metadata, which describes the data or the way it has to be displayed. The metadata is stored in a dictionary, which is accessible through the `metadata` attribute of the data set (and may also be browsed in the **Properties** view, with the **Metadata** button).

The DataLab **Workspace** is defined as the collection of all data sets which are currently loaded in DataLab, in both the **Signals** and **Images** panels.

Loading and saving the workspace

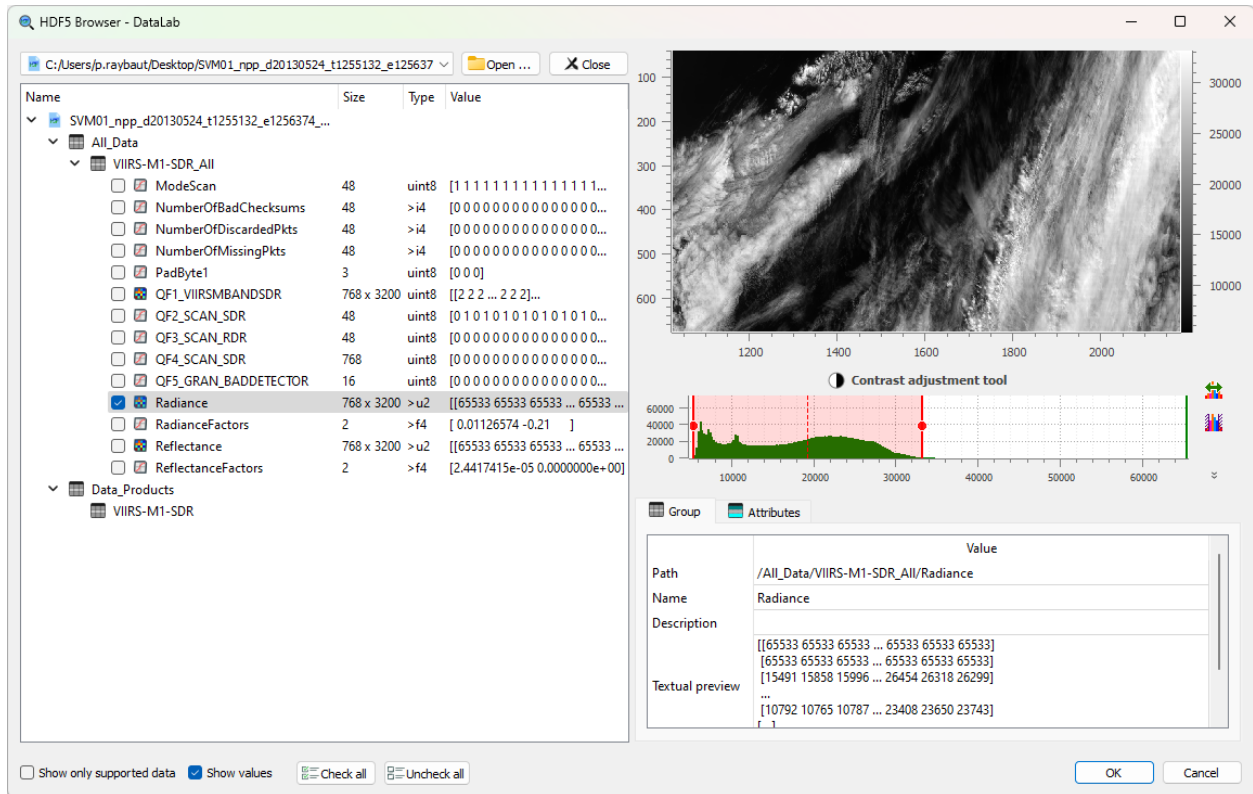
The following actions are available to manage the workspace from the **File** menu:

- **Open HDF5 file:** load a workspace from an HDF5 file.
- **Save to HDF5 file:** save the current workspace to an HDF5 file.
- **Browse HDF5 file:** open the [HDF5 Browser](#) to explore the content of an HDF5 file and import data sets into the workspace.

Note: Data sets may also be saved or loaded individually, using data formats such as `.txt` or `.npy` for 1D signals (see [Open signal](#) for the list of supported formats), or `.tiff` or `.dcm` for 2D images (see [Open image](#) for the list of supported formats).

2.2.2 HDF5 Browser

The “HDF5 Browser” is a modal dialog box allowing to import almost any 1D and 2D data into DataLab workspace (and eventually metadata).



Compatible curve or image data are displayed in a hierarchical view on the left panel, as well as other scalar data (scalar values are just shown for context purpose and may not be imported into DataLab workspace).

The right panel displays the selected curve or image data. It also shows information on “Group” (path, description, etc.) and “Attributes” (names and values).

The HDF5 browser is fairly simple to use:

- On the left panel, select the curve or image data you want to import
- Selected data is plotted on the right panel
- Click on “Check all” if you want to import all compatible data
- Then validate by clicking on “OK”

Note: The HDF5 browser may be used to explore multiple HDF5 files at once, thus allowing to import data from different files into the same DataLab workspace.

2.2.3 Macros

Overview

There are many ways to extend DataLab with new functionality (see [Plugins](#) or [Remote controlling](#)). The easiest way to do so is by using macros. Macros are small Python scripts that can be executed from the “Macro Panel” in DataLab.



Fig. 3: The Macro Panel in DataLab.

Macros can be used to automate repetitive tasks, or to create new functionality. As the plugin and remote control system, macros rely on the DataLab high-level API to interact with the application. This means that you can reuse the same code snippets in macros, plugins, and remote control scripts.

Warning: DataLab handles macros as Python scripts. This means that you can use the full power of Python to create your macros. Even though this is a powerful feature, it also means that you should be careful when running macros from unknown sources, as they can potentially harm your system.

See also:

The DataLab high-level API is documented in the [API](#) section. The plugin system is documented in the [Plugins](#) section, and the remote control system is documented in the [Remote controlling](#) section.

Main features

The Macro Panel is a simple interface to:

- Create new macros, using the “New macro” button.
- Rename existing macros, using the “Rename macro” button.
- Import/export macros from/to files, using the “Import macro” and “Export macro” buttons.
- Execute macros, using the “Run macro” button.
- Stop the execution of a macro, using the “Stop macro” button.

Macros are embedded in the DataLab workspace, so they are saved together with the rest of the data (i.e. with signals and images) when exporting the workspace to a HDF5 file. This means that you can share your macros with other users simply by sharing the workspace file.

Note: Macro are executed in a separate process, so they won’t block the main DataLab application. This means that you can continue working with DataLab while a macro is running and that *you can stop a macro at any time* using the button.

Example

For a detailed example of how to create a macro, see the [Prototyping a custom processing pipeline](#) tutorial.

2.2.4 Remote controlling

DataLab may be controlled remotely using the [XML-RPC](#) protocol which is natively supported by Python (and many other languages). Remote controlling allows to access DataLab main features from a separate process.

Note: If you are looking for a lightweight alternative solution to remote control DataLab (i.e. without having to install the whole DataLab package and its dependencies on your environment), please have a look at the [DataLab Simple Client](#) package (*pip install cdlclient*).

From an IDE

DataLab may be controlled remotely from an IDE (e.g. [Spyder](#) or any other IDE, or even a Jupyter Notebook) that runs a Python script. It allows to connect to a running DataLab instance, adds a signal and an image, and then runs calculations. This feature is exposed by the *RemoteProxy* class that is provided in module `cdl.proxy`.

From a third-party application

DataLab may also be controlled remotely from a third-party application, for the same purpose.

If the third-party application is written in Python 3, it may directly use the *RemoteProxy* class as mentioned above. From another language, it is also achievable, but it requires to implement a XML-RPC client in this language using the same methods of proxy server as in the *RemoteProxy* class.

Data (signals and images) may also be exchanged between DataLab and the remote client application, in both directions.

The remote client application may be written in any language that supports XML-RPC. For example, it is possible to write a remote client application in Python, Java, C++, C#, etc. The remote client application may be a graphical application or a command line application.

The remote client application may be run on the same computer as DataLab or on a different computer. In the latter case, the remote client application must know the IP address of the computer running DataLab.

The remote client application may be run before or after DataLab. In the latter case, the remote client application must try to connect to DataLab until it succeeds.

Supported features

Supported features are the following:

- Switch to signal or image panel
- Remove all signals and images
- Save current session to a HDF5 file
- Open HDF5 files into current session
- Browse HDF5 file
- Open a signal or an image from file
- Add a signal
- Add an image
- Get object list
- Run calculation with parameters

Note: The signal and image objects are described on this section: [Internal data model](#).

Some examples are provided to help implementing such a communication between your application and DataLab:

- See module: `cdl.tests.remoteclient_app`
- See module: `cdl.tests.remoteclient_unit`

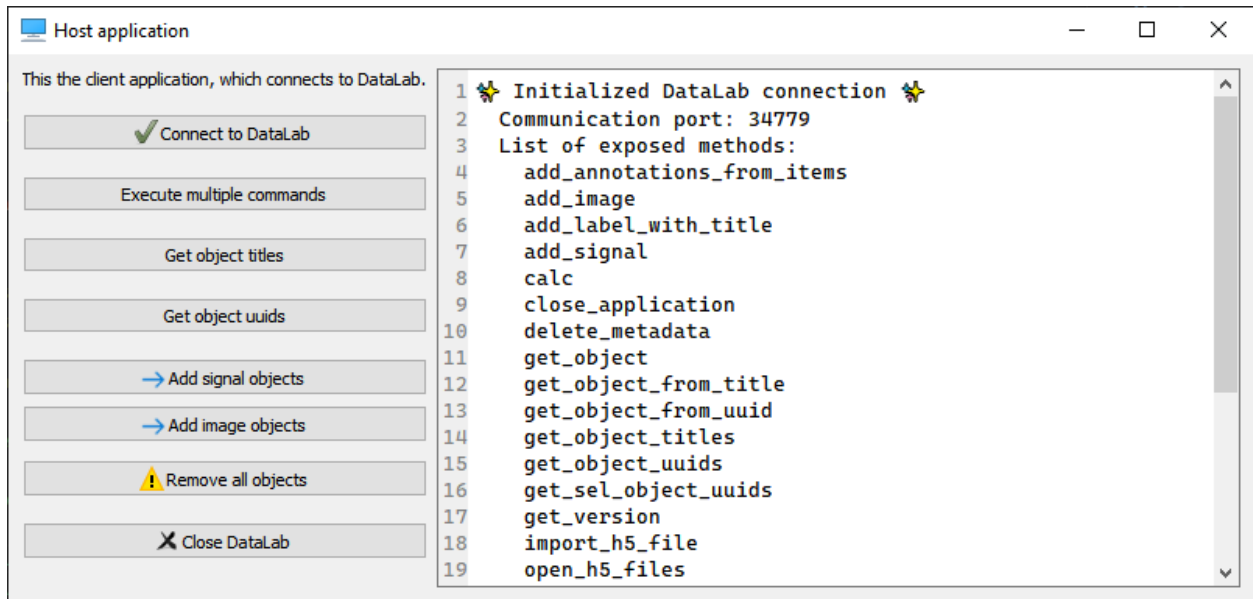


Fig. 4: Screenshot of remote client application test (`cdl.tests.remoteclient_app`)

Examples

When using Python 3, you may directly use the *RemoteProxy* class as in examples cited above or below.

Here is an example in Python 3 of a script that connects to a running DataLab instance, adds a signal and an image, and then runs calculations (the cell structure of the script make it convenient to be used in *Spyder* IDE):

```
"""
Example of remote control of DataLab current session,
from a Python script running outside DataLab (e.g. in Spyder)

Created on Fri May 12 12:28:56 2023

@author: p.raybaut
"""

# %% Importing necessary modules

# NumPy for numerical array computations:
import numpy as np

# DataLab remote control client:
from cdlclient import SimpleRemoteProxy as RemoteProxy

# %% Connecting to DataLab current session

proxy = RemoteProxy()

# %% Executing commands in DataLab (...)

z = np.random.rand(20, 20)
```

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```

proxy.add_image("toto", z)

# %% Executing commands in DataLab (...)

proxy.toggle_auto_refresh(False) # Turning off auto-refresh
x = np.array([1.0, 2.0, 3.0])
y = np.array([4.0, 5.0, -1.0])
proxy.add_signal("toto", x, y)

# %% Executing commands in DataLab (...)

proxy.compute_derivative()
proxy.toggle_auto_refresh(True) # Turning on auto-refresh

# %% Executing commands in DataLab (...)

proxy.set_current_panel("image")

# %% Executing a lot of commands without refreshing DataLab

z = np.random.rand(400, 400)
proxy.add_image("foobar", z)
with proxy.context_no_refresh():
    for _idx in range(100):
        proxy.compute_fft()

```

Here is a Python 2.7 reimplementaion of this class:

```

# Copyright (c) DataLab Platform Developers, BSD 3-Clause license, see LICENSE file.

"""
DataLab remote controlling class for Python 2.7
"""

import io
import os
import os.path as osp
import socket
import sys

import ConfigParser as cp
import numpy as np
from guidata.userconfig import get_config_dir
from xmlrpclib import Binary, ServerProxy

def array_to_rpcbinary(data):
    """Convert NumPy array to XML-RPC Binary object, with shape and dtype"""
    dbytes = io.BytesIO()
    np.save(dbytes, data, allow_pickle=False)
    return Binary(dbytes.getvalue())

```

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```

def get_cdl_xmlrpc_port():
    """Return DataLab current XML-RPC port"""
    if sys.platform == "win32" and "HOME" in os.environ:
        os.environ.pop("HOME") # Avoid getting old WinPython settings dir
    fname = osp.join(get_config_dir(), ".DataLab", "DataLab.ini")
    ini = cp.ConfigParser()
    ini.read(fname)
    try:
        return ini.get("main", "rpc_server_port")
    except (cp.NoSectionError, cp.NoOptionError):
        raise ConnectionRefusedError("DataLab has not yet been executed")

class RemoteClient(object):
    """Object representing a proxy/client to DataLab XML-RPC server"""

    def __init__(self):
        self.port = None
        self.serverproxy = None

    def connect(self, port=None):
        """Connect to DataLab XML-RPC server"""
        if port is None:
            port = get_cdl_xmlrpc_port()
        self.port = port
        url = "http://127.0.0.1:" + port
        self.serverproxy = ServerProxy(url, allow_none=True)
        try:
            self.get_version()
        except socket.error:
            raise ConnectionRefusedError("DataLab is currently not running")

    def get_version(self):
        """Return DataLab public version"""
        return self.serverproxy.get_version()

    def close_application(self):
        """Close DataLab application"""
        self.serverproxy.close_application()

    def raise_window(self):
        """Raise DataLab window"""
        self.serverproxy.raise_window()

    def get_current_panel(self):
        """Return current panel"""
        return self.serverproxy.get_current_panel()

    def set_current_panel(self, panel):
        """Switch to panel"""
        self.serverproxy.set_current_panel(panel)

```

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```

def reset_all(self):
    """Reset all application data"""
    self.serverproxy.reset_all()

def toggle_auto_refresh(self, state):
    """Toggle auto refresh state"""
    self.serverproxy.toggle_auto_refresh(state)

def toggle_show_titles(self, state):
    """Toggle show titles state"""
    self.serverproxy.toggle_show_titles(state)

def save_to_h5_file(self, filename):
    """Save to a DataLab HDF5 file"""
    self.serverproxy.save_to_h5_file(filename)

def open_h5_files(self, h5files, import_all, reset_all):
    """Open a DataLab HDF5 file or import from any other HDF5 file"""
    self.serverproxy.open_h5_files(h5files, import_all, reset_all)

def import_h5_file(self, filename, reset_all):
    """Open DataLab HDF5 browser to Import HDF5 file"""
    self.serverproxy.import_h5_file(filename, reset_all)

def load_from_files(self, filenames):
    """Open objects from files in current panel (signals/images)"""
    self.serverproxy.load_from_files(filenames)

def add_signal(
    self, title, xdata, ydata, xunit=None, yunit=None, xlabel=None, ylabel=None
):
    """Add signal data to DataLab"""
    xbinary = array_to_rpcbinary(xdata)
    ybinary = array_to_rpcbinary(ydata)
    p = self.serverproxy
    return p.add_signal(title, xbinary, ybinary, xunit, yunit, xlabel, ylabel)

def add_image(
    self,
    title,
    data,
    xunit=None,
    yunit=None,
    zunit=None,
    xlabel=None,
    ylabel=None,
    zlabel=None,
):
    """Add image data to DataLab"""
    zbinary = array_to_rpcbinary(data)
    p = self.serverproxy

```

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```

    return p.add_image(title, zbinary, xunit, yunit, zunit, xlabel, ylabel, zlabel)

def get_object_titles(self, panel=None):
    """Get object (signal/image) list for current panel"""
    return self.serverproxy.get_object_titles(panel)

def get_object(self, nb_id_title=None, panel=None):
    """Get object (signal/image) by number, id or title"""
    return self.serverproxy.get_object(nb_id_title, panel)

def get_object_uuids(self, panel=None, group=None):
    """Get object (signal/image) list for current panel"""
    return self.serverproxy.get_object_uuids(panel, group)

def test_remote_client():
    """DataLab Remote Client test"""
    cdl = RemoteClient()
    cdl.connect()
    data = np.array([[3, 4, 5], [7, 8, 0]], dtype=np.uint16)
    cdl.add_image("toto", data)

if __name__ == "__main__":
    test_remote_client()

```

Connection dialog

The DataLab package also provides a connection dialog that may be used to connect to a running DataLab instance. It is exposed by the `cdl.widgets.connection.ConnectionDialog` class.

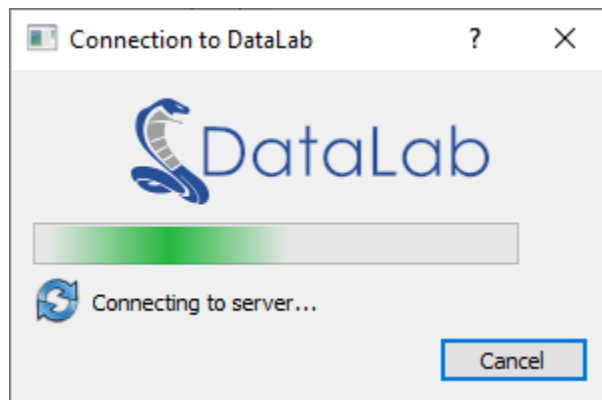


Fig. 5: Screenshot of connection dialog (`cdl.widgets.connection.ConnectionDialog`)

Example of use:

```

# Copyright (c) DataLab Platform Developers, BSD 3-Clause license, see LICENSE file.
"""

```

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```

DataLab Remote client connection dialog example
"""

# guitest: show,skip

from guidata.qthelpers import qt_app_context
from qtpy import QtWidgets as QW

from cdl.proxy import RemoteProxy
from cdl.widgets.connection import ConnectionDialog

def test_dialog():
    """Test connection dialog"""
    proxy = RemoteProxy(autoconnect=False)
    with qt_app_context():
        dlg = ConnectionDialog(proxy.connect)
        if dlg.exec():
            QW.QMessageBox.information(None, "Connection", "Successfully connected")
        else:
            QW.QMessageBox.critical(None, "Connection", "Connection failed")

if __name__ == "__main__":
    test_dialog()

```

Public API: remote client

`class cdl.core.remote.RemoteClient`

Object representing a proxy/client to DataLab XML-RPC server. This object is used to call DataLab functions from a Python script.

Examples

Here is a simple example of how to use RemoteClient in a Python script or in a Jupyter notebook:

```

>>> from cdl.core.remote import RemoteClient
>>> proxy = RemoteClient()
>>> proxy.connect()
Connecting to DataLab XML-RPC server...OK (port: 28867)
>>> proxy.get_version()
'1.0.0'
>>> proxy.add_signal("toto", np.array([1., 2., 3.]), np.array([4., 5., -1.]))
True
>>> proxy.get_object_titles()
['toto']
>>> proxy["toto"]
<cdl.core.model.signal.SignalObj at 0x7f7f1c0b4a90>
>>> proxy[1]
<cdl.core.model.signal.SignalObj at 0x7f7f1c0b4a90>

```

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```
>>> proxy[1].data
array([1., 2., 3.])
```

connect(*port: str | None = None, timeout: float | None = None, retries: int | None = None*) → *None*

Try to connect to DataLab XML-RPC server.

Parameters

- **port** – XML-RPC port to connect to. If not specified, the port is automatically retrieved from DataLab configuration.
- **timeout** – Timeout in seconds. Defaults to 5.0.
- **retries** – Number of retries. Defaults to 10.

Raises

- **ConnectionRefusedError** – Unable to connect to DataLab
- **ValueError** – Invalid timeout (must be >= 0.0)
- **ValueError** – Invalid number of retries (must be >= 1)

disconnect() → *None*

Disconnect from DataLab XML-RPC server.

is_connected() → *bool*

Return True if connected to DataLab XML-RPC server.

get_method_list() → *list[str]*

Return list of available methods.

add_signal(*title: str, xdata: ndarray, ydata: ndarray, xunit: str | None = None, yunit: str | None = None, xlabel: str | None = None, ylabel: str | None = None*) → *bool*

Add signal data to DataLab.

Parameters

- **title** – Signal title
- **xdata** – X data
- **ydata** – Y data
- **xunit** – X unit. Defaults to None.
- **yunit** – Y unit. Defaults to None.
- **xlabel** – X label. Defaults to None.
- **ylabel** – Y label. Defaults to None.

Returns

True if signal was added successfully, False otherwise

Raises

- **ValueError** – Invalid xdata dtype
- **ValueError** – Invalid ydata dtype

add_image(title: *str*, data: *ndarray*, xunit: *str* | *None* = *None*, yunit: *str* | *None* = *None*, zunit: *str* | *None* = *None*, xlabel: *str* | *None* = *None*, ylabel: *str* | *None* = *None*, zlabel: *str* | *None* = *None*) → *bool*

Add image data to DataLab.

Parameters

- **title** – Image title
- **data** – Image data
- **xunit** – X unit. Defaults to *None*.
- **yunit** – Y unit. Defaults to *None*.
- **zunit** – Z unit. Defaults to *None*.
- **xlabel** – X label. Defaults to *None*.
- **ylabel** – Y label. Defaults to *None*.
- **zlabel** – Z label. Defaults to *None*.

Returns

True if image was added successfully, False otherwise

Raises

ValueError – Invalid data dtype

add_object(obj: *SignalObj* | *ImageObj*) → *None*

Add object to DataLab.

Parameters

obj – Signal or image object

calc(name: *str*, param: *DataSet* | *None* = *None*) → *None*

Call compute function name in current panel's processor.

Parameters

- **name** – Compute function name
- **param** – Compute function parameter. Defaults to *None*.

Raises

ValueError – unknown function

get_object(nb_id_title: *int* | *str* | *None* = *None*, panel: *str* | *None* = *None*) → *SignalObj* | *ImageObj*

Get object (signal/image) from index.

Parameters

- **nb_id_title** – Object number, or object id, or object title. Defaults to *None* (current object).
- **panel** – Panel name. Defaults to *None* (current panel).

Returns

Object

Raises

KeyError – if object not found

get_object_shapes(nb_id_title: *int* | *str* | *None* = *None*, panel: *str* | *None* = *None*) → *list*

Get plot item shapes associated to object (signal/image).

Parameters

- **nb_id_title** – Object number, or object id, or object title. Defaults to None (current object).
- **panel** – Panel name. Defaults to None (current panel).

Returns

List of plot item shapes

add_annotations_from_items(items: *list*, refresh_plot: *bool* = *True*, panel: *str* | *None* = *None*) → *None*

Add object annotations (annotation plot items).

Parameters

- **items** – annotation plot items
- **refresh_plot** – refresh plot. Defaults to True.
- **panel** – panel name (valid values: “signal”, “image”). If None, current panel is used.

add_group(title: *str*, panel: *str* | *None* = *None*, select: *bool* = *False*) → *None*

Add group to DataLab.

Parameters

- **title** – Group title
- **panel** – Panel name (valid values: “signal”, “image”). Defaults to None.
- **select** – Select the group after creation. Defaults to False.

add_label_with_title(title: *str* | *None* = *None*, panel: *str* | *None* = *None*) → *None*

Add a label with object title on the associated plot

Parameters

- **title** – Label title. Defaults to None. If None, the title is the object title.
- **panel** – panel name (valid values: “signal”, “image”). If None, current panel is used.

close_application() → *None*

Close DataLab application

context_no_refresh() → *Generator*[*None*, *None*, *None*]

Return a context manager to temporarily disable auto refresh.

Returns

Context manager

Example

```
>>> with proxy.context_no_refresh():
...     proxy.add_image("image1", data1)
...     proxy.compute_fft()
...     proxy.compute_wiener()
...     proxy.compute_ifft()
...     # Auto refresh is disabled during the above operations
```

delete_metadata(refresh_plot: *bool* = *True*, keep_roi: *bool* = *False*) → *None*

Delete metadata of selected objects

Parameters

- **refresh_plot** – Refresh plot. Defaults to True.
- **keep_roi** – Keep ROI. Defaults to False.

get_current_panel() → *str*

Return current panel name.

Returns

“signal”, “image”, “macro”))

Return type

Panel name (valid values

get_group_titles_with_object_infos() → *tuple[list[str], list[list[str]], list[list[str]]]*

Return groups titles and lists of inner objects uuids and titles.

Returns

groups titles, lists of inner objects uuids and titles

Return type

Tuple

get_object_titles(*panel: str | None = None*) → *list[str]*

Get object (signal/image) list for current panel. Objects are sorted by group number and object index in group.

Parameters

panel – panel name (valid values: “signal”, “image”, “macro”). If None, current data panel is used (i.e. signal or image panel).

Returns

List of object titles

Raises

ValueError – if panel not found

get_object_uuids(*panel: str | None = None, group: int | str | None = None*) → *list[str]*

Get object (signal/image) uuid list for current panel. Objects are sorted by group number and object index in group.

Parameters

- **panel** – panel name (valid values: “signal”, “image”). If None, current panel is used.
- **group** – Group number, or group id, or group title. Defaults to None (all groups).

Returns

List of object uuids

Raises

ValueError – if panel not found

classmethod get_public_methods() → *list[str]*

Return all public methods of the class, except itself.

Returns

List of public methods

get_sel_object_uuids(*include_groups: bool = False*) → *list[str]*

Return selected objects uuids.

Parameters

include_groups – If True, also return objects from selected groups.

Returns

List of selected objects uuids.

get_version() → *str*

Return DataLab public version.

Returns

DataLab version

import_h5_file(*filename: str, reset_all: bool | None = None*) → *None*

Open DataLab HDF5 browser to Import HDF5 file.

Parameters

- **filename** – HDF5 file name
- **reset_all** – Reset all application data. Defaults to None.

import_macro_from_file(*filename: str*) → *None*

Import macro from file

Parameters

filename – Filename.

load_from_directory(*path: str*) → *None*

Open objects from directory in current panel (signals/images).

Parameters

path – directory path

load_from_files(*filenames: list[str]*) → *None*

Open objects from files in current panel (signals/images).

Parameters

filenames – list of file names

open_h5_files(*h5files: list[str] | None = None, import_all: bool | None = None, reset_all: bool | None = None*) → *None*

Open a DataLab HDF5 file or import from any other HDF5 file.

Parameters

- **h5files** – List of HDF5 files to open. Defaults to None.
- **import_all** – Import all objects from HDF5 files. Defaults to None.
- **reset_all** – Reset all application data. Defaults to None.

raise_window() → *None*

Raise DataLab window

reset_all() → *None*

Reset all application data

run_macro(*number_or_title: int | str | None = None*) → *None*

Run macro.

Parameters

number_or_title – Macro number, or macro title. Defaults to None (current macro).

Raises

ValueError – if macro not found

save_to_h5_file(*filename: str*) → *None*

Save to a DataLab HDF5 file.

Parameters

filename – HDF5 file name

select_groups(*selection: list[int | str] | None = None, panel: str | None = None*) → *None*

Select groups in current panel.

Parameters

- **selection** – List of group numbers (1 to N), or list of group uuids, or None to select all groups. Defaults to None.
- **panel** – panel name (valid values: “signal”, “image”). If None, current panel is used. Defaults to None.

select_objects(*selection: list[int | str], panel: str | None = None*) → *None*

Select objects in current panel.

Parameters

- **selection** – List of object numbers (1 to N) or uuids to select
- **panel** – panel name (valid values: “signal”, “image”). If None, current panel is used. Defaults to None.

set_current_panel(*panel: str*) → *None*

Switch to panel.

Parameters

panel – Panel name (valid values: “signal”, “image”, “macro”))

stop_macro(*number_or_title: int | str | None = None*) → *None*

Stop macro.

Parameters

number_or_title – Macro number, or macro title. Defaults to None (current macro).

Raises

ValueError – if macro not found

toggle_auto_refresh(*state: bool*) → *None*

Toggle auto refresh state.

Parameters

state – Auto refresh state

toggle_show_titles(*state: bool*) → *None*

Toggle show titles state.

Parameters

state – Show titles state

Public API: additional methods

The remote control class methods (either using the proxy or the remote client) may be completed with additional methods which are dynamically added at runtime. This mechanism allows to access the methods of the processors of DataLab (see `cdl.core.gui.processor`).

Signal processor

When working with signals, the methods of `cdl.core.gui.processor.signal.SignalProcessor` may be accessed.

class `cdl.core.gui.processor.signal.SignalProcessor`(*panel*: `SignalPanel` | `ImagePanel`, *plotwidget*: `PlotWidget`)

Object handling signal processing: operations, processing, analysis

compute_sum() → `None`

Compute sum with `cdl.computation.signal.compute_addition()`

compute_addition_constant(*param*: `ConstantParam` | `None = None`) → `None`

Compute sum with a constant with `cdl.computation.signal.compute_addition_constant()`

compute_average() → `None`

Compute average with `cdl.computation.signal.compute_addition()` and divide by the number of signals

compute_product() → `None`

Compute product with `cdl.computation.signal.compute_product()`

compute_product_constant(*param*: `ConstantParam` | `None = None`) → `None`

Compute product with a constant with `cdl.computation.signal.compute_product_constant()`

compute_swap_axes() → `None`

Swap data axes with `cdl.computation.signal.compute_swap_axes()`

compute_inverse() → `None`

Compute inverse

compute_abs() → `None`

Compute absolute value with `cdl.computation.signal.compute_abs()`

compute_re() → `None`

Compute real part with `cdl.computation.signal.compute_re()`

compute_im() → `None`

Compute imaginary part with `cdl.computation.signal.compute_im()`

compute_astype(*param*: `DataTypeSParam` | `None = None`) → `None`

Convert data type with `cdl.computation.signal.compute_astype()`

compute_log10() → `None`

Compute Log10 with `cdl.computation.signal.compute_log10()`

compute_exp() → `None`

Compute Log10 with `cdl.computation.signal.compute_exp()`

compute_sqrt() → None

Compute square root with `cdl.computation.signal.compute_sqrt()`

compute_power(*param*: PowerParam | None = None) → None

Compute power with `cdl.computation.signal.compute_power()`

compute_arithmetic(*obj2*: SignalObj | None = None, *param*: ArithmeticParam | None = None) → None

Compute arithmetic operation between two signals with `cdl.computation.signal.compute_arithmetic()`

compute_difference(*obj2*: SignalObj | list[SignalObj] | None = None) → None

Compute difference between two signals with `cdl.computation.signal.compute_difference()`

compute_difference_constant(*param*: ConstantParam | None = None) → None

Compute difference with a constant with `cdl.computation.signal.compute_difference_constant()`

compute_quadratic_difference(*obj2*: SignalObj | list[SignalObj] | None = None) → None

Compute quadratic difference between two signals with `cdl.computation.signal.compute_quadratic_difference()`

compute_division(*obj2*: SignalObj | list[SignalObj] | None = None) → None

Compute division between two signals with `cdl.computation.signal.compute_division()`

compute_division_constant(*param*: ConstantParam | None = None) → None

Compute division by a constant with `cdl.computation.signal.compute_division_constant()`

compute_peak_detection(*param*: PeakDetectionParam | None = None) → None

Detect peaks from data with `cdl.computation.signal.compute_peak_detection()`

compute_reverse_x() → None

Reverse X axis with `cdl.computation.signal.compute_reverse_x()`

compute_cartesian2polar(*param*: AngleUnitParam | None = None) → None

Convert cartesian to polar coordinates with `cdl.computation.signal.compute_cartesian2polar()`

compute_polar2cartesian(*param*: AngleUnitParam | None = None) → None

Convert polar to cartesian coordinates with `cdl.computation.signal.compute_polar2cartesian()`

compute_normalize(*param*: NormalizeParam | None = None) → None

Normalize data with `cdl.computation.signal.compute_normalize()`

compute_derivative() → None

Compute derivative with `cdl.computation.signal.compute_derivative()`

compute_integral() → None

Compute integral with `cdl.computation.signal.compute_integral()`

compute_calibration(*param*: XYCalibrateParam | None = None) → None

Compute data linear calibration with `cdl.computation.signal.compute_calibration()`

compute_clip(*param*: ClipParam | None = None) → None

Compute maximum data clipping with `cdl.computation.signal.compute_clip()`

compute_offset_correction(*param*: ROIIDParam | None = None) → None

Compute offset correction with `cdl.computation.signal.compute_offset_correction()`

compute_gaussian_filter(*param*: GaussianParam | None = None) → None
 Compute gaussian filter with `cdl.computation.signal.compute_gaussian_filter()`

compute_moving_average(*param*: MovingAverageParam | None = None) → None
 Compute moving average with `cdl.computation.signal.compute_moving_average()`

compute_moving_median(*param*: MovingMedianParam | None = None) → None
 Compute moving median with `cdl.computation.signal.compute_moving_median()`

compute_wiener() → None
 Compute Wiener filter with `cdl.computation.signal.compute_wiener()`

compute_lowpass(*param*: LowPassFilterParam | None = None) → None
 Compute high-pass filter with `cdl.computation.signal.compute_filter()`

compute_highpass(*param*: HighPassFilterParam | None = None) → None
 Compute high-pass filter with `cdl.computation.signal.compute_filter()`

compute_bandpass(*param*: BandPassFilterParam | None = None) → None
 Compute band-pass filter with `cdl.computation.signal.compute_filter()`

compute_bandstop(*param*: BandStopFilterParam | None = None) → None
 Compute band-stop filter with `cdl.computation.signal.compute_filter()`

compute_fft(*param*: FFTParam | None = None) → None
 Compute FFT with `cdl.computation.signal.compute_fft()`

compute_ifft(*param*: FFTParam | None = None) → None
 Compute iFFT with `cdl.computation.signal.compute_ifft()`

compute_magnitude_spectrum(*param*: SpectrumParam | None = None) → None
 Compute magnitude spectrum with `cdl.computation.signal.compute_magnitude_spectrum()`

compute_phase_spectrum() → None
 Compute phase spectrum with `cdl.computation.signal.compute_phase_spectrum()`

compute_psd(*param*: SpectrumParam | None = None) → None
 Compute power spectral density with `cdl.computation.signal.compute_psd()`

compute_interpolation(*obj2*: SignalObj | None = None, *param*: InterpolationParam | None = None)
 Compute interpolation with `cdl.computation.signal.compute_interpolation()`

compute_resampling(*param*: ResamplingParam | None = None)
 Compute resampling with `cdl.computation.signal.compute_resampling()`

compute_detrending(*param*: DetrendingParam | None = None)
 Compute detrending with `cdl.computation.signal.compute_detrending()`

compute_convolution(*obj2*: SignalObj | None = None) → None
 Compute convolution with `cdl.computation.signal.compute_convolution()`

compute_windowing(*param*: WindowingParam | None = None) → None
 Compute windowing with `cdl.computation.signal.compute_windowing()`

compute_allan_variance(*param*: AllanVarianceParam | None = None) → None
 Compute Allan variance with `cdl.computation.signal.compute_allan_variance()`

compute_allan_deviation(*param*: `AllanVarianceParam` | *None* = *None*) → *None*
Compute Allan deviation with `cdl.computation.signal.compute_allan_deviation()`

compute_overlapping_allan_variance(*param*: `AllanVarianceParam` | *None* = *None*) → *None*
Compute overlapping Allan variance with `cdl.computation.signal.compute_overlapping_allan_variance()`

compute_modified_allan_variance(*param*: `AllanVarianceParam` | *None* = *None*) → *None*
Compute modified Allan variance with `cdl.computation.signal.compute_modified_allan_variance()`

compute_hadamard_variance(*param*: `AllanVarianceParam` | *None* = *None*) → *None*
Compute Hadamard variance with `cdl.computation.signal.compute_hadamard_variance()`

compute_total_variance(*param*: `AllanVarianceParam` | *None* = *None*) → *None*
Compute total variance with `cdl.computation.signal.compute_total_variance()`

compute_time_deviation(*param*: `AllanVarianceParam` | *None* = *None*) → *None*
Compute time deviation with `cdl.computation.signal.compute_time_deviation()`

compute_all_stability(*param*: `AllanVarianceParam` | *None* = *None*) → *None*
Compute all stability analysis features using the following functions:

- `cdl.computation.signal.compute_allan_variance()`
- `cdl.computation.signal.compute_allan_deviation()`
- `cdl.computation.signal.compute_overlapping_allan_variance()`
- `cdl.computation.signal.compute_modified_allan_variance()`
- `cdl.computation.signal.compute_hadamard_variance()`
- `cdl.computation.signal.compute_total_variance()`
- `cdl.computation.signal.compute_time_deviation()`

compute_polyfit(*param*: `PolynomialFitParam` | *None* = *None*) → *None*
Compute polynomial fitting curve

compute_fit(*title*: *str*, *fitdlgfunc*: *Callable*) → *None*
Compute fitting curve using an interactive dialog

Parameters

- **title** – Title of the dialog
- **fitdlgfunc** – Fitting dialog function

compute_multigaussianfit() → *None*
Compute multi-Gaussian fitting curve using an interactive dialog

compute_fwhm(*param*: `FWHMParm` | *None* = *None*) → `dict[str, ResultShape]`
Compute FWHM with `cdl.computation.signal.compute_fwhm()`

compute_fw1e2() → `dict[str, ResultShape]`
Compute FW at $1/e^2$ with `cdl.computation.signal.compute_fw1e2()`

compute_stats() → `dict[str, ResultProperties]`
Compute data statistics with `cdl.computation.signal.compute_stats()`

compute_histogram(*param*: HistogramParam | None = None) → dict[str, ResultShape]
 Compute histogram with `cdl.computation.signal.compute_histogram()`

compute_contrast() → dict[str, ResultProperties]
 Compute contrast with `cdl.computation.signal.compute_contrast()`

compute_x_at_minmax() → dict[str, ResultProperties]
 Compute x at min/max with `cdl.computation.signal.compute_x_at_minmax()`

compute_x_at_y(*param*: FindAbscissaParam | None = None) → dict[str, ResultProperties]
 Compute x at y with `cdl.computation.signal.compute_x_at_y()`.

compute_sampling_rate_period() → dict[str, ResultProperties]
 Compute sampling rate and period (mean and std) with `cdl.computation.signal.compute_sampling_rate_period()`

compute_bandwidth_3db() → None
 Compute bandwidth at -3dB with `cdl.computation.signal.compute_bandwidth_3db()`

compute_dynamic_parameters(*param*: DynamicParam | None = None) → dict[str, ResultProperties]
 Compute Dynamic Parameters (ENOB, SINAD, THD, SFDR, SNR) with `cdl.computation.signal.compute_dynamic_parameters()`

Image processor

When working with images, the methods of `cdl.core.gui.processor.image.ImageProcessor` may be accessed.

class `cdl.core.gui.processor.image.ImageProcessor`(*panel*: SignalPanel | ImagePanel, *plotwidget*: PlotWidget)

Object handling image processing: operations, processing, analysis

compute_normalize(*param*: NormalizeParam | None = None) → None
 Normalize data with `cdl.computation.image.compute_normalize()`

compute_sum() → None
 Compute sum with `cdl.computation.image.compute_addition()`

compute_addition_constant(*param*: ConstantParam | None = None) → None
 Compute sum with a constant using `cdl.computation.image.compute_addition_constant()`

compute_average() → None
 Compute average with `cdl.computation.image.compute_addition()` and dividing by the number of images

compute_product() → None
 Compute product with `cdl.computation.image.compute_product()`

compute_product_constant(*param*: ConstantParam | None = None) → None
 Compute product with a constant using `cdl.computation.image.compute_product_constant()`

compute_logp1(*param*: LogP1Param | None = None) → None
 Compute base 10 logarithm using `cdl.computation.image.compute_logp1()`

compute_rotate(*param*: RotateParam | None = None) → None
 Rotate data arbitrarily using `cdl.computation.image.compute_rotate()`

compute_rotate90() → None

Rotate data 90° with `cdl.computation.image.compute_rotate90()`

compute_rotate270() → None

Rotate data 270° with `cdl.computation.image.compute_rotate270()`

compute_fliph() → None

Flip data horizontally using `cdl.computation.image.compute_fliph()`

compute_flipv() → None

Flip data vertically with `cdl.computation.image.compute_flipv()`

distribute_on_grid(*param*: GridParam | None = None) → None

Distribute images on a grid

reset_positions() → None

Reset image positions

compute_resize(*param*: ResizeParam | None = None) → None

Resize image with `cdl.computation.image.compute_resize()`

compute_binning(*param*: BinningParam | None = None) → None

Binning image with `cdl.computation.image.compute_binning()`

compute_line_profile(*param*: LineProfileParam | None = None) → None

Compute profile along a vertical or horizontal line with `cdl.computation.image.compute_line_profile()`

compute_segment_profile(*param*: SegmentProfileParam | None = None)

Compute profile along a segment with `cdl.computation.image.compute_segment_profile()`

compute_average_profile(*param*: AverageProfileParam | None = None) → None

Compute average profile with `cdl.computation.image.compute_average_profile()`

compute_radial_profile(*param*: RadialProfileParam | None = None) → None

Compute radial profile with `cdl.computation.image.compute_radial_profile()`

compute_histogram(*param*: HistogramParam | None = None) → None

Compute histogram with `cdl.computation.image.compute_histogram()`

compute_swap_axes() → None

Swap data axes with `cdl.computation.image.compute_swap_axes()`.

compute_inverse() → None

Compute inverse

compute_abs() → None

Compute absolute value with `cdl.computation.image.compute_abs()`

compute_re() → None

Compute real part with `cdl.computation.image.compute_re()`

compute_im() → None

Compute imaginary part with `cdl.computation.image.compute_im()`

compute_astype(*param*: DataTypeParam | None = None) → None

Convert data type with `cdl.computation.image.compute_astype()`

compute_log10() → None

Compute Log10 with `cdl.computation.image.compute_log10()`

compute_exp() → None

Compute Log10 with `cdl.computation.image.compute_exp()`

compute_arithmetic(obj2: ImageObj | None = None, param: ArithmeticParam | None = None) → None

Compute arithmetic operation between two images with `cdl.computation.image.compute_arithmetic()`

compute_difference(obj2: ImageObj | list[ImageObj] | None = None) → None

Compute difference between two images with `cdl.computation.image.compute_difference()`

compute_difference_constant(param: ConstantParam | None = None) → None

Compute difference with a constant with `cdl.computation.image.compute_difference_constant()`

compute_quadratic_difference(obj2: ImageObj | list[ImageObj] | None = None) → None

Compute quadratic difference between two images with `cdl.computation.image.compute_quadratic_difference()`

compute_division(obj2: ImageObj | list[ImageObj] | None = None) → None

Compute division between two images with `cdl.computation.image.compute_division()`

compute_division_constant(param: ConstantParam | None = None) → None

Compute division by a constant with `cdl.computation.image.compute_division_constant()`

compute_flatfield(obj2: ImageObj | None = None, param: FlatFieldParam | None = None) → None

Compute flat field correction with `cdl.computation.image.compute_flatfield()`

compute_calibration(param: ZCalibrateParam | None = None) → None

Compute data linear calibration with `cdl.computation.image.compute_calibration()`

compute_clip(param: ClipParam | None = None) → None

Compute maximum data clipping with `cdl.computation.image.compute_clip()`

compute_offset_correction(param: ROI2DParam | None = None) → None

Compute offset correction with `cdl.computation.image.compute_offset_correction()`

compute_gaussian_filter(param: GaussianParam | None = None) → None

Compute gaussian filter with `cdl.computation.image.compute_gaussian_filter()`

compute_moving_average(param: MovingAverageParam | None = None) → None

Compute moving average with `cdl.computation.image.compute_moving_average()`

compute_moving_median(param: MovingMedianParam | None = None) → None

Compute moving median with `cdl.computation.image.compute_moving_median()`

compute_wiener() → None

Compute Wiener filter with `cdl.computation.image.compute_wiener()`

compute_fft(param: FFTParam | None = None) → None

Compute FFT with `cdl.computation.image.compute_fft()`

compute_ifft(param: FFTParam | None = None) → None

Compute iFFT with `cdl.computation.image.compute_ifft()`

compute_magnitude_spectrum(*param*: SpectrumParam | *None* = *None*) → *None*

Compute magnitude spectrum with `cdl.computation.image.compute_magnitude_spectrum()`

compute_phase_spectrum() → *None*

Compute phase spectrum with `cdl.computation.image.compute_phase_spectrum()`

compute_psd(*param*: SpectrumParam | *None* = *None*) → *None*

Compute Power Spectral Density (PSD) with `cdl.computation.image.compute_psd()`

compute_butterworth(*param*: ButterworthParam | *None* = *None*) → *None*

Compute Butterworth filter with `cdl.computation.image.compute_butterworth()`

compute_threshold(*param*: ThresholdParam | *None* = *None*) → *None*

Compute parametric threshold with `cdl.computation.image.threshold.compute_threshold()`

compute_threshold_isodata() → *None*

Compute threshold using Isodata algorithm with `cdl.computation.image.threshold.compute_threshold_isodata()`

compute_threshold_li() → *None*

Compute threshold using Li algorithm with `cdl.computation.image.threshold.compute_threshold_li()`

compute_threshold_mean() → *None*

Compute threshold using Mean algorithm with `cdl.computation.image.threshold.compute_threshold_mean()`

compute_threshold_minimum() → *None*

Compute threshold using Minimum algorithm with `cdl.computation.image.threshold.compute_threshold_minimum()`

compute_threshold_otsu() → *None*

Compute threshold using Otsu algorithm with `cdl.computation.image.threshold.compute_threshold_otsu()`

compute_threshold_triangle() → *None*

Compute threshold using Triangle algorithm with `cdl.computation.image.threshold.compute_threshold_triangle()`

compute_threshold_yen() → *None*

Compute threshold using Yen algorithm with `cdl.computation.image.threshold.compute_threshold_yen()`

compute_all_threshold() → *None*

Compute all threshold algorithms using the following functions:

- `cdl.computation.image.threshold.compute_threshold_isodata()`
- `cdl.computation.image.threshold.compute_threshold_li()`
- `cdl.computation.image.threshold.compute_threshold_mean()`
- `cdl.computation.image.threshold.compute_threshold_minimum()`
- `cdl.computation.image.threshold.compute_threshold_otsu()`
- `cdl.computation.image.threshold.compute_threshold_triangle()`
- `cdl.computation.image.threshold.compute_threshold_yen()`

compute_adjust_gamma(*param*: AdjustGammaParam | *None* = *None*) → *None*
 Compute gamma correction with `cdl.computation.image.exposure.compute_adjust_gamma()`

compute_adjust_log(*param*: AdjustLogParam | *None* = *None*) → *None*
 Compute log correction with `cdl.computation.image.exposure.compute_adjust_log()`

compute_adjust_sigmoid(*param*: AdjustSigmoidParam | *None* = *None*) → *None*
 Compute sigmoid correction with `cdl.computation.image.exposure.compute_adjust_sigmoid()`

compute_rescale_intensity(*param*: RescaleIntensityParam | *None* = *None*) → *None*
 Rescale image intensity levels with `:py:func`cdl.computation.image.exposure.compute_rescale_intensity``

compute_equalize_hist(*param*: EqualizeHistParam | *None* = *None*) → *None*
 Histogram equalization with `cdl.computation.image.exposure.compute_equalize_hist()`

compute_equalize_adapthist(*param*: EqualizeAdaptHistParam | *None* = *None*) → *None*
 Adaptive histogram equalization with `cdl.computation.image.exposure.compute_equalize_adapthist()`

compute_denoise_tv(*param*: DenoiseTVParam | *None* = *None*) → *None*
 Compute Total Variation denoising with `cdl.computation.image.restoration.compute_denoise_tv()`

compute_denoise_bilateral(*param*: DenoiseBilateralParam | *None* = *None*) → *None*
 Compute bilateral filter denoising with `cdl.computation.image.restoration.compute_denoise_bilateral()`

compute_denoise_wavelet(*param*: DenoiseWaveletParam | *None* = *None*) → *None*
 Compute Wavelet denoising with `cdl.computation.image.restoration.compute_denoise_wavelet()`

compute_denoise_tophat(*param*: MorphologyParam | *None* = *None*) → *None*
 Denoise using White Top-Hat with `cdl.computation.image.restoration.compute_denoise_tophat()`

compute_all_denoise(*params*: list | *None* = *None*) → *None*
 Compute all denoising filters using the following functions:

- `cdl.computation.image.restoration.compute_denoise_tv()`
- `cdl.computation.image.restoration.compute_denoise_bilateral()`
- `cdl.computation.image.restoration.compute_denoise_wavelet()`
- `cdl.computation.image.restoration.compute_denoise_tophat()`

compute_white_tophat(*param*: MorphologyParam | *None* = *None*) → *None*
 Compute White Top-Hat with `cdl.computation.image.morphology.compute_white_tophat()`

compute_black_tophat(*param*: MorphologyParam | *None* = *None*) → *None*
 Compute Black Top-Hat with `cdl.computation.image.morphology.compute_black_tophat()`

compute_erosion(*param*: MorphologyParam | *None* = *None*) → *None*
 Compute Erosion with `cdl.computation.image.morphology.compute_erosion()`

compute_dilation(*param*: MorphologyParam | *None* = *None*) → *None*
 Compute Dilation with `cdl.computation.image.morphology.compute_dilation()`

compute_opening(*param*: MorphologyParam | None = None) → None
Compute morphological opening with `cdl.computation.image.morphology.compute_opening()`

compute_closing(*param*: MorphologyParam | None = None) → None
Compute morphological closing with `cdl.computation.image.morphology.compute_closing()`

compute_all_morphology(*param*: MorphologyParam | None = None) → None
Compute all morphology filters using the following functions:

- `cdl.computation.image.morphology.compute_white_tophat()`
- `cdl.computation.image.morphology.compute_black_tophat()`
- `cdl.computation.image.morphology.compute_erosion()`
- `cdl.computation.image.morphology.compute_dilation()`
- `cdl.computation.image.morphology.compute_opening()`
- `cdl.computation.image.morphology.compute_closing()`

compute_canny(*param*: CannyParam | None = None) → None
Compute Canny filter with `cdl.computation.image.edges.compute_canny()`

compute_roberts() → None
Compute Roberts filter with `cdl.computation.image.edges.compute_roberts()`

compute_prewitt() → None
Compute Prewitt filter with `cdl.computation.image.edges.compute_prewitt()`

compute_prewitt_h() → None
Compute Prewitt filter (horizontal) with `cdl.computation.image.edges.compute_prewitt_h()`

compute_prewitt_v() → None
Compute Prewitt filter (vertical) with `cdl.computation.image.edges.compute_prewitt_v()`

compute_sobel() → None
Compute Sobel filter with `cdl.computation.image.edges.compute_sobel()`

compute_sobel_h() → None
Compute Sobel filter (horizontal) with `cdl.computation.image.edges.compute_sobel_h()`

compute_sobel_v() → None
Compute Sobel filter (vertical) with `cdl.computation.image.edges.compute_sobel_v()`

compute_scharr() → None
Compute Scharr filter with `cdl.computation.image.edges.compute_scharr()`

compute_scharr_h() → None
Compute Scharr filter (horizontal) with `cdl.computation.image.edges.compute_scharr_h()`

compute_scharr_v() → None
Compute Scharr filter (vertical) with `cdl.computation.image.edges.compute_scharr_v()`

compute_farid() → None
Compute Farid filter with `cdl.computation.image.edges.compute_farid()`

compute_farid_h() → None
Compute Farid filter (horizontal) with `cdl.computation.image.edges.compute_farid_h()`

compute_farid_v() → None

Compute Farid filter (vertical) with `cdl.computation.image.edges.compute_farid_v()`

compute_laplace() → None

Compute Laplace filter with `cdl.computation.image.edges.compute_laplace()`

compute_all_edges() → None

Compute all edges filters using the following functions:

- `cdl.computation.image.edges.compute_roberts()`
- `cdl.computation.image.edges.compute_prewitt()`
- `cdl.computation.image.edges.compute_prewitt_h()`
- `cdl.computation.image.edges.compute_prewitt_v()`
- `cdl.computation.image.edges.compute_sobel()`
- `cdl.computation.image.edges.compute_sobel_h()`
- `cdl.computation.image.edges.compute_sobel_v()`
- `cdl.computation.image.edges.compute_scharr()`
- `cdl.computation.image.edges.compute_scharr_h()`
- `cdl.computation.image.edges.compute_scharr_v()`
- `cdl.computation.image.edges.compute_farid()`
- `cdl.computation.image.edges.compute_farid_h()`
- `cdl.computation.image.edges.compute_farid_v()`
- `cdl.computation.image.edges.compute_laplace()`

compute_stats() → dict[str, ResultProperties]

Compute data statistics with `cdl.computation.image.compute_stats()`

compute_centroid() → dict[str, ResultShape]

Compute image centroid with `cdl.computation.image.compute_centroid()`

compute_enclosing_circle() → dict[str, ResultShape]

Compute minimum enclosing circle with `cdl.computation.image.compute_enclosing_circle()`

compute_peak_detection() (*param*: Peak2DDetectionParam | None = None) → dict[str, ResultShape]

Compute 2D peak detection with `cdl.computation.image.compute_peak_detection()`

compute_contour_shape() (*param*: ContourShapeParam | None = None) → dict[str, ResultShape]

Compute contour shape fit with `cdl.computation.image.detection.compute_contour_shape()`

compute_hough_circle_peaks() (*param*: HoughCircleParam | None = None) → dict[str, ResultShape]

Compute peak detection based on a circle Hough transform with `cdl.computation.image.compute_hough_circle_peaks()`

compute_blob_dog() (*param*: BlobDOGParam | None = None) → dict[str, ResultShape]

Compute blob detection using Difference of Gaussian method with `cdl.computation.image.detection.compute_blob_dog()`

compute_blob_doh() (*param*: BlobDOHParam | None = None) → dict[str, ResultShape]

Compute blob detection using Determinant of Hessian method with `cdl.computation.image.detection.compute_blob_doh()`

`compute_blob_log(param: BlobLOGParam | None = None) → dict[str, ResultShape]`

Compute blob detection using Laplacian of Gaussian method with `cdl.computation.image.detection.compute_blob_log()`

`compute_blob_opencv(param: BlobOpenCVParam | None = None) → dict[str, ResultShape]`

Compute blob detection using OpenCV with `cdl.computation.image.detection.compute_blob_opencv()`

2.2.5 Internal data model

In its internal data model, DataLab stores data using two main classes:

- `cdl.obj.SignalObj`, which represents a signal object, and
- `cdl.obj.ImageObj`, which represents an image object.

These classes are defined in the `cdl.core.model` package but are exposed publicly in the `cdl.obj` package.

Also, DataLab uses many different datasets (based on `guidata`'s `DataSet` class) to store the parameters of the computations. These datasets are defined in different modules but are exposed publicly in the `cdl.param` package.

See also:

The *API* section for more information on the public API.

2.2.6 Plugins

DataLab is a modular application. It is possible to add new features to DataLab by writing plugins. A plugin is a Python module that is loaded at startup by DataLab. A plugin may add new features to DataLab, or modify existing features.

The plugin system currently supports the following features:

- Processing features: add new processing tasks to the DataLab processing system, including specific graphical user interfaces.
- Input/output features: add new file formats to the DataLab file I/O system.
- HDF5 features: add new HDF5 file formats to the DataLab HDF5 I/O system.

What is a plugin?

A plugin is a Python module that is loaded at startup by DataLab. A plugin may add new features to DataLab, or modify existing features.

A plugin is a Python module which file name starts with `cdl_`, and which contains a class derived from the `cdl.plugins.PluginBase` class. The name of the class is not important, as long as it is derived from `cdl.plugins.PluginBase` and has a `PLUGIN_INFO` attribute that is an instance of the `cdl.plugins.PluginInfo` class. The `PLUGIN_INFO` attribute is used by DataLab to retrieve information about the plugin.

Note: DataLab's plugin discovery mechanism will only load plugins that are defined in Python files which names start with `cdl_` (e.g. `cdl_myplugin.py`).

Where to put a plugin?

As plugins are Python modules, they can be put anywhere in the Python path of the DataLab installation.

Special additional locations are available for plugins:

- The *plugins* directory in the user configuration folder (e.g. *C:/Users/JohnDoe/.DataLab/plugins* on Windows or *~/.DataLab/plugins* on Linux).
- The *plugins* directory in the same folder as the *DataLab* executable in case of a standalone installation.
- The *plugins* directory in the *cdl* package in case for internal plugins only (i.e. it is not recommended to put your own plugins there).

How to develop a plugin?

To develop a plugin, you may start by deriving from one of the example plugins (see below) and modify it to suit your needs.

If you want to code a plugin in your usual Python development environment (preferably with an IDE like [Spyder](#)) and take advantage of the code completion, you can add the *cdl* package to your Python path.

This can be done:

- By installing DataLab in your Python environment (using one of the following methods: *Conda package*, *Package manager pip*, *Wheel package*, or *Source package*),
- Or by adding the *cdl* package to your Python path manually:
 - Download the DataLab source code from the [PyPI page](#),
 - Unzip the source code to a folder on your computer,
 - Add the *cdl* package to your Python path (e.g. by using the *PYTHONPATH Manager* in Spyder).

Note: Even if you have installed the *cdl* package properly in your Python environment, you won't be able to run the DataLab application from your development environment to test your plugin. You will need to run DataLab from the command line or from the shortcut created during the installation.

Example: processing plugin

Here is a simple example of a plugin that adds a new features to DataLab.

```
# Copyright (c) DataLab Platform Developers, BSD 3-Clause license, see LICENSE file.

"""
Test Data Plugin for DataLab
-----

This plugin is an example of DataLab plugin. It provides test data samples
and some actions to test DataLab functionalities.
"""

import cdl.obj as dlo
import cdl.tests.data as test_data
from cdl.computation import image as cpima
```

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```

from cdl.computation import signal as cpsig
from cdl.config import _
from cdl.plugins import PluginBase, PluginInfo

# -----
# All computation functions must be defined as global functions, otherwise
# they cannot be pickled and sent to the worker process
# -----

def add_noise_to_signal(
    src: dlo.SignalObj, p: test_data.GaussianNoiseParam
) -> dlo.SignalObj:
    """Add gaussian noise to signal"""
    dst = cpsig.dst_11(src, "add_gaussian_noise", f"mu={p.mu},sigma={p.sigma}")
    test_data.add_gaussian_noise_to_signal(dst, p)
    return dst

def add_noise_to_image(src: dlo.ImageObj, p: dlo.NormalRandomParam) -> dlo.ImageObj:
    """Add gaussian noise to image"""
    dst = cpima.dst_11(src, "add_gaussian_noise", f"mu={p.mu},sigma={p.sigma}")
    test_data.add_gaussian_noise_to_image(dst, p)
    return dst

class PluginTestData(PluginBase):
    """DataLab Test Data Plugin"""

    PLUGIN_INFO = PluginInfo(
        name=_("Test data"),
        version="1.0.0",
        description=_("Testing DataLab functionalities"),
    )

    # Signal processing features -----
    def add_noise_to_signal(self) -> None:
        """Add noise to signal"""
        self.signalpanel.processor.compute_11(
            add_noise_to_signal,
            paramclass=test_data.GaussianNoiseParam,
            title=_("Add noise"),
        )

    def create_paracetamol_signal(self) -> None:
        """Create paracetamol signal"""
        obj = test_data.create_paracetamol_signal()
        self.proxy.add_object(obj)

    def create_noisy_signal(self) -> None:
        """Create noisy signal"""
        obj = self.signalpanel.new_object(add_to_panel=False)

```

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```

    if obj is not None:
        noiseparam = test_data.GaussianNoiseParam(_("Noise"))
        self.signalpanel.processor.update_param_defaults(noiseparam)
        if noiseparam.edit(self.main):
            test_data.add_gaussian_noise_to_signal(obj, noiseparam)
            self.proxy.add_object(obj)

# Image processing features -----
def add_noise_to_image(self) -> None:
    """Add noise to image"""
    self.imagepanel.processor.compute_11(
        add_noise_to_image,
        paramclass=dlo.NormalRandomParam,
        title=_("Add noise"),
    )

def create_peak2d_image(self) -> None:
    """Create 2D peak image"""
    obj = self.imagepanel.new_object(add_to_panel=False)
    if obj is not None:
        param = test_data.PeakDataParam.create(size=max(obj.data.shape))
        self.imagepanel.processor.update_param_defaults(param)
        if param.edit(self.main):
            obj.data = test_data.get_peak2d_data(param)
            self.proxy.add_object(obj)

def create_sincos_image(self) -> None:
    """Create 2D sin cos image"""
    newparam = self.edit_new_image_parameters(hide_image_type=True)
    if newparam is not None:
        obj = test_data.create_sincos_image(newparam)
        self.proxy.add_object(obj)

def create_noisygauss_image(self) -> None:
    """Create 2D noisy gauss image"""
    newparam = self.edit_new_image_parameters(
        hide_image_height=True, hide_image_type=True
    )
    if newparam is not None:
        obj = test_data.create_noisygauss_image(newparam, add_annotations=False)
        self.proxy.add_object(obj)

def create_multigauss_image(self) -> None:
    """Create 2D multi gauss image"""
    newparam = self.edit_new_image_parameters(
        hide_image_height=True, hide_image_type=True
    )
    if newparam is not None:
        obj = test_data.create_multigauss_image(newparam)
        self.proxy.add_object(obj)

def create_2dstep_image(self) -> None:

```

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```

        """Create 2D step image"""
        newparam = self.edit_new_image_parameters(hide_image_type=True)
        if newparam is not None:
            obj = test_data.create_2dstep_image(newparam)
            self.proxy.add_object(obj)

    def create_ring_image(self) -> None:
        """Create 2D ring image"""
        param = test_data.RingParam(_("Ring"))
        if param.edit(self.main):
            obj = test_data.create_ring_image(param)
            self.proxy.add_object(obj)

    def create_annotated_image(self) -> None:
        """Create annotated image"""
        obj = test_data.create_annotated_image()
        self.proxy.add_object(obj)

# Plugin menu entries -----
def create_actions(self) -> None:
    """Create actions"""
    # Signal Panel -----
    sah = self.signalpanel.acthandler
    with sah.new_menu(_("Test data")):
        sah.new_action(_("Add noise to signal"), triggered=self.add_noise_to_signal)
        sah.new_action(
            _("Load spectrum of paracetamol"),
            triggered=self.create_paracetamol_signal,
            select_condition="always",
            separator=True,
        )
        sah.new_action(
            _("Create noisy signal"),
            triggered=self.create_noisy_signal,
            select_condition="always",
        )
    # Image Panel -----
    iah = self.imagepanel.acthandler
    with iah.new_menu(_("Test data")):
        iah.new_action(_("Add noise to image"), triggered=self.add_noise_to_image)
        # with iah.new_menu(_("Data samples")):
        iah.new_action(
            _("Create image with peaks"),
            triggered=self.create_peak2d_image,
            select_condition="always",
            separator=True,
        )
        iah.new_action(
            _("Create 2D sin cos image"),
            triggered=self.create_sincos_image,
            select_condition="always",
        )

```

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```

    iah.new_action(
        _("Create 2D noisy gauss image"),
        triggered=self.create_noisygauss_image,
        select_condition="always",
    )
    iah.new_action(
        _("Create 2D multi gauss image"),
        triggered=self.create_multigauss_image,
        select_condition="always",
    )
    iah.new_action(
        _("Create annotated image"),
        triggered=self.create_annotated_image,
        select_condition="always",
    )
    iah.new_action(
        _("Create 2D step image"),
        triggered=self.create_2dstep_image,
        select_condition="always",
    )
    iah.new_action(
        _("Create ring image"),
        triggered=self.create_ring_image,
        select_condition="always",
    )

```

Example: input/output plugin

Here is a simple example of a plugin that adds a new file formats to DataLab.

```

# Copyright (c) DataLab Platform Developers, BSD 3-Clause license, see LICENSE file.

"""
Image file formats Plugin for DataLab
-----

This plugin is an example of DataLab plugin.
It provides image file formats from cameras, scanners, and other acquisition devices.
"""

import struct

import numpy as np

from cdl.core.io.base import FormatInfo
from cdl.core.io.image.base import ImageFormatBase

# =====
# Thales Pixium FXD file format
# =====

```

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```

class FXDFile:
    """Class implementing Thales Pixium FXD Image file reading feature

    Args:
        fname (str): path to FXD file
        debug (bool): debug mode
    """

    HEADER = "<111111ffl"

    def __init__(self, fname: str = None, debug: bool = False) -> None:
        self.__debug = debug
        self.file_format = None # long
        self.nbcolls = None # long
        self.nbrows = None # long
        self.nbframes = None # long
        self.pixeltype = None # long
        self.quantlevels = None # long
        self.maxlevel = None # float
        self.minlevel = None # float
        self.comment_length = None # long
        self.fname = None
        self.data = None
        if fname is not None:
            self.load(fname)

    def __repr__(self) -> str:
        """Return a string representation of the object"""
        info = (
            ("Image width", f"{self.nbcolls:d}"),
            ("Image Height", f"{self.nbrows:d}"),
            ("Frame number", f"{self.nbframes:d}"),
            ("File format", f"{self.file_format:d}"),
            ("Pixel type", f"{self.pixeltype:d}"),
            ("Quantlevels", f"{self.quantlevels:d}"),
            ("Min. level", f"{self.minlevel:f}"),
            ("Max. level", f"{self.maxlevel:f}"),
            ("Comment length", f"{self.comment_length:d}"),
        )
        desc_len = max(len(d) for d in list(zip(*info))[0]) + 3
        res = ""
        for description, value in info:
            res += ("{: " + str(desc_len) + "}}{}\n").format(description + ": ", value)

        res = object.__repr__(self) + "\n" + res
        return res

    def load(self, fname: str) -> None:
        """Load header and image pixel data

        Args:

```

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```

        fname (str): path to FXD file
    """
    with open(fname, "rb") as data_file:
        header_s = struct.Struct(self.HEADER)
        record = data_file.read(9 * 4)
        unpacked_rec = header_s.unpack(record)
        (
            self.file_format,
            self.nbcolls,
            self.nbrows,
            self.nbframes,
            self.pixeltype,
            self.quantlevels,
            self.maxlevel,
            self.minlevel,
            self.comment_length,
        ) = unpacked_rec
        if self.__debug:
            print(unpacked_rec)
            print(self)
        data_file.seek(128 + self.comment_length)
        if self.pixeltype == 0:
            size, dtype = 4, np.float32
        elif self.pixeltype == 1:
            size, dtype = 2, np.uint16
        elif self.pixeltype == 2:
            size, dtype = 1, np.uint8
        else:
            raise NotImplementedError(f"Unsupported pixel type: {self.pixeltype}")
        block = data_file.read(self.nbrows * self.nbcolls * size)
        data = np.frombuffer(block, dtype=dtype)
        self.data = data.reshape(self.nbrows, self.nbcolls)

class FXDImageFormat(ImageFormatBase):
    """Object representing Thales Pixium (FXD) image file type"""

    FORMAT_INFO = FormatInfo(
        name="Thales Pixium",
        extensions="*.fxd",
        readable=True,
        writeable=False,
    )

    @staticmethod
    def read_data(filename: str) -> np.ndarray:
        """Read data and return it

        Args:
            filename (str): path to FXD file

        Returns:

```

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```

        np.ndarray: image data
        """
        fxd_file = FXDFile(filename)
        return fxd_file.data

# =====
# Dürr NDT XYZ file format
# =====

class XYZImageFormat(ImageFormatBase):
    """Object representing Dürr NDT XYZ image file type"""

    FORMAT_INFO = FormatInfo(
        name="Dürr NDT",
        extensions="*.xyz",
        readable=True,
        writeable=True,
    )

    @staticmethod
    def read_data(filename: str) -> np.ndarray:
        """Read data and return it

        Args:
            filename (str): path to XYZ file

        Returns:
            np.ndarray: image data
        """
        with open(filename, "rb") as fdesc:
            cols = int(np.fromfile(fdesc, dtype=np.uint16, count=1)[0])
            rows = int(np.fromfile(fdesc, dtype=np.uint16, count=1)[0])
            arr = np.fromfile(fdesc, dtype=np.uint16, count=cols * rows)
            arr = arr.reshape((rows, cols))
        return np.fliplr(arr)

    @staticmethod
    def write_data(filename: str, data: np.ndarray) -> None:
        """Write data to file

        Args:
            filename: File name
            data: Image array data
        """
        data = np.fliplr(data)
        with open(filename, "wb") as fdesc:
            fdesc.write(np.array(data.shape[1], dtype=np.uint16).tobytes())
            fdesc.write(np.array(data.shape[0], dtype=np.uint16).tobytes())
            fdesc.write(data.tobytes())

```


Other examples

Other examples of plugins can be found in the *plugins/examples* directory of the DataLab source code (explore [here on GitHub](#)).

Public API

DataLab plugin system

DataLab plugin system provides a way to extend the application with new functionalities.

Plugins are Python modules that relies on two classes:

- *PluginInfo*, which stores information about the plugin
- *PluginBase*, which is the base class for all plugins

Plugins may also extends DataLab I/O features by providing new image or signal formats. To do so, they must provide a subclass of *ImageFormatBase* or *SignalFormatBase*, in which format infos are defined using the *FormatInfo* class.

```
class cdl.plugins.PluginRegistry(name, bases, attrs)
    Metaclass for registering plugins

    classmethod get_plugin_classes() → list[type[PluginBase]]
        Return plugin classes

    classmethod get_plugins() → list[PluginBase]
        Return plugin instances

    classmethod get_plugin(name_or_class: str | type[PluginBase]) → PluginBase | None
        Return plugin instance

    classmethod register_plugin(plugin: PluginBase)
        Register plugin

    classmethod unregister_plugin(plugin: PluginBase)
        Unregister plugin

    classmethod get_plugin_infos(html: bool = True) → str
        Return plugin infos (names, versions, descriptions) in html format

    Parameters
        html – return html formatted text (default: True)

class cdl.plugins.PluginInfo(name: str = None, version: str = '0.0.0', description: str = '', icon: str = None)
    Plugin info

class cdl.plugins.PluginBaseMeta(name, bases, namespace, /, **kwargs)
    Mixed metaclass to avoid conflicts

class cdl.plugins.PluginBase
    Plugin base class

    property signalpanel: SignalPanel
        Return signal panel
```

property imagepanel: *ImagePanel*

Return image panel

show_warning(*message: str*)

Show warning message

show_error(*message: str*)

Show error message

show_info(*message: str*)

Show info message

ask_yesno(*message: str, title: str | None = None, cancelable: bool = False*) → *bool*

Ask yes/no question

edit_new_signal_parameters(*title: str | None = None, size: int | None = None, hide_signal_type: bool = True*) → *NewSignalParam*

Create and edit new signal parameter dataset

Parameters

- **title** – title of the new signal
- **size** – size of the new signal (default: None, get from current signal)
- **hide_signal_type** – hide signal type parameter (default: True)

Returns

New signal parameter dataset (or None if canceled)

edit_new_image_parameters(*title: str | None = None, shape: tuple[int, int] | None = None, hide_image_height: bool = False, hide_image_type: bool = True, hide_image_dtype: bool = False*) → *NewImageParam | None*

Create and edit new image parameter dataset

Parameters

- **title** – title of the new image
- **shape** – shape of the new image (default: None, get from current image)
- **hide_image_height** – hide image height parameter (default: False)
- **hide_image_type** – hide image type parameter (default: True)
- **hide_image_dtype** – hide image data type parameter (default: False)

Returns

New image parameter dataset (or None if canceled)

is_registered()

Return True if plugin is registered

register(*main: main.CDLMainWindow*) → *None*

Register plugin

unregister()

Unregister plugin

register_hooks()

Register plugin hooks

unregister_hooks()

Unregister plugin hooks

abstract create_actions()

Create actions

`cdl.plugins.discover_plugins() → list[type[PluginBase]]`

Discover plugins using naming convention

Returns

List of discovered plugins (as classes)

`cdl.plugins.get_available_plugins() → list[PluginBase]`

Instantiate and get available plugins

Returns

List of available plugins (as instances)

2.2.7 Log viewer

Despite countless efforts (unit testing, test coverage...), DataLab might crash or behave unexpectedly.

For those situations, DataLab provides two logs (located in your home directory):

- “Traceback log”, for Python exceptions
- “Faulthandler log”, for system failures (e.g. Qt-related crash)

Note: The log viewer is accessible from the “?” menu in the main window.

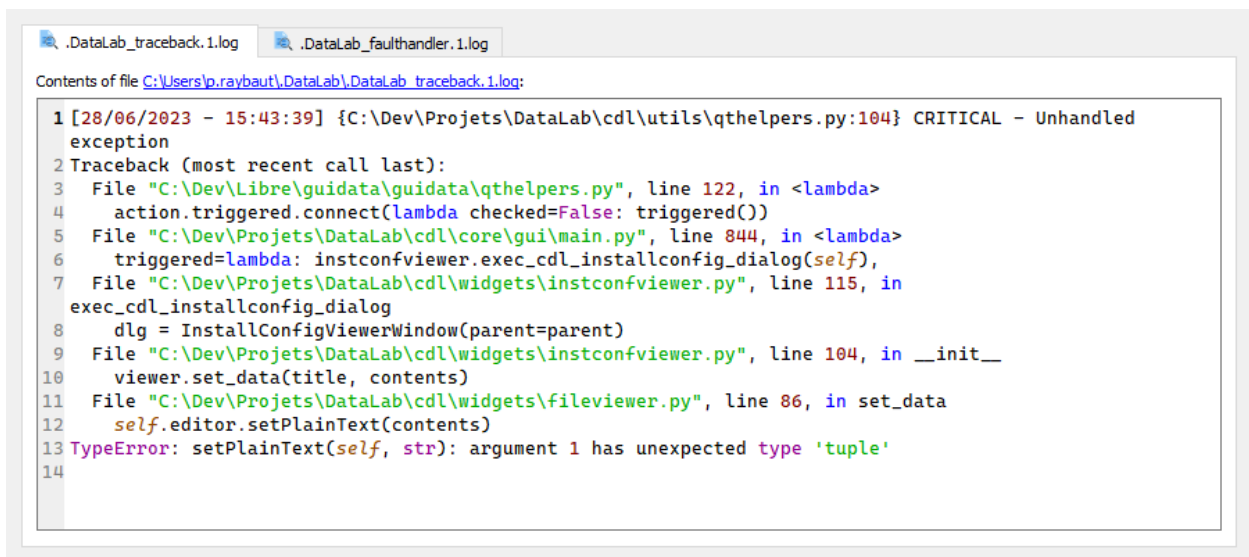


Fig. 6: DataLab log viewer (see “?” menu)

If DataLab crashed or if any Python exception is raised during its execution, those log files will be updated accordingly. DataLab will even notify that new informations are available in log files at next startup. This is an invitation to submit a bug report.

Reporting unexpected behavior or any other bug on [GitHub Issues](#) will be greatly appreciated, especially if those log file contents are attached to the report (as information on your installation configuration, see [Installation and configuration viewer](#)).

2.2.8 Installation and configuration viewer

Because of the multiple ways of installing DataLab on your machine, understanding why the application behaves unexpectedly without any information on your configuration could be very challenging.

That is why DataLab provides the dialog box “Installation and configuration” which gathers all the information about your installation and configuration.

Note: The installation and configuration viewer is accessible from the “?” menu in the main window.

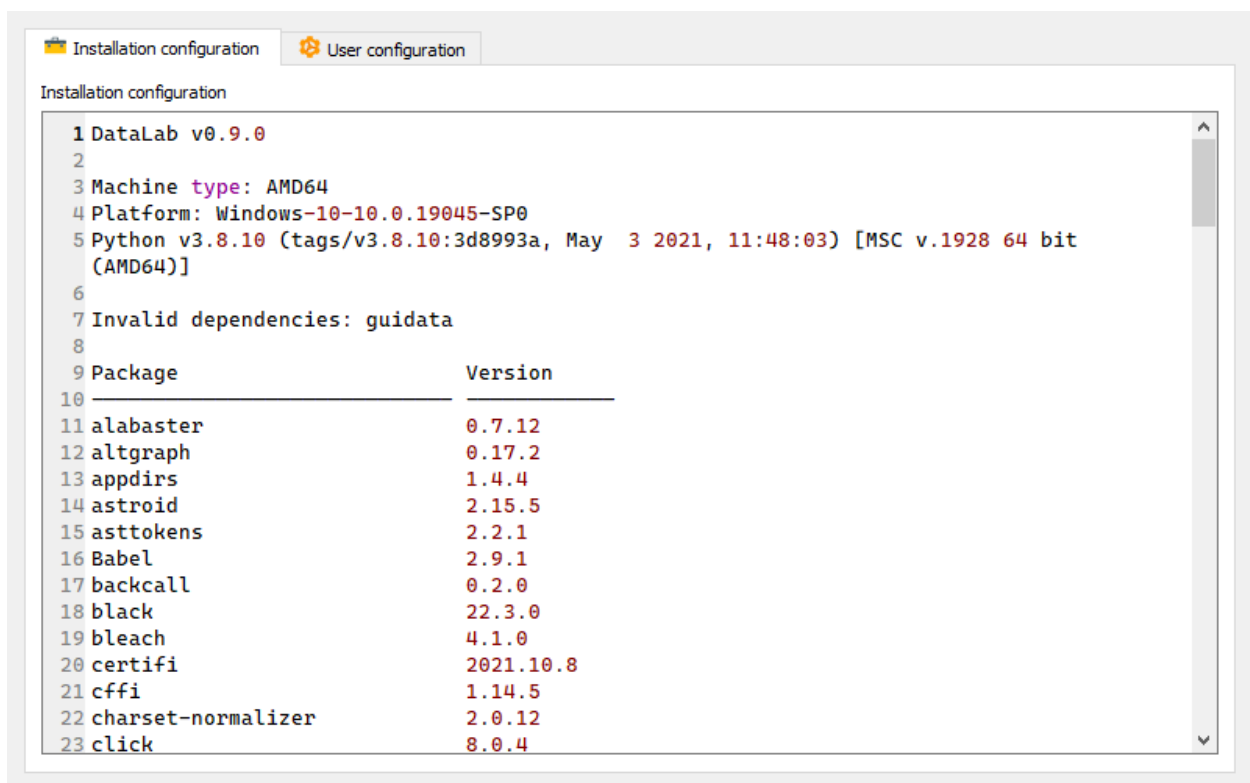


Fig. 7: Installation and configuration (see “?” menu)

Reporting unexpected behavior or any other bug on [GitHub Issues](#) will be greatly appreciated, especially if above contents are attached to the report (as well log files, see [Log viewer](#)).

2.2.9 Settings

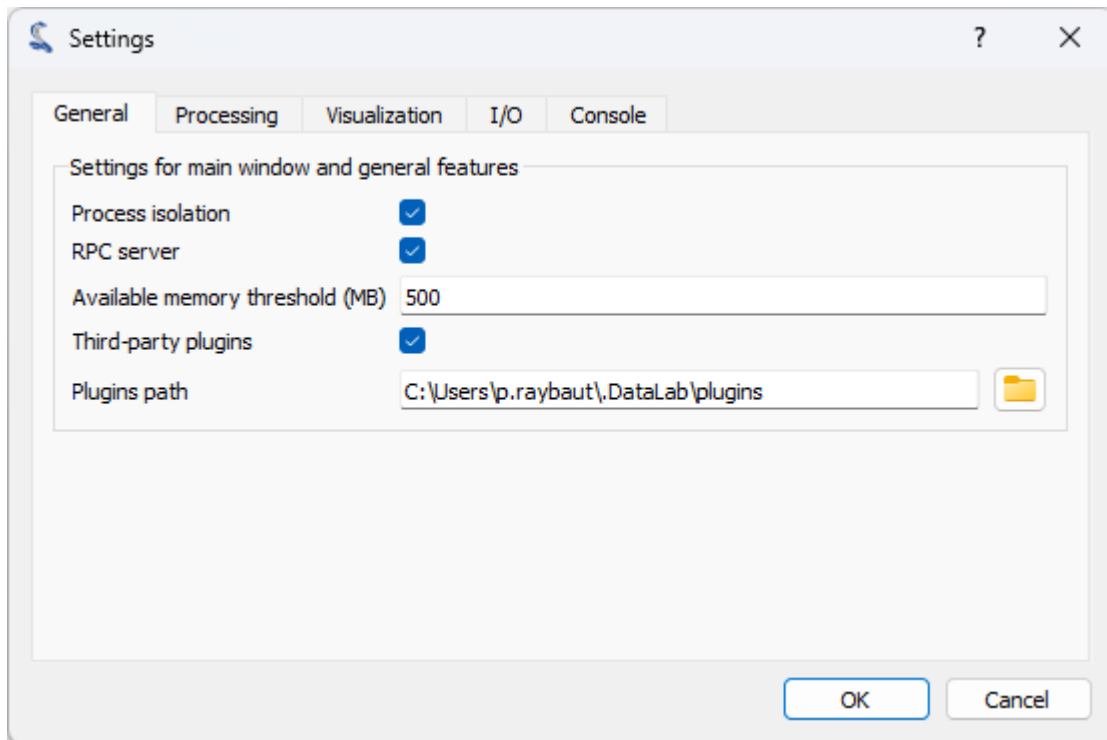


Fig. 8: Screenshot of the “Settings” dialog box.

2.2.10 Command line features

Run DataLab

To run DataLab from the command line, type the following:

```
$ datalab
```

To show help on command line usage, simply run:

```
$ datalab --help
usage: app.py [-h] [-b path] [-v] [--unattended] [--screenshot] [--delay DELAY] [--
  ↪xmlrpcport PORT]
           [--verbose {quiet,minimal,normal}]
           [h5]

Run DataLab

positional arguments:
h5                      HDF5 file names (separated by ';'), optionally with dataset name.
  ↪(separated by ',')
```

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```

-h, --help            show this help message and exit
-b path, --h5browser path
                        path to open with HDF5 browser
-v, --version          show DataLab version
--reset               reset DataLab configuration
--unattended          non-interactive mode
--accept_dialogs      accept dialogs in unattended mode
--screenshot          automatic screenshots
--delay DELAY         delay (ms) before quitting application in unattended mode
--xmlrpcport XMLRPCPORT
                        XML-RPC port number
--verbose {quiet,normal,debug}
                        verbosity level: for debugging/testing purpose

```

Open HDF5 file at startup

To open HDF5 files, or even import only a specified HDF5 dataset, use the following:

```

$ datalab /path/to/file1.h5
$ datalab /path/to/file1.h5,/path/to/dataset1
$ datalab /path/to/file1.h5,/path/to/dataset1;/path/to/file2.h5,/path/to/dataset2

```

Open HDF5 browser at startup

To open the HDF5 browser at startup, use one of the following commands:

```

$ datalab -b /path/to/file1.h5
$ datalab --h5browser /path/to/file1.h5

```

Run DataLab demo

To execute DataLab demo, run the following:

```

$ datalab-demo

```

Run technical validation tests

Note: Technical validation tests are directly included in individual unit tests and are disseminated throughout the code. The test functions including validation tests are marked with the `@pytest.mark.validation` decorator.

To execute DataLab technical validation tests, run the following:

```

$ pytest -m validation

```

See also:

See section [Validation](#) for more information on DataLab's validation strategy.

Run complete test suite

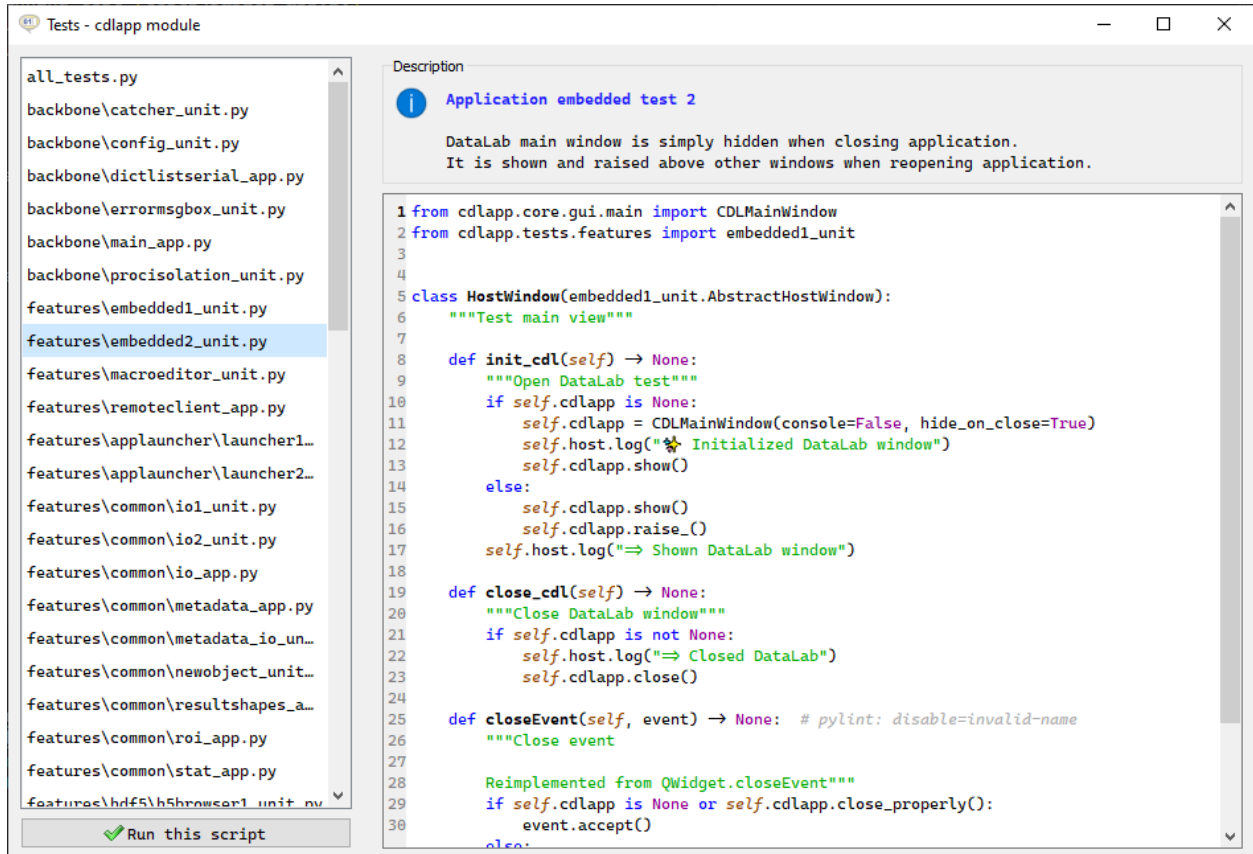
To execute all DataLab unit tests, simply run:

```
$ pytest
```

Run interactive tests

To execute DataLab interactive tests, run the following:

```
$ datalab-tests
```



2.3 Signal processing

This section describes the features specific to the signal processing panel. The signal processing panel is the default panel when DataLab is started.

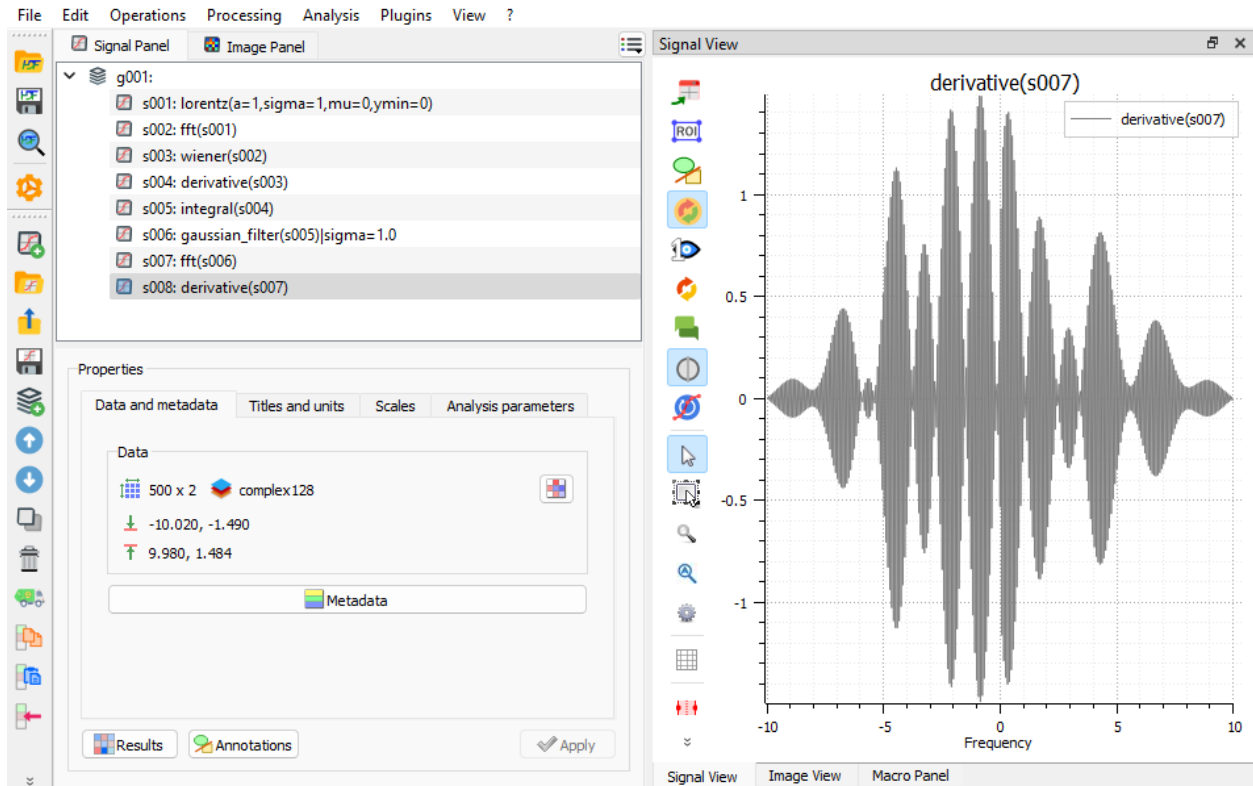


Fig. 9: DataLab main window: Signal processing view

2.3.1 Create, open and save Signals

This section describes how to create, open and save signals (and workspaces).

When the “Signal Panel” is selected, the menus and toolbars are updated to provide signal-related actions.

The “File” menu allows you to:

- Create, open, save and close signals (see below).
- Save and restore the current workspace or browse HDF5 files (see [Workspace](#)).
- Edit DataLab preferences (see [Settings](#)).

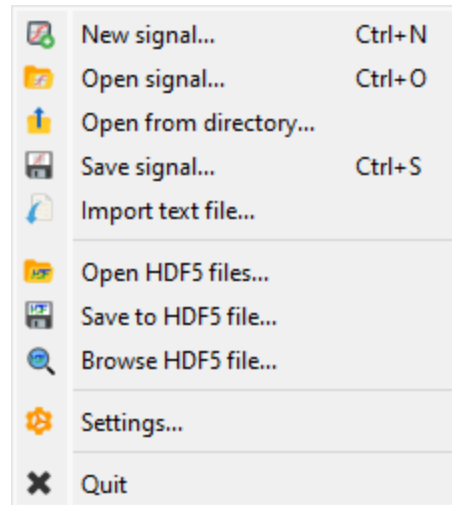


Fig. 10: Screenshot of the “File” menu.

New signal

Create a new signal from various models:

Model	Equation
Zeros	$y[i] = 0$
Gaussian	$y = y_0 + \frac{A}{\sqrt{2\pi} \cdot \sigma} \cdot \exp(-\frac{1}{2} \cdot (\frac{x - x_0}{\sigma})^2)$
Lorentzian	$y = y_0 + \frac{A}{\sigma \cdot \pi} \cdot \frac{1}{1 + (\frac{x - x_0}{\sigma})^2}$
Voigt	$y = y_0 + A \cdot \frac{\text{Re}(\exp(-z^2) \cdot \text{erfc}(-j \cdot z))}{\sqrt{2\pi} \cdot \sigma}$ with $z = \frac{x - x_0 - j \cdot \sigma}{\sqrt{2} \cdot \sigma}$
Random (uniform law)	$y[i] \in [-0.5, 0.5]$
Random (normal law)	$y[i] \sim \mathcal{N}(-0.5, 0.5)$
Sine	$y = y_0 + A \cdot \sin(2\pi \cdot f \cdot x + \phi)$
Cosine	$y = y_0 + A \cdot \cos(2\pi \cdot f \cdot x + \phi)$
Sawtooth	$y = y_0 + A \cdot \left(2 \left(f x + \frac{\phi}{2\pi} - \left\lfloor f x + \frac{\phi}{2\pi} + \frac{1}{2} \right\rfloor \right) \right)$
Triangle	$y = y_0 + A \cdot \text{sawtooth}(2\pi f x + \phi, \text{width} = 0.5)$
Square	$y = y_0 + A \cdot \text{sgn}(\sin(2\pi f x + \phi))$
Cardinal sine	$y = y_0 + A \cdot \text{sinc}(2\pi f x + \phi)$
Step	$y = y_0 + A \cdot \begin{cases} 1 & \text{if } x > x_0 \\ 0 & \text{otherwise} \end{cases}$
Exponential	$y = y_0 + A \cdot \exp(B \cdot x)$
Pulse	$y = y_0 + A \cdot \begin{cases} 1 & \text{if } x_0 < x < x_1 \\ 0 & \text{otherwise} \end{cases}$
Polynomial	$y = y_0 + A_0 + A_1 \cdot x + A_2 \cdot x^2 + \dots + A_n \cdot x^n$
Experimental	Manual input of X and Y values

Open signal

Create a new signal from the following supported filetypes:

File type	Extensions
Text files	.txt, .csv
NumPy arrays	.npy
MAT-Files	.mat

Save signal

Save current signal to the following supported filetypes:

File type	Extensions
Text files	.csv

Import text file

DataLab can natively import signal files (e.g. CSV, NPY, etc.). However some specific text file formats may not be supported. In this case, you can use the *Import text file* feature, which allows you to import a text file and convert it to a signal.

This feature is accessible from the *File* menu, under the *Import text file* option.

It opens an import wizard that guides you through the process of importing the text file.

Step 1: Select the source

The first step is to select the source of the text file. You can either select a file from your computer or the clipboard if you have copied the text from another application.

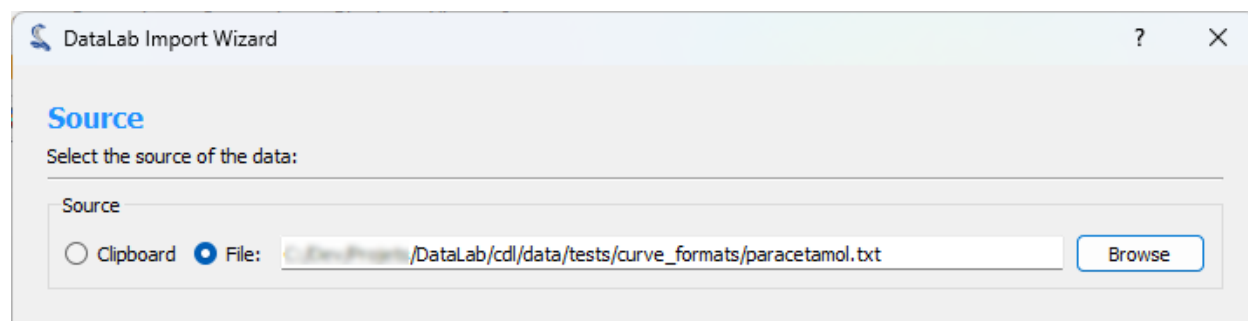


Fig. 11: Step 1: Select the source

Step 2: Preview and configure the import

The second step consists of configuring the import and previewing the result. You can configure the following options:

- **Delimiter:** The character used to separate the values in the text file.
- **Comments:** The character used to indicate that the line is a comment and should be ignored.
- **Rows to Skip:** The number of rows to skip at the beginning of the file.
- **Maximum Number of Rows:** The maximum number of rows to import. If the file contains more rows, they will be ignored.
- **Transpose:** If checked, the rows and columns will be transposed.
- **Data type:** The destination data type of the imported data.
- **First Column is X:** If checked, the first column will be used as the X axis.

When you are done configuring the import, click the *Apply* button to see the result.

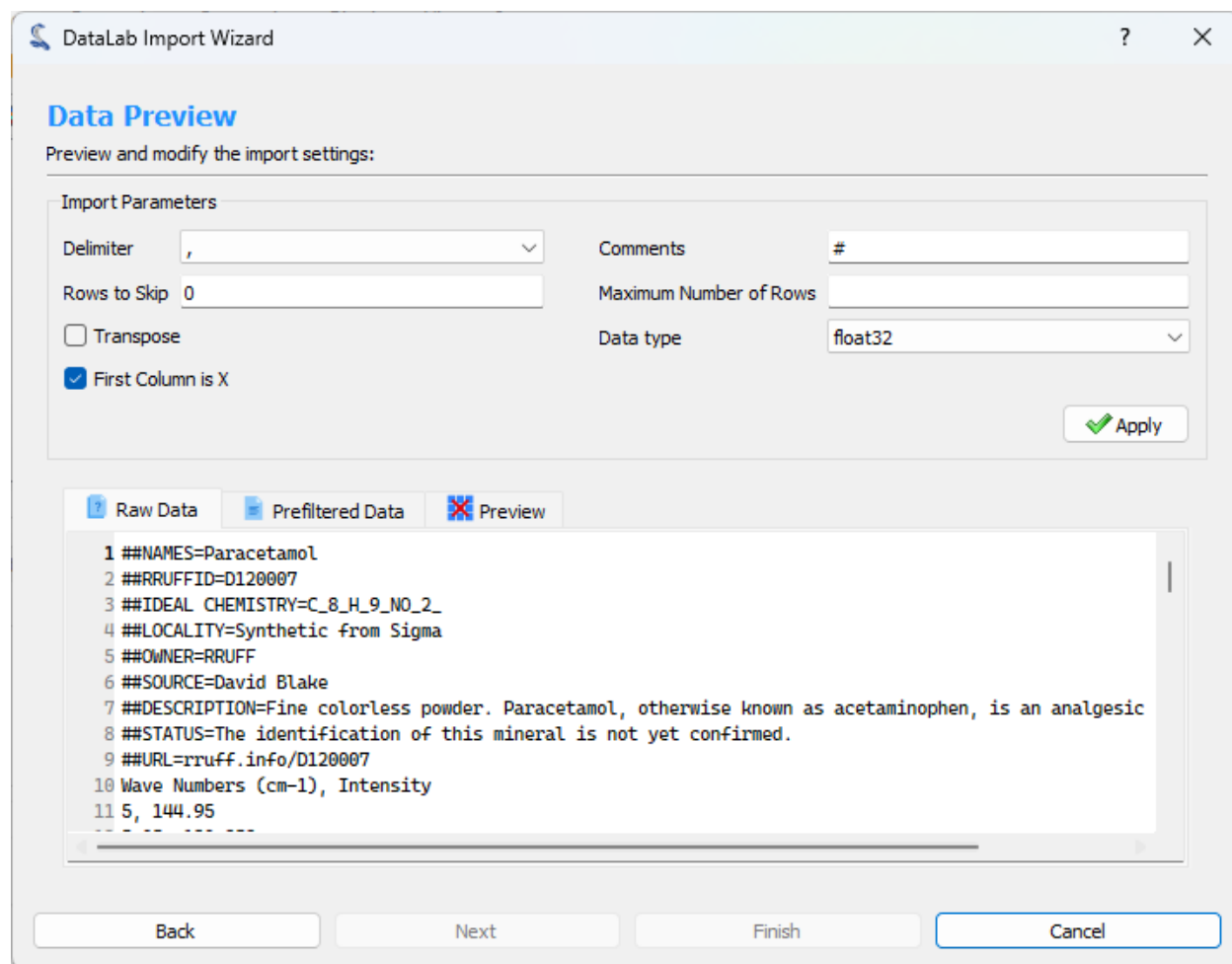


Fig. 12: Step 2: Configure the import

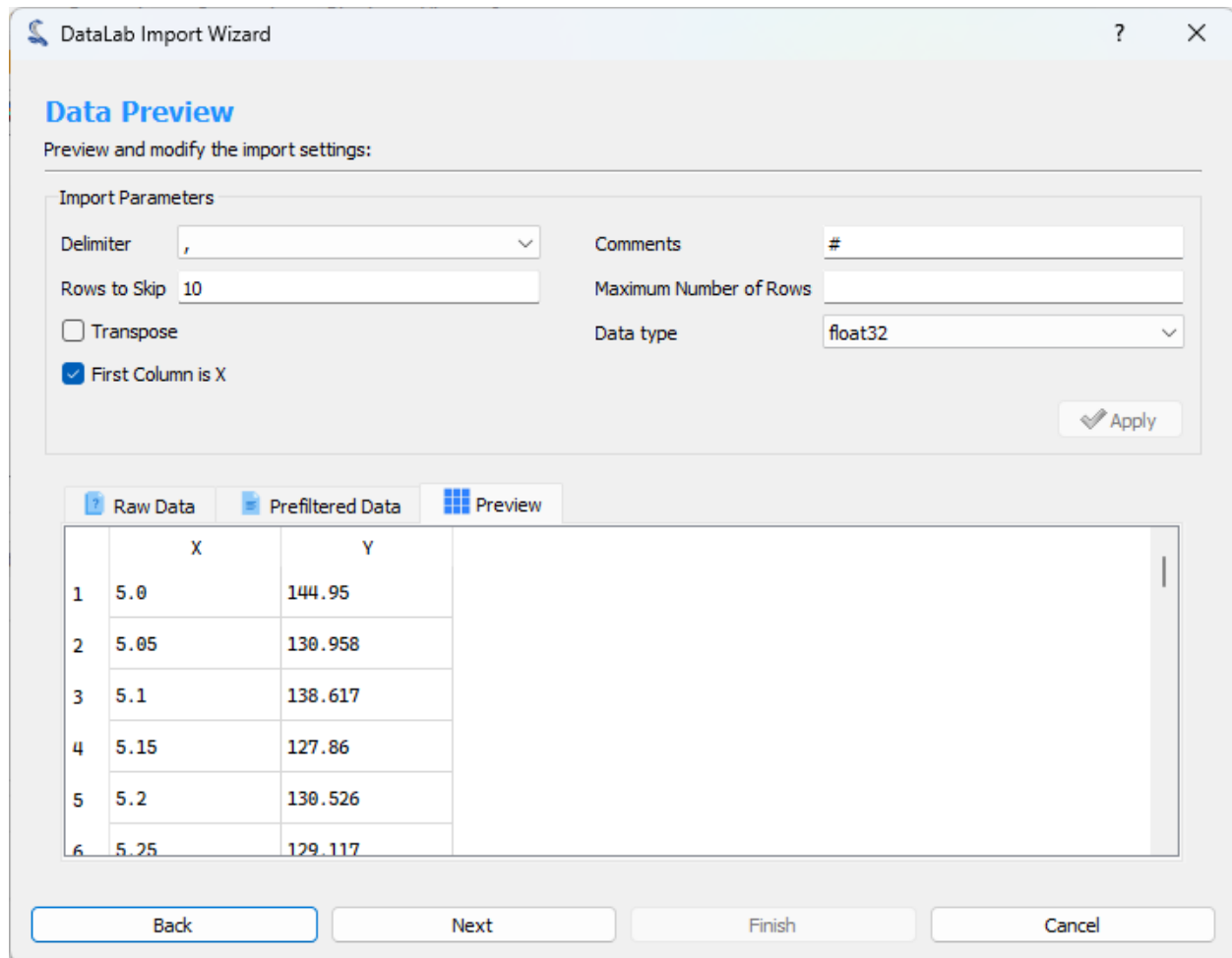


Fig. 13: Step 2: Preview the result

Step 3: Show graphical representation

The third step shows a graphical representation of the imported data. You can use the *Finish* button to import the data into DataLab workspace.

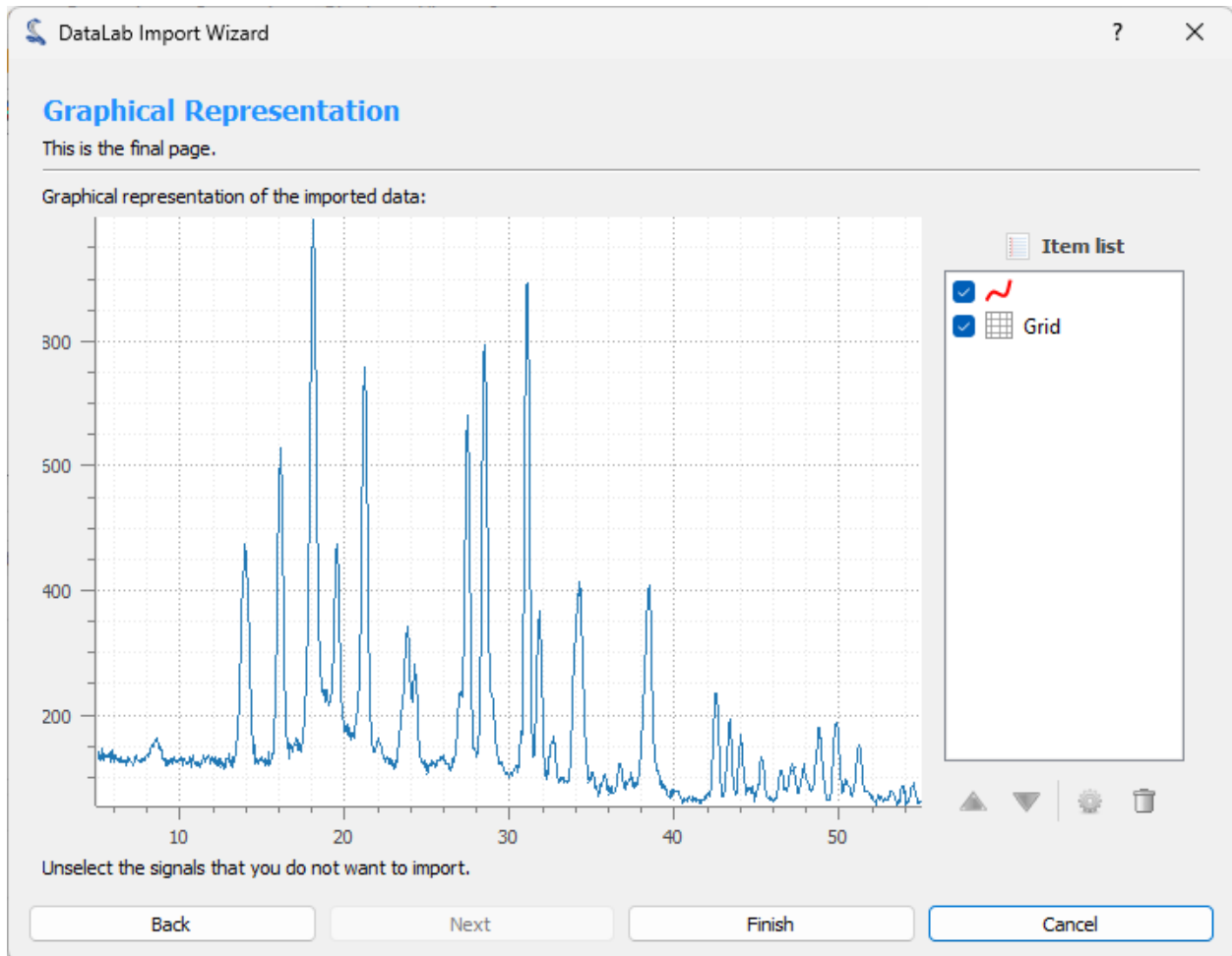


Fig. 14: Step 3: Show graphical representation

2.3.2 Manipulate metadata

This section describes how to manipulate metadata in DataLab.

The “Edit” menu allows you to perform classic editing operations on the current signal or group of signals (create/rename group, move up/down, delete signal/group of signals, etc.).

It also allows you to manipulate metadata associated with the current signal.

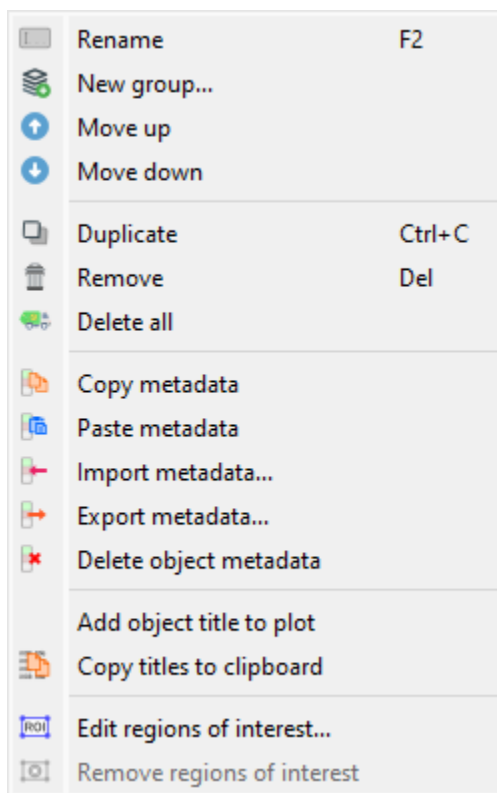


Fig. 15: Screenshot of the “Edit” menu.

Copy/paste metadata

As metadata contains useful information about the signal, it can be copied and pasted from one signal to another by selecting the “Copy metadata” and “Paste metadata” actions in the “Edit” menu.

This feature allows you to transfer that information from one signal to another:

- *Regions Of Interest (ROIs)*: that is a very efficient way to reuse the same ROI on different signals and easily compare the results of the analysis on those signals
- Analyze results, such as peak positions or FWHM intervals (the relevance of transferring such information depends on the context and is up to the user to decide)
- Any other information that you may have added to the metadata of a signal

Note: Copying metadata from a signal to another will overwrite the metadata of the destination signal (for the metadata keys that are common to both signals) or simply add the metadata keys that are not present in the destination signal.

Import/export metadata

Metadata can also be imported and exported from/to a JSON file using the “Import metadata” and “Export metadata” actions in the “Edit” menu. This is exactly the same as the copy/paste metadata feature (see above for more details on the use cases of this feature), but it allows you to save the metadata to a file and then import it back later.

Delete metadata

When deleting metadata using the “Delete metadata” action in the “Edit” menu, you will be prompted to confirm the deletion of Region of Interests (ROIs) if they are present in the metadata. After this eventual confirmation, the metadata will be deleted, meaning that analysis results, ROIs, and any other information associated with the signal will be lost.

Signal titles

Signal titles may be considered as metadata from a user point of view, even if they are not stored in the metadata of the signal (but in an attribute of the signal object).

The “Edit” menu allows you to:

- “Add object title to plot”: this action will add a label on top of the signal with its title.
- “Copy titles to clipboard”: this action will copy the titles of the selected signals to the clipboard, which might be useful to paste them in a text editor or in a spreadsheet.

Example of the content of the clipboard:

```
g001:
  s001: lorentz(a=1,sigma=1,mu=0,ymin=0)
  s002: derivative(s001)
  s003: wiener(s002)
g002: derivative(g001)
  s004: derivative(s001)
  s005: derivative(s002)
  s006: derivative(s003)
g003: fft(g002)
  s007: fft(s004)
  s008: fft(s005)
  s009: fft(s006)
```

Regions Of Interest (ROI)

The Regions Of Interest (ROI) are signal areas that are defined by the user to perform specific operations, processing, or analysis on them.

ROI are taken into account almost in all computing features in DataLab:

- The “Operations” menu features are done only on the ROI if one is defined (except if the operation changes the number of points, like interpolation or resampling).
- The “Processing” menu actions are performed only on the ROI if one is defined (except if the destination signal data type is different from the source’s, like in the Fourier analysis features).
- The “Analysis” menu actions are done only on the ROI if one is defined.

Note: ROI are stored as metadata, and thus attached to signal.

The “Edit” menu allows you to:

- “Edit regions of interest” : open a dialog box to manage ROI associated with the selected signal (add, remove, move, resize, etc.). The ROI definition dialog is exactly the same as ROI extraction (see below): the ROI is defined by moving the position and adjusting the width of an horizontal range.

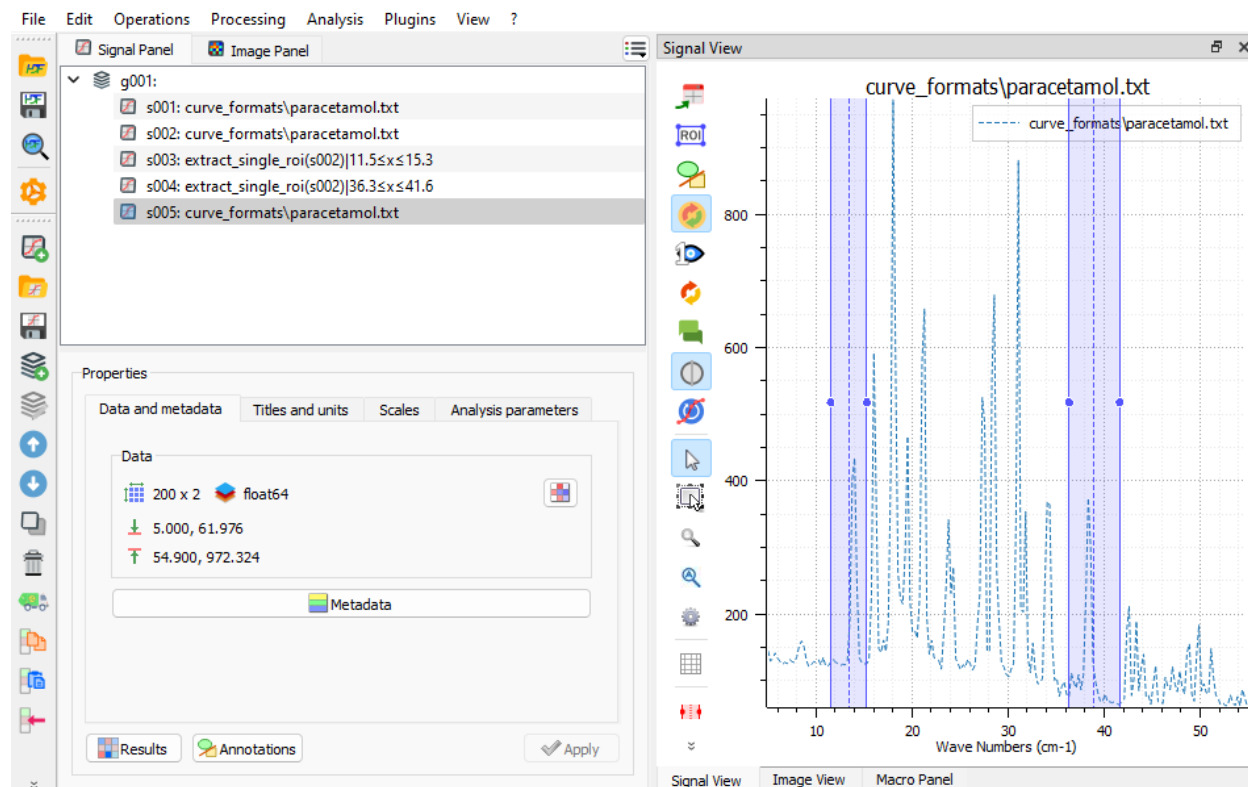


Fig. 16: A signal with an ROI.

- “Remove regions of interest” : remove all defined ROI for the selected signals.

2.3.3 Operations on Signals

This section describes the operations that can be performed on signals.

See also:

[Processing Signals](#) for more information on signal processing features, or [Analysis features on Signals](#) for information on analysis features on signals.

When the “Signal Panel” is selected, the menus and toolbars are updated to provide signal-related actions.

The “Operations” menu allows you to perform various operations on the selected signals, such as arithmetic operations, peak detection, or convolution.

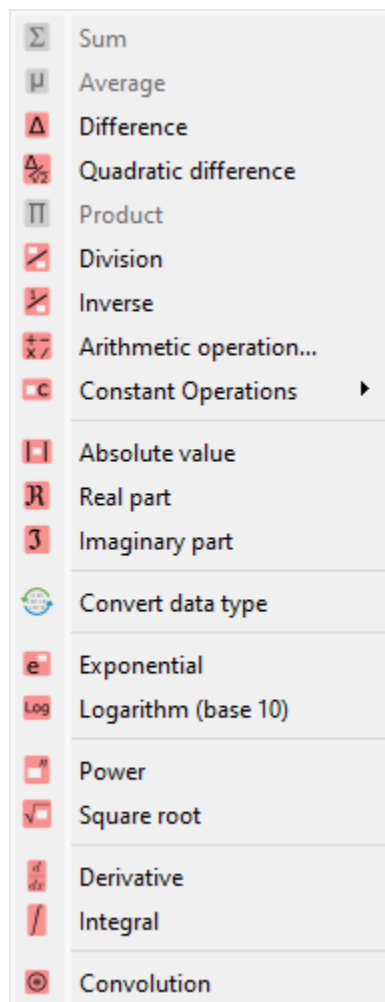


Fig. 17: Screenshot of the “Operations” menu.

Basic arithmetic operations

Operation	Description
Sum	$y_M = \sum_{k=0}^{M-1} y_k$
Average	$y_M = \frac{1}{M} \sum_{k=0}^{M-1} y_k$
Difference	$y_2 = y_1 - y_0$
Product	$y_M = \prod_{k=0}^{M-1} y_k$
Division	$y_2 = \frac{y_1}{y_0}$
Inverse	$y_2 = \frac{1}{y_1}$

Operations with a constant

Create a new signal which is the result of a constant operation on each selected signal:

Operation	Description
Addition	$y_k = y_{k-1} + c$
Subtraction	$y_k = y_{k-1} - c$
Multiplication	$y_k = y_{k-1} \times c$
Division	$y_k = \frac{y_{k-1}}{c}$

Absolute value, real and imaginary parts

Operation	Description
Absolute value	$y_k = y_{k-1} $
Real part	$y_k = \Re(y_{k-1})$
Imaginary part	$y_k = \Im(y_{k-1})$

Data type conversion

The “Convert data type” action allows you to convert the data type of the selected signals.

Note: Data type conversion relies on `numpy.ndarray.astype()` function with the default parameters (`casting='unsafe'`).

Basic mathematical functions

Function	Description
Exponential	$y_k = \exp(y_{k-1})$
Logarithm (base 10)	$y_k = \log_{10}(y_{k-1})$
Power	$y_k = y_{k-1}^n$
Square root	$y_k = \sqrt{y_{k-1}}$

Other mathematical operations

Operation	Implementation
Derivative	Based on <code>numpy.gradient</code>
Integral	Based on <code>scipy.integrate.cumulative_trapezoid</code>
Convolution	Based on <code>scipy.signal.convolve</code>

2.3.4 Processing Signals

This section describes the signal processing features available in DataLab.

See also:

[Operations on Signals](#) for more information on operations that can be performed on signals, or [Analysis features on Signals](#) for information on analysis features on signals.

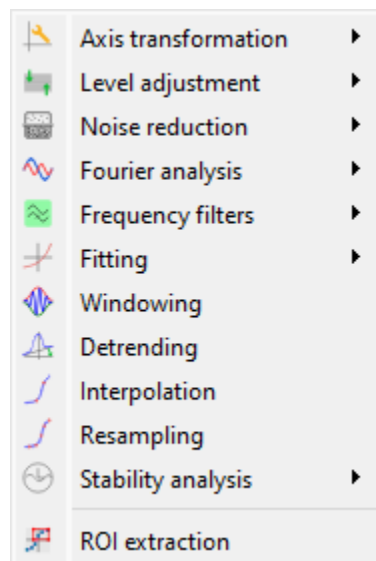


Fig. 18: Screenshot of the “Processing” menu.

When the “Signal Panel” is selected, the menus and toolbars are updated to provide signal-related actions.

The “Processing” menu allows you to perform various processing on the selected signals, such as smoothing, normalization, or interpolation.

Axis transformation

Linear calibration

Create a new signal which is a linear calibration of each selected signal with respect to X or Y axis:

Parameter	Linear calibration
X-axis	$x_1 = a.x_0 + b$
Y-axis	$y_1 = a.y_0 + b$

Swap X/Y axes

Create a new signal which is the result of swapping X/Y data.

Reverse X-axis

Create a new signal which is the result of reversing X data.

Convert to Cartesian coordinates

Create a new signal which is the result of converting polar coordinates to Cartesian coordinates.

Note: This function assumes that the x-axis represents the radius and the y-axis represents the angle. Negative values are not allowed for the radius, and will be clipped to 0 (a warning will be raised).

Convert to polar coordinates

Create a new signal which is the result of converting Cartesian coordinates to polar coordinates.

Level adjustment

Normalize

Create a new signal which is the normalization of each selected signal by maximum, amplitude, sum, energy or RMS:

Parameter	Normalization
Maximum	$y_1 = \frac{y_0}{\max(y_0)}$
Amplitude	$y_1 = \frac{y'_0}{\max(y'_0)}$ with $y'_0 = y_0 - \min(y_0)$
Area	$y_1 = \frac{y_0}{\sum_{n=0}^N y_0[n]}$
Energy	$y_1 = \frac{y_0}{\sqrt{\sum_{n=0}^N y_0[n] ^2}}$
RMS	$y_1 = \frac{y_0}{\sqrt{\frac{1}{N} \sum_{n=0}^N y_0[n] ^2}}$

Clipping

Create a new signal which is the result of clipping each selected signal.

Offset correction

Create a new signal which is the result of offset correction of each selected signal. This operation is performed by subtracting the signal baseline which is estimated by the mean value of a user-defined range.

Noise reduction

Create a new signal which is the result of noise reduction of each selected signal.

The following filters are available:

Filter	Formula/implementation
Gaussian filter	<code>scipy.ndimage.gaussian_filter</code>
Moving average	<code>scipy.ndimage.uniform_filter</code>
Moving median	<code>scipy.ndimage.median_filter</code>
Wiener filter	<code>scipy.signal.wiener</code>

Fourier analysis

Create a new signal which is the result of a Fourier analysis of each selected signal.

The following functions are available:

Function	Description	Formula/implementation
FFT	Fast Fourier Transform	<code>numpy.fft.fft</code>
Inverse FFT	Inverse Fast Fourier Transform	<code>numpy.fft.ifft</code>
Magnitude spectrum	Optionnal: use logarithmic scale (dB)	$y_1 = FFT(y_0) $ or $20 \cdot \log_{10}(FFT(y_0))$ (dB)
Phase spectrum		$y_1 = \angle FFT(y_0)$
Power spectral density (PSD)	Optionnal: use logarithmic scale (dB). PSD is estimated using Welch's method (see <code>scipy.signal.welch</code>)	$Y_k = PSD(y_k)$ or $10 \cdot \log_{10}(PSD(y_k))$ (dB)

Note: FFT and inverse FFT are performed using frequency shifting if the option is enabled in DataLab settings (see *Settings*).

Frequency filters

Create a new signal which is the result of applying a frequency filter to each selected signal.

The following filters are available:

Filter	Description
Low-pass	Filter out high frequencies, above a cutoff frequency
High-pass	Filter out low frequencies, below a cutoff frequency
Band-pass	Filter out frequencies outside a range
Band-stop	Filter out frequencies inside a range

For each filter, the following methods are available:

Method	Description
Bessel	Bessel filter, using SciPy's <code>scipy.signal.bessel</code> function
Butterworth	Butterworth filter, using SciPy's <code>scipy.signal.butter</code> function
Chebyshev I	Chebyshev type I filter, using SciPy's <code>scipy.signal.cheby1</code> function
Chebyshev II	Chebyshev type II filter, using SciPy's <code>scipy.signal.cheby2</code> function
Elliptic	Elliptic filter, using SciPy's <code>scipy.signal.ellip</code> function

Fitting

Open an interactive curve fitting tool in a modal dialog box.

Model	Equation
Linear	$y = c_0 + c_1.x$
Polynomial	$y = c_0 + c_1.x + c_2.x^2 + \dots + c_n.x^n$
Gaussian	$y = y_0 + \frac{A}{\sqrt{2\pi}.\sigma} \cdot \exp(-\frac{1}{2} \cdot (\frac{x-x_0}{\sigma})^2)$
Lorentzian	$y = y_0 + \frac{A}{\sigma.\pi} \cdot \frac{1}{1 + (\frac{x-x_0}{\sigma})^2}$
Voigt	$y = y_0 + A \cdot \frac{\text{Re}(\exp(-z^2)) \cdot \text{erfc}(-j.z))}{\sqrt{2\pi}.\sigma}$ with $z = \frac{x-x_0-j.\sigma}{\sqrt{2}.\sigma}$
Multi-Gaussian	$y = y_0 + \sum_{i=0}^K \frac{A_i}{\sqrt{2\pi}.\sigma_i} \cdot \exp(-\frac{1}{2} \cdot (\frac{x-x_{0,i}}{\sigma_i})^2)$
Exponential	$y = y_0 + A \cdot \exp(B.x)$
Sinusoidal	$y = y_0 + A \cdot \sin(2\pi.f.x + \phi)$
Cumulative Distribution Function (CDF)	$y = y_0 + A \cdot \text{erf}(\frac{x-x_0}{\sigma.\sqrt{2}})$

Windowing

Create a new signal which is the result of applying a window function to each selected signal.

The following window functions are available:

Window function	Reference
Barthann	<code>scipy.signal.windows.barthann()</code>
Bartlett	<code>numpy.bartlett()</code>
Blackman	<code>scipy.signal.windows.blackman()</code>
Blackman-Harris	<code>scipy.signal.windows.blackmanharris()</code>
Bohman	<code>scipy.signal.windows.bohman()</code>
Boxcar	<code>scipy.signal.windows.boxcar()</code>
Cosine	<code>scipy.signal.windows.cosine()</code>
Exponential	<code>scipy.signal.windows.exponential()</code>
Flat top	<code>scipy.signal.windows.flatop()</code>
Gaussian	<code>scipy.signal.windows.gaussian()</code>
Hamming	<code>numpy.hamming()</code>
Hanning	<code>numpy.hanning()</code>
Kaiser	<code>scipy.signal.windows.kaiser()</code>
Lanczos	<code>scipy.signal.windows.lanczos()</code>
Nuttall	<code>scipy.signal.windows.nuttall()</code>
Parzen	<code>scipy.signal.windows.parzen()</code>
Rectangular	<code>numpy.ones()</code>
Taylor	<code>scipy.signal.windows.taylor()</code>
Tukey	<code>scipy.signal.windows.tukey()</code>

Detrending

Create a new signal which is the detrending of each selected signal. This feature is based on SciPy's [scipy.signal.detrend](#) function.

The following parameters are available:

Parameter	Description
Method	Detrending method: 'linear' or 'constant'. See SciPy's scipy.signal.detrend function.

Interpolation

Create a new signal which is the interpolation of each selected signal with respect to a second signal X-axis (which might be the same as one of the selected signals).

The following interpolation methods are available:

Method	Description
Linear	Linear interpolation, using using NumPy's interp function
Spline	Cubic spline interpolation, using using SciPy's scipy.interpolate.splev function
Quadratic	Quadratic interpolation, using using NumPy's polyval function
Cubic	Cubic interpolation, using using SciPy's Akima1DInterpolator class
Barycentric	Barycentric interpolation, using using SciPy's BarycentricInterpolator class
PCHIP	Piecewise Cubic Hermite Interpolating Polynomial (PCHIP) interpolation, using using SciPy's PchipInterpolator class

Resampling

Create a new signal which is the resampling of each selected signal.

The following parameters are available:

Parameter	Description
Method	Interpolation method (see previous section)
Fill value	Interpolation fill value (see previous section)
Xmin	Minimum X value
Xmax	Maximum X value
Mode	Resampling mode: step size or number of points
Step size	Resampling step size
Number of points	Resampling number of points

Stability analysis

Create a new signal which is the result of a stability analysis of each selected signal.

The following stability analysis methods are available:

Function	Description
Allan variance	Measure of the stability of a signal: defined as the variance of the difference between two successive measurements as a function of the time interval between them.
Allan deviation	Square root of the Allan variance.
Overlapping Allan deviation	A more robust version of the Allan variance that overlaps successive segments to improve statistical confidence.
Modified Allan variance	A variation of the Allan variance that accounts for phase noise by introducing a filtering operation.
Hadamard variance	An alternative to Allan variance, more robust to linear frequency drift in the signal
Total variance	Extends the Allan variance concept to cover all possible averaging intervals.
Time deviation	Derived from Allan deviation, quantifies stability in terms of time rather than frequency.

Note: The “All stability features” option allows to compute all stability analysis methods at once.

ROI extraction

Create a new signal from a user-defined Region of Interest (ROI).

2.3.5 Analysis features on Signals

This section describes the signal analysis features available in DataLab.

See also:

[Operations on Signals](#) for more information on operations that can be performed on signals, or [Processing Signals](#) for information on processing features on signals.

When the “Signal Panel” is selected, the menus and toolbars are updated to provide signal-related actions.

The “Analysis” menu allows you to perform various computations on the selected signals, such as statistics, full width at half-maximum, or full width at $1/e^2$.

Note: In DataLab vocabulary, an “analysis” is a feature that computes a scalar result from a signal. This result is stored as metadata, and thus attached to signal. This is different from a “processing” which creates a new signal from an existing one.

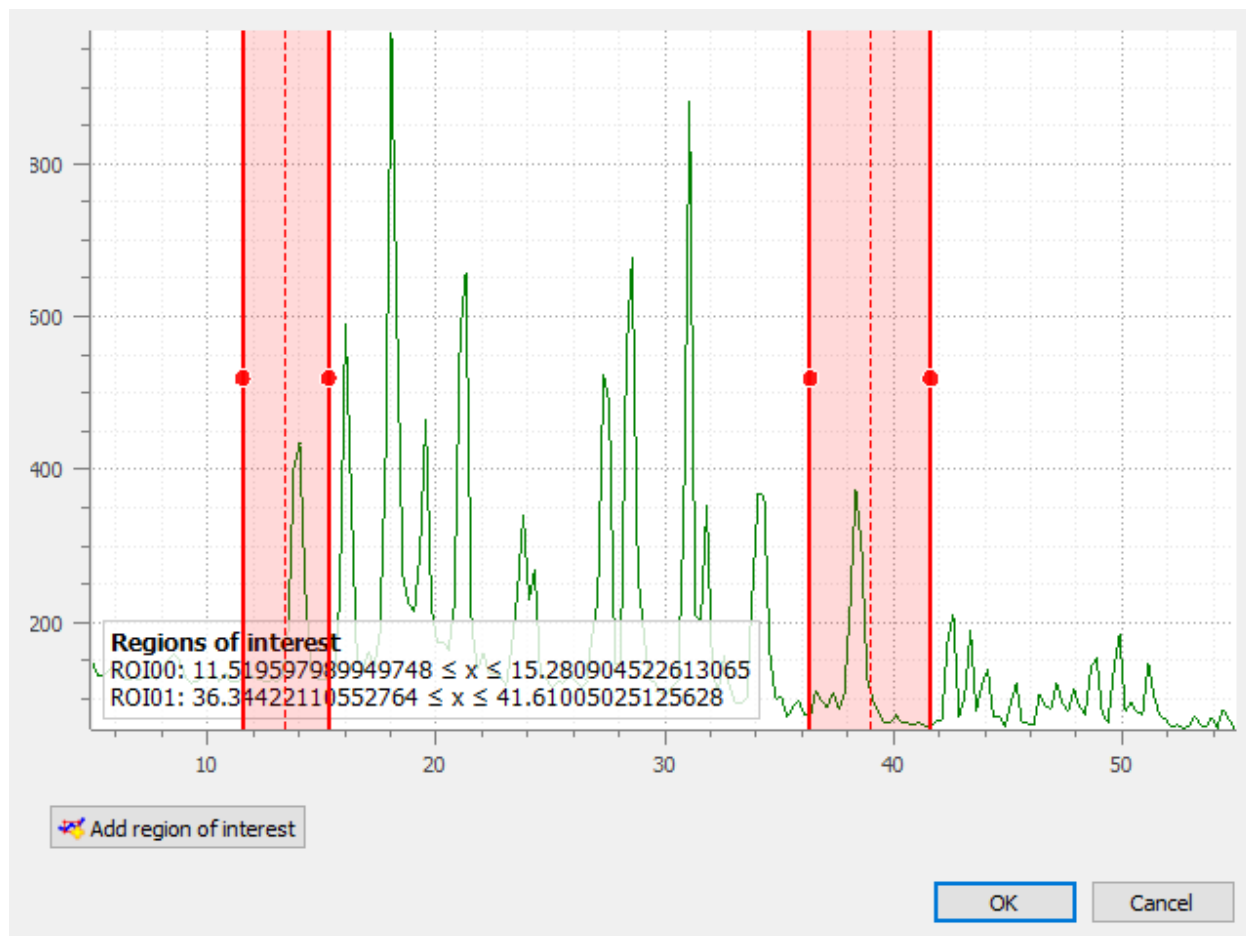


Fig. 19: ROI extraction dialog: the ROI is defined by moving the position and adjusting the width of an horizontal range.

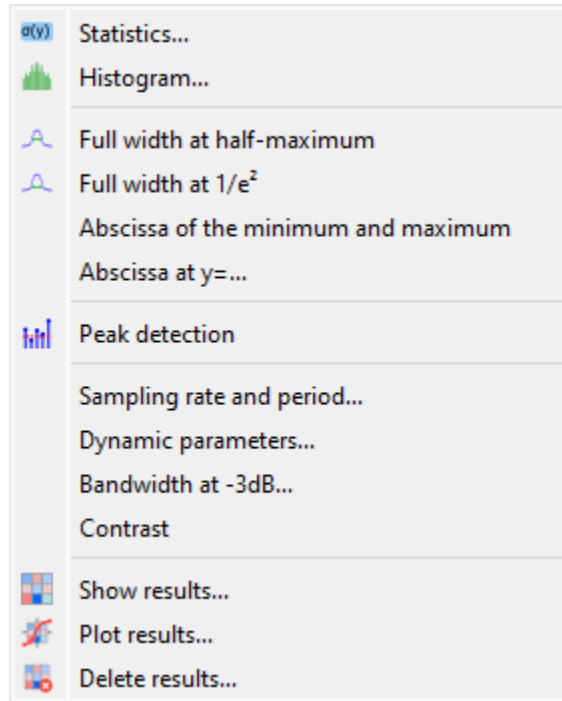


Fig. 20: Screenshot of the “Analysis” menu.

Statistics

Compute statistics on selected signal and show a summary table.

Histogram

Compute histogram of selected signal and show it.

Parameters are:

Parameter	Description
Bins	Number of bins
Lower limit	Lower limit of the histogram
Upper limit	Upper limit of the histogram

Full width at half-maximum

Compute the Full Width at Half-Maximum (FWHM) of selected signal, using one of the following methods:

Method	Description
Zero-crossing	Find the zero-crossings of the signal after having centered its amplitude around zero
Gauss	Fit data to a Gaussian model using least-square method
Lorentz	Fit data to a Lorentzian model using least-square method
Voigt	Fit data to a Voigt model using least-square method

	min(y)	max(y)	<y>	$\sigma(y)$	$\Sigma(y)$	$\int y dx$
s000	7.6946e-23	0.398862	0.0499	0.107641	24.95	1
s000 ROI00	1.1479e-22	0.398862	0.0501004	0.10781	12.475	0.492007

Format Resize ☒ Background color

Close

Fig. 21: Example of statistical summary table: each row is associated to an ROI (the first row gives the statistics for the whole data).

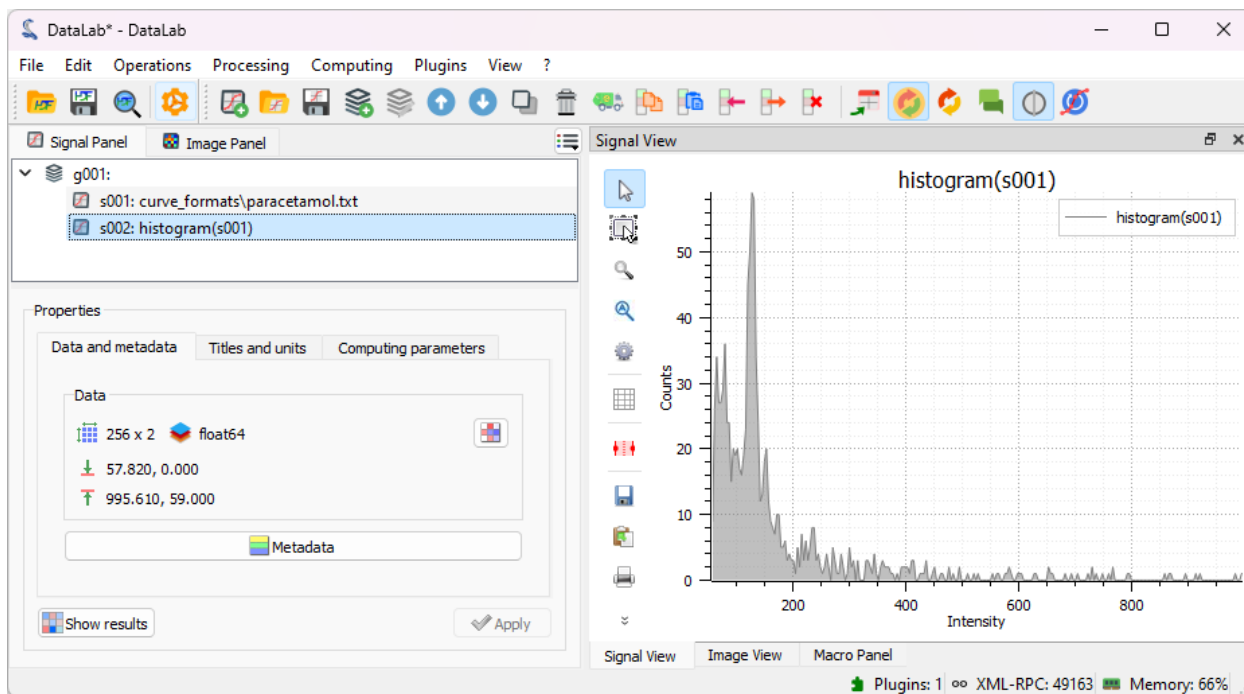


Fig. 22: Example of histogram.

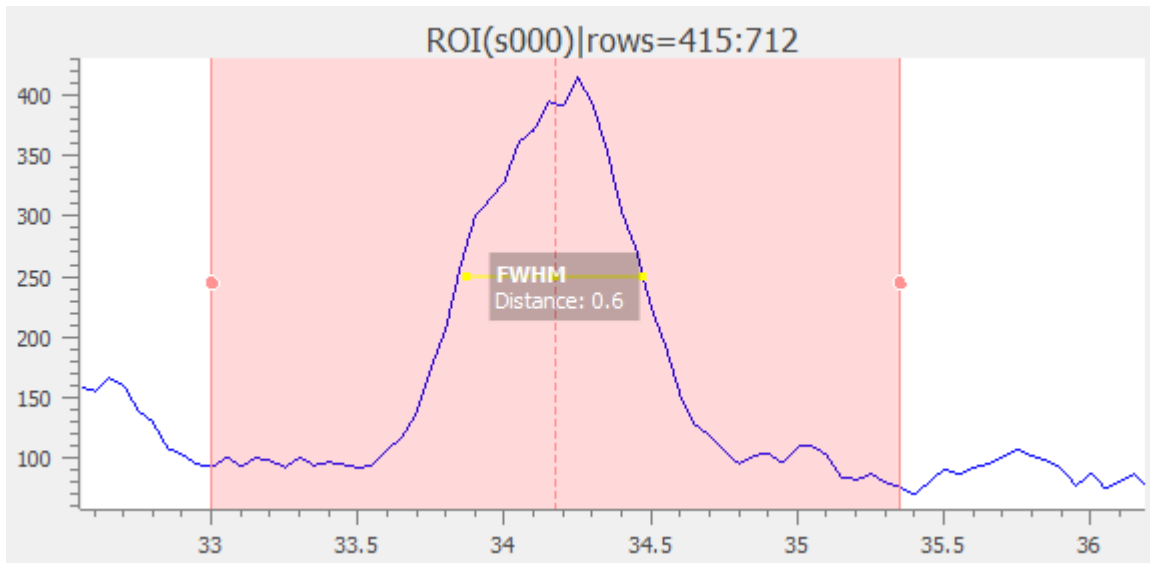


Fig. 23: The computed result is displayed as an annotated segment.

Full width at $1/e^2$

Fit data to a Gaussian model using least-square method. Then, compute the full width at $1/e^2$.

Note: Computed scalar results are systematically stored as metadata. Metadata is attached to signal and serialized with it when exporting current session in a HDF5 file.

Arguments of the min and max

Compute the smallest argument of the minima and the smallest argument of the maxima of the selected signal.

Abscissa at $y=...$

Compute the abscissa at a given ordinate value for the selected signal. If there is no solution, the displayed result is NaN. If there are multiple solutions, the displayed result is the smallest value.

Peak detection

Create a new signal from semi-automatic peak detection of each selected signal.

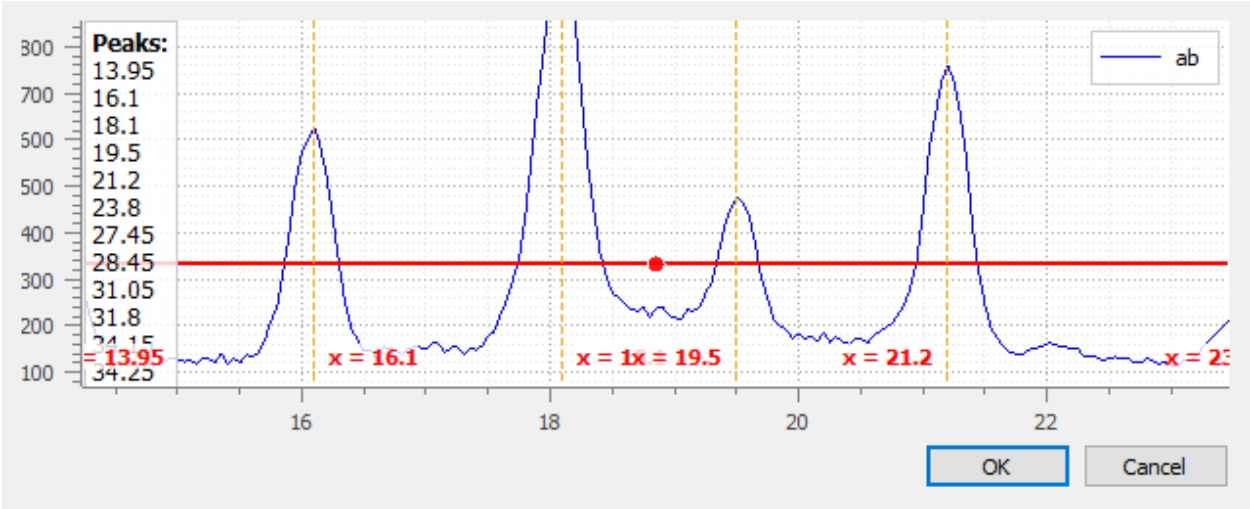


Fig. 24: Peak detection dialog: threshold is adjustable by moving the horizontal marker, peaks are detected automatically (see vertical markers with labels indicating peak position)

Sampling rate and period

Compute the sampling rate and period of selected signal.

Warning: This feature assumes that the X values are regularly spaced.

Dynamic parameters

Compute the following dynamic parameters on selected signal:

Parameter	Description
f	Frequency (sinusoidal fit)
ENOB	Effective Number Of Bits
SNR	Signal-to-Noise Ratio
SINAD	Signal-to-Noise And Distortion Ratio
THD	Total Harmonic Distortion
SFDR	Spurious-Free Dynamic Range

Bandwidth at -3 dB

Assuming the signal is a filter response, compute the bandwidth at -3 dB by finding the frequency range where the signal is above -3 dB.

Warning: This feature assumes that the signal is a filter response, already expressed in dB.

Contrast

Compute the contrast of selected signal.

The contrast is defined as the ratio of the difference and the sum of the maximum and minimum values:

$$\text{Contrast} = \frac{\max(y) - \min(y)}{\max(y) + \min(y)}$$

Note: This feature assumes that the signal is a profile from an image, where the contrast is meaningful. This justifies the optical definition of contrast.

Show results

Show the results of all analyses performed on the selected signals. This shows the same table as the one shown after having performed a computation.

Plot results

Plot the results of analyses performed on the selected signals, with user-defined X and Y axes (e.g. plot the FWHM as a function of the signal index).

2.3.6 View options for Signals

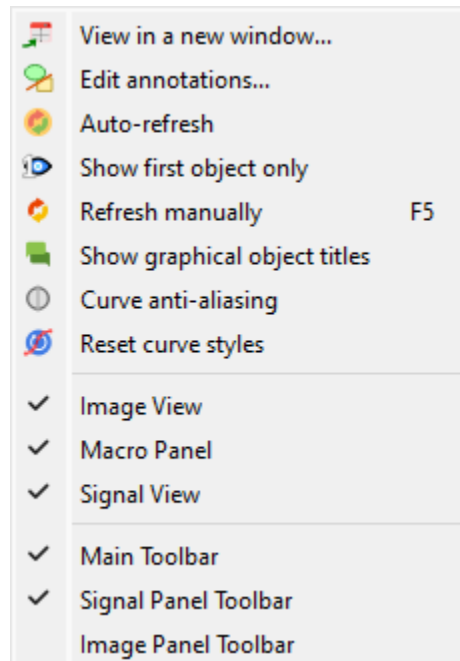


Fig. 25: Screenshot of the “View” menu.

When the “Signal Panel” is selected, the menus and toolbars are updated to provide signal-related actions.

The “View” menu allows you to visualize the current signal or group of signals. It also allows you to show/hide titles, to enable/disable anti-aliasing, or to refresh the visualization.

View in a new window

Open a new window to visualize the selected signals.

This option allows you to visualize the selected signals in a separate window, in which you can visualize the data more comfortably (e.g., by maximizing the window) and you can also annotate the data.

When you click on the button “Annotations” in the toolbar of the new window, the annotation editing mode is activated (see the section “Edit annotations” below).

Edit annotations

Open a new window to edit annotations.

This option allows you to show the selected signals in a separate window, in which you can visualize the data more comfortably (e.g., by maximizing the window) as well as to add or edit annotations.

Annotations are used to add comments or labels to the data, and they can be used to highlight specific events or regions of interest.

Note: The annotations are saved in the metadata of the signal, so they are persistent and will be displayed every time you visualize the signal.

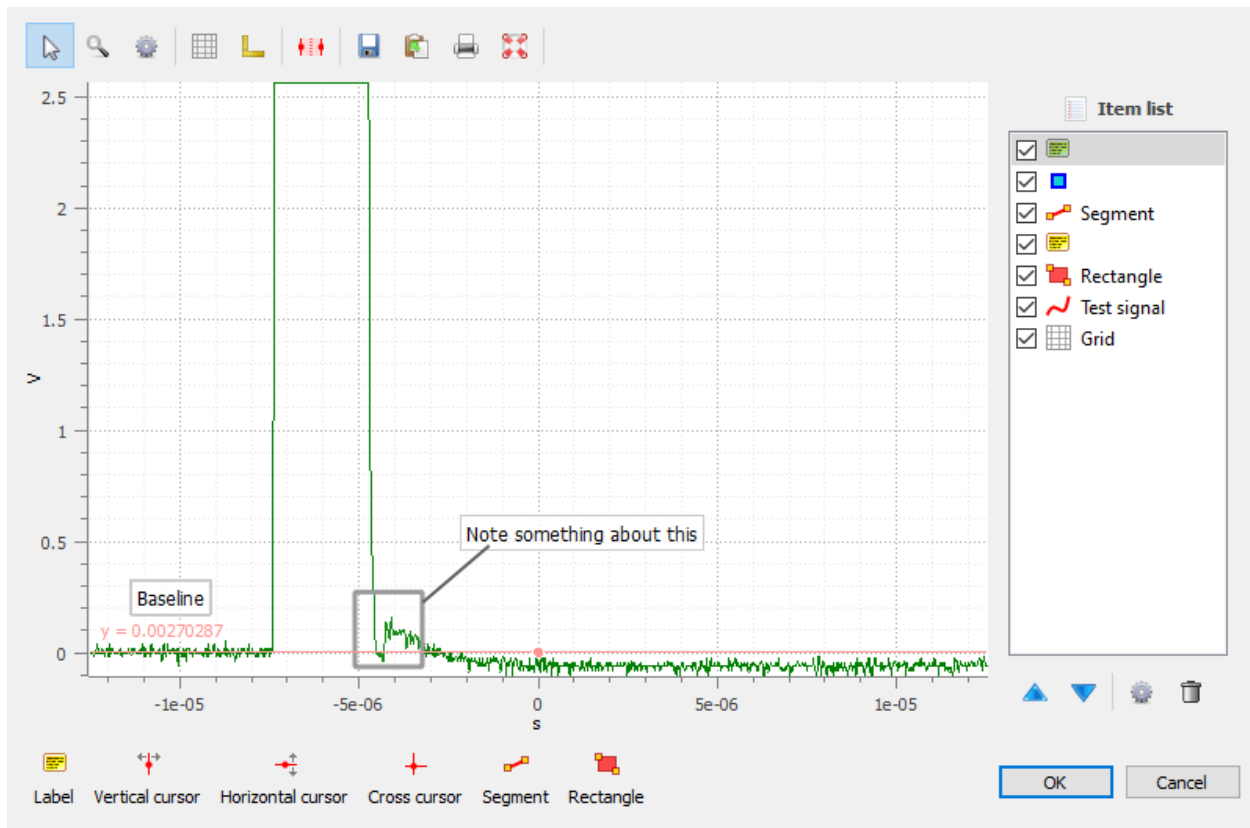


Fig. 26: Annotations may be added in the separate view.

The typical workflow to edit annotations is as follows:

1. Select the “Edit annotations” option.
2. In the new window, add annotations by clicking on the corresponding buttons at the bottom of the window.
3. Eventually, customize the annotations by changing their properties (e.g., the text, the color, the position, etc.) using the “Parameters” option in the context menu of the annotations.
4. When you are done, click on the “OK” button to save the annotations. This will close the window and the annotations will be saved in the metadata of the signal and will be displayed in the main window.

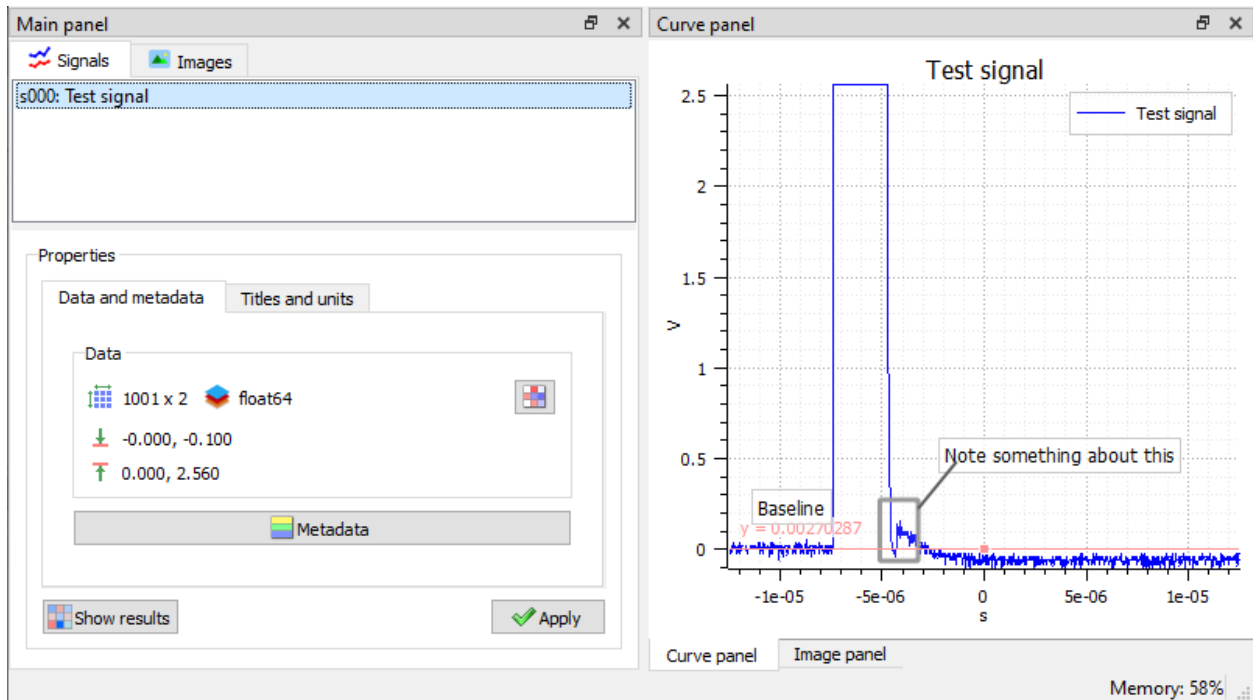


Fig. 27: Annotations are now part of the signal metadata.

Note: Annotations may be copied from a signal to another by using the “copy/paste metadata” features.

Auto-refresh

Automatically refresh the visualization when the data changes:

- When enabled (default), the plot view is automatically refreshed when the data changes.
- When disabled, the plot view is not refreshed until you manually refresh it by using the “Refresh manually” menu entry.

Even though the refresh algorithm is optimized, it may still take some time to refresh the plot view when the data changes, especially when the data set is large. Therefore, you may want to disable the auto-refresh feature when you are working with large data sets, and enable it again when you are done. This will avoid unnecessary refreshes.

Refresh manually

Refresh the visualization manually.

This triggers a refresh of the plot view. It is useful when the auto-refresh feature is disabled, or when you want to force a refresh of the plot view.

Show graphical object titles

Show/hide titles of analysis results or annotations.

This option allows you to show or hide the titles of the graphical objects (e.g., the titles of the analysis results or annotations). Hiding the titles can be useful when you want to visualize the data without any distractions, or if there are too many titles and they are overlapping.

Curve anti-aliasing

Enable/disable anti-aliasing of curves.

Anti-aliasing makes the curves look smoother, but it may also make them look less sharp.

Note: Anti-aliasing is enabled by default.

Warning: Anti-aliasing may slow down the visualization, especially when working with large data sets.

Reset curve styles

Reset the curve style cycle to the beginning.

When plotting curves, DataLab automatically assigns a color and a line style to each curve. Both parameters are chosen from a predefined list of colors and line styles, and are assigned in a round-robin fashion.

This menu entry allows you to reset the curve styles, so that the next time you plot curves, the first curve will be assigned the first color and the first line style of the predefined lists, and the loop will start again from there.

2.4 Image processing

This section describes the features specific to the image processing panel. The image processing panel can be selected by clicking on the “Images” tab at the bottom-right of the DataLab main window.

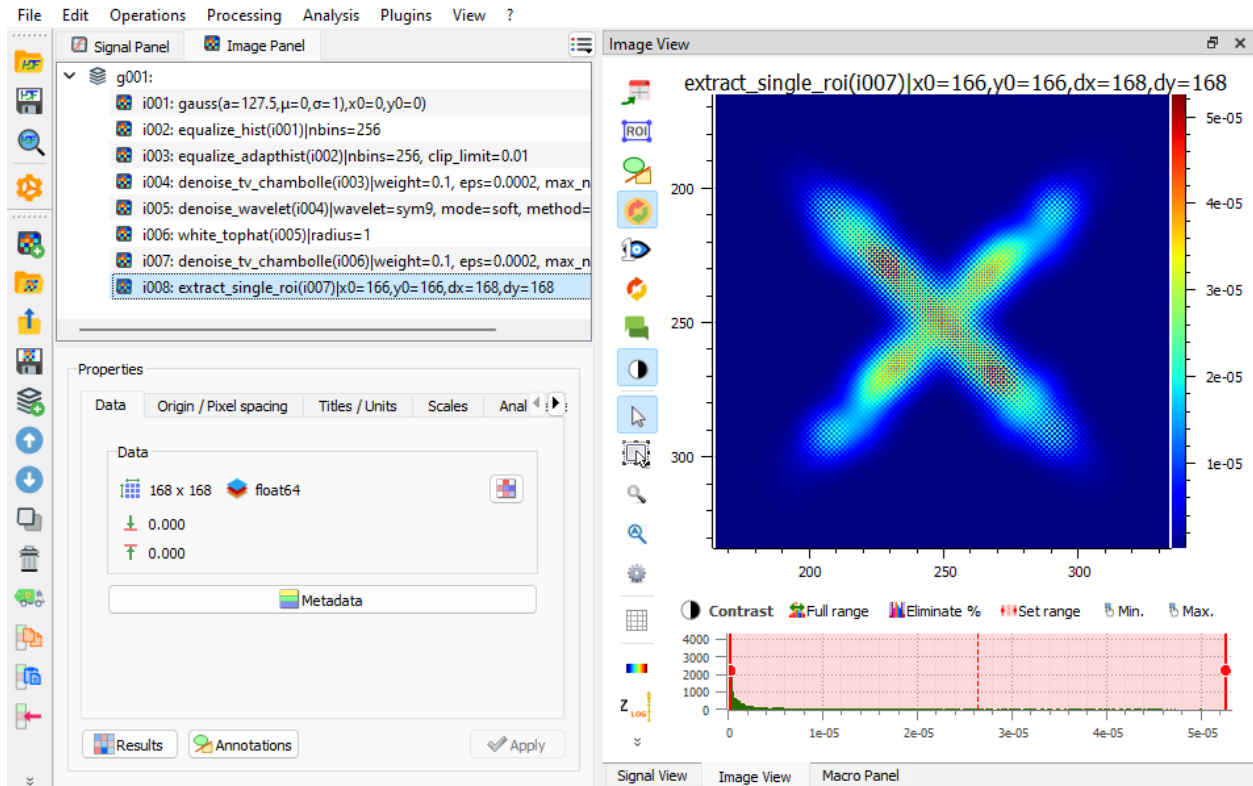


Fig. 28: DataLab main window: Image processing view

2.4.1 Create, open and save Images

This section describes how to create, open and save images (and workspaces).

When the “Image Panel” is selected, the menus and toolbars are updated to provide image-related actions.

The “File” menu allows you to:

- Create, open, save and close images (see below).
- Save and restore the current workspace or browse HDF5 files (see [Workspace](#)).
- Edit DataLab preferences (see [Settings](#)).

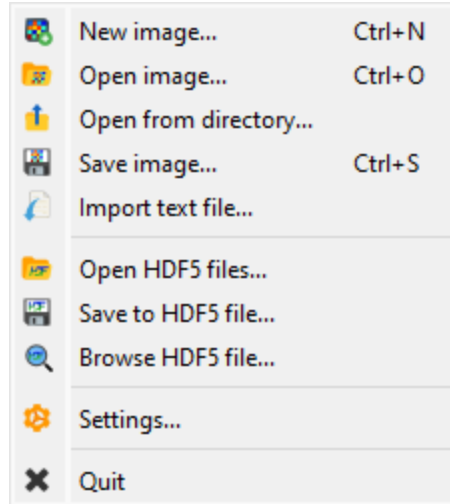


Fig. 29: Screenshot of the “File” menu.

New image

Create a new image from various models (supported datatypes: uint8, uint16, int16, float32, float64):

Model	Equation
Zeros	$z[i] = 0$
Empty	Data is directly taken from memory as it is
Random	$z[i] \in [0, z_{max})$ where z_{max} is the datatype maximum value
2D Gaussian	$z = A.exp(-\frac{(\sqrt{(x-x_0)^2 + (y-y_0)^2} - \mu)^2}{2\sigma^2})$

Open image

Create a new image from the following supported filetypes:

File type	Extensions
PNG files	.png
TIFF files	.tif, .tiff
8-bit images	.jpg, .gif
NumPy arrays	.npy
MAT-Files	.mat
Text files	.txt, .csv, .asc
Andor SIF files	.sif
Princeton Instruments SPE files	.spe
Opticks GEL files	.gel
Hamamatsu NDPI files	.ndpi
PCO Camera REC files	.rec
SPIRICON files	.scor-data
FXD files	.fxd
Bitmap images	.bmp

Note: DataLab also supports any image format that can be read by the *imageio* library, provided that the associated plugin(s) are installed (see [imageio documentation](#)) and that the output NumPy array data type and shape are supported by DataLab.

To add a new file format, you may use the *imageio_formats* entry of DataLab configuration file. This entry is a formatted like the *IMAGEIO_FORMATS* object which represents the natively supported formats:

```
cdl.config.IMAGEIO_FORMATS = (('*.gel', 'Opticks GEL'), ('*.spe', 'Princeton Instruments SPE'), ('*.ndpi', 'Hamamatsu Slide Scanner NDPI'), ('*.rec', 'PCO Camera REC'))
```

Save image

Save current image (see “Open image” supported filetypes).

Import text file

DataLab can natively import many types of image files (e.g. TIFF, JPEG, PNG, etc.). However some specific text file formats may not be supported. In this case, you can use the *Import text file* feature, which allows you to import a text file and convert it to an image.

This feature is accessible from the *File* menu, under the *Import text file* option.

It opens an import wizard that guides you through the process of importing the text file.

Step 1: Select the source

The first step is to select the source of the text file. You can either select a file from your computer or the clipboard if you have copied the text from another application.

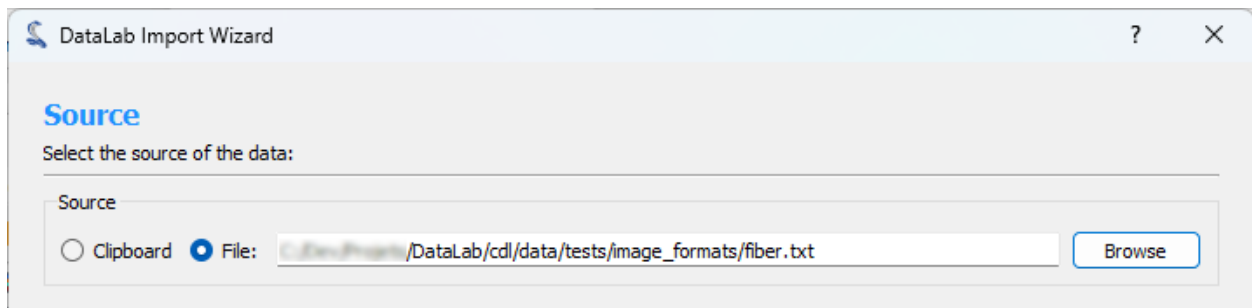


Fig. 30: Step 1: Select the source

Step 2: Preview and configure the import

The second step consists of configuring the import and previewing the result. You can configure the following options:

- **Delimiter:** The character used to separate the values in the text file.
- **Comments:** The character used to indicate that the line is a comment and should be ignored.
- **Rows to Skip:** The number of rows to skip at the beginning of the file.
- **Maximum Number of Rows:** The maximum number of rows to import. If the file contains more rows, they will be ignored.
- **Transpose:** If checked, the rows and columns will be transposed.
- **Data type:** The destination data type of the imported data.

When you are done configuring the import, click the *Apply* button to see the result.

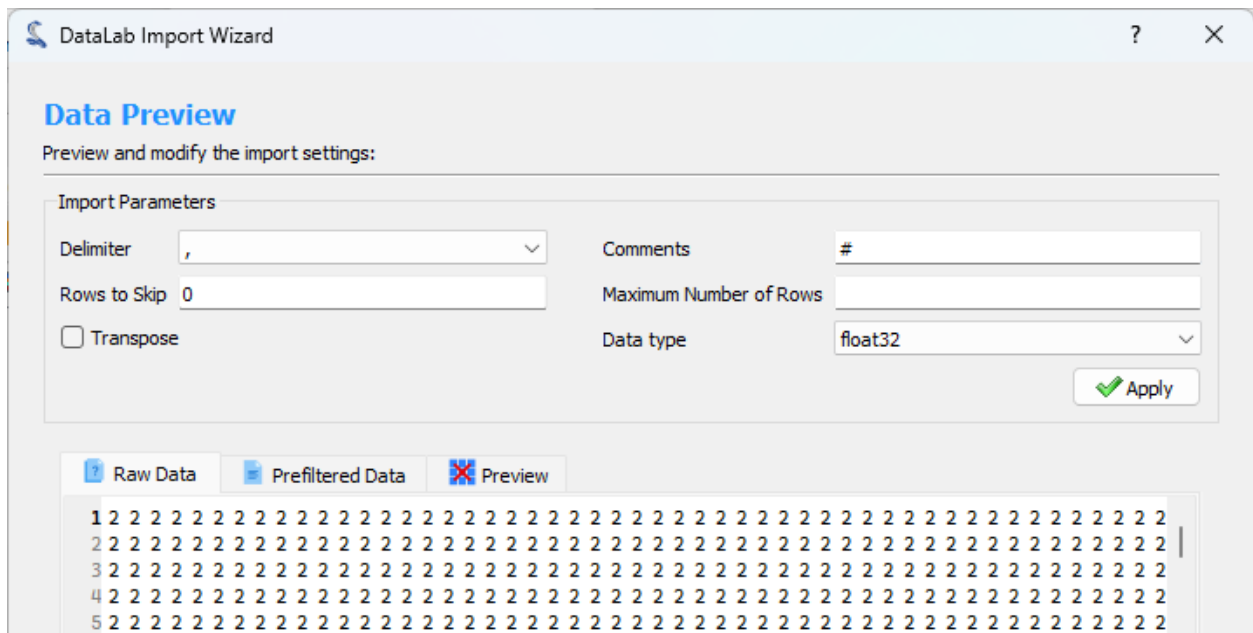


Fig. 31: Step 2: Configure the import

Step 3: Show graphical representation

The third step shows a graphical representation of the imported data. You can use the *Finish* button to import the data into DataLab workspace.

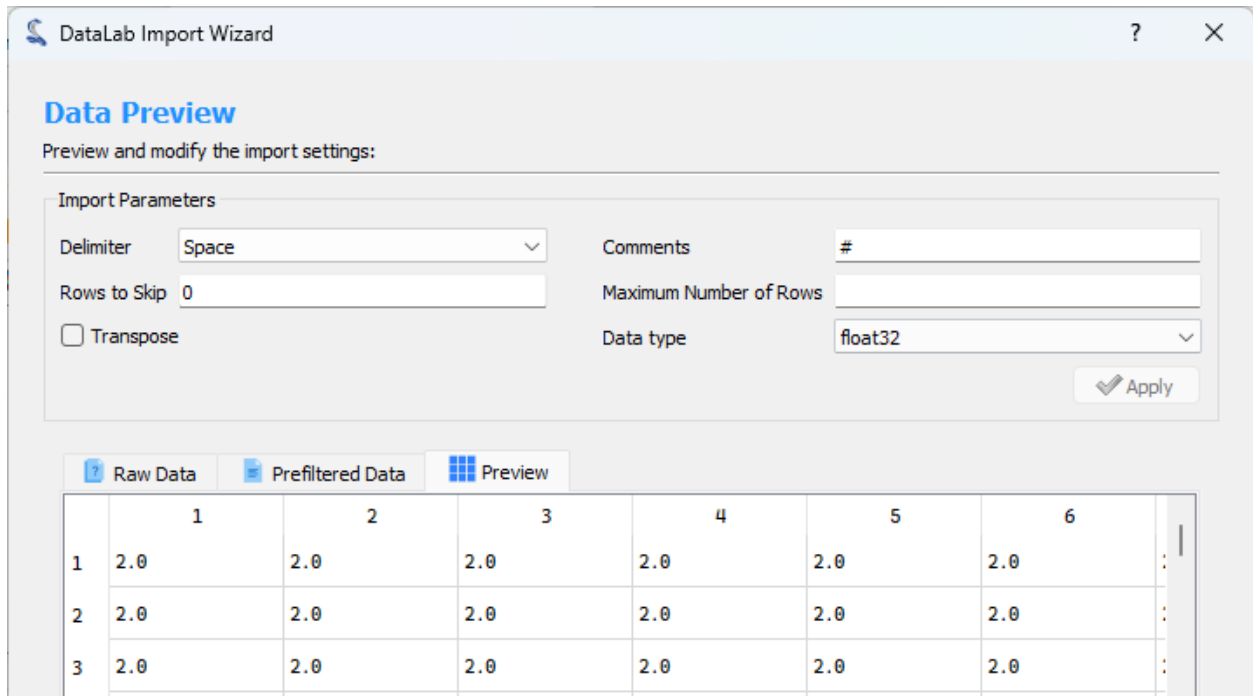


Fig. 32: Step 2: Preview the result

2.4.2 Manipulate metadata

This section describes how to manipulate metadata in DataLab.

The “Edit” menu allows you to perform classic editing operations on the current image or group of images (create/rename group, move up/down, delete image/group of images, etc.).

It also allows you to manipulate metadata associated with the current image.

Copy/paste metadata

As metadata contains useful information about the image, it can be copied and pasted from one image to another by selecting the “Copy metadata” and “Paste metadata” actions in the “Edit” menu.

This feature allows you to transfer those information from one image to another:

- *Regions Of Interest (ROIs)*: that is a very efficient way to reuse the same ROI on different images and easily compare the results of the analysis on those images
- Analyze results, such as a centroid position or a contour detection (the relevance of transferring such information depends on the context and is up to the user to decide)
- Any other information that you may have added to the metadata of an image

Note: Copying metadata from an image to another will overwrite the metadata of the destination image (for the metadata keys that are common to both images) or simply add the metadata keys that are not present in the destination image.

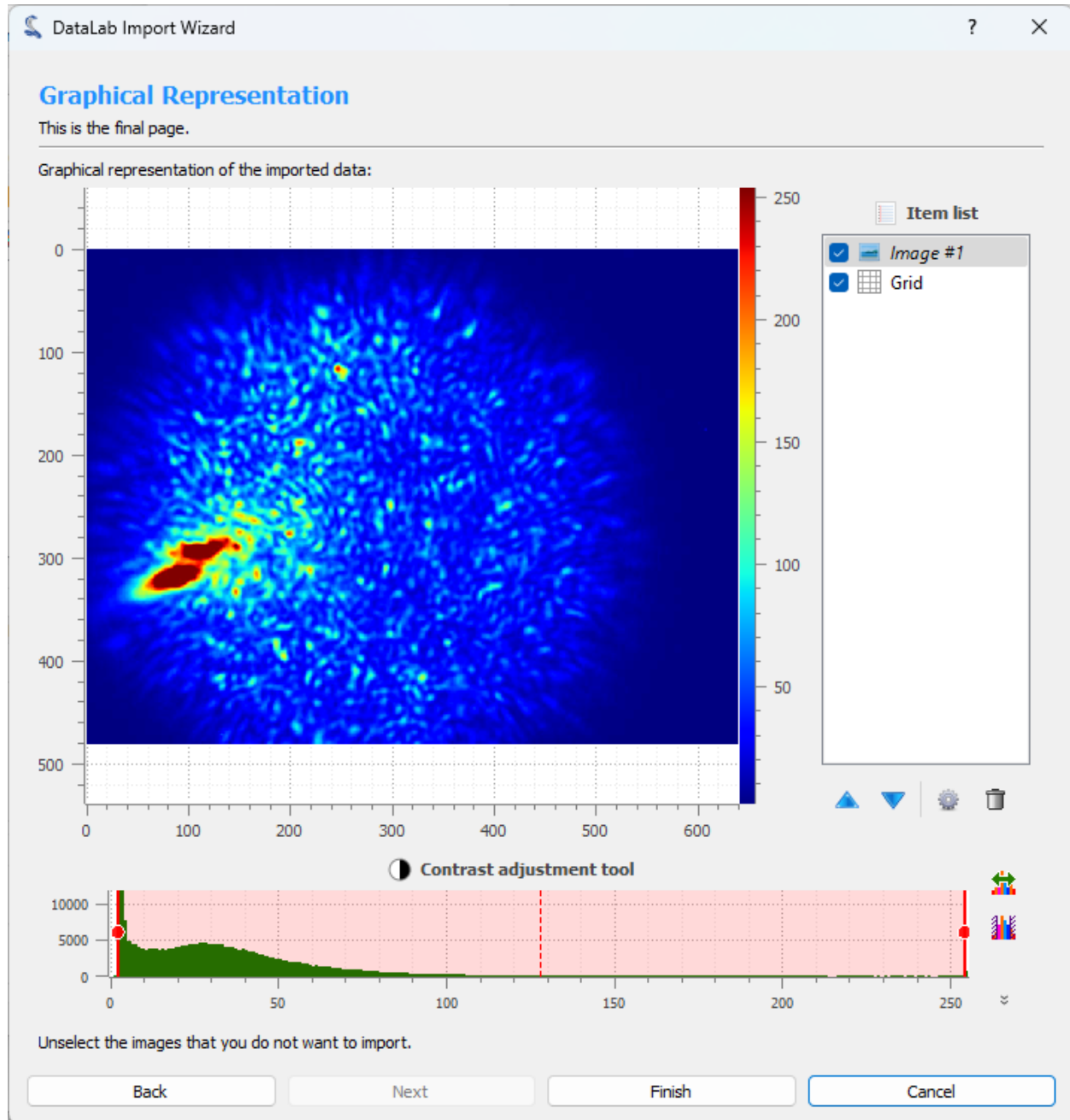


Fig. 33: Step 3: Show graphical representation

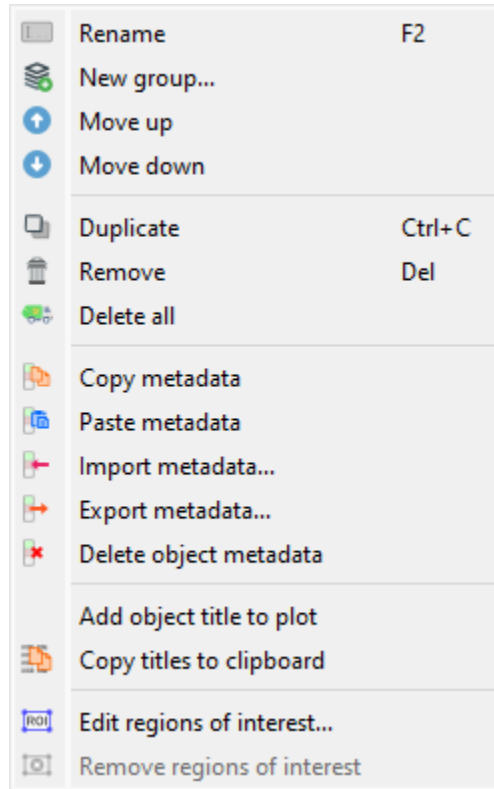


Fig. 34: Screenshot of the “Edit” menu.

Import/export metadata

Metadata can also be imported and exported from/to a JSON file using the “Import metadata” and “Export metadata” actions in the “Edit” menu. This is exactly the same as the copy/paste metadata feature (see above for more details on the use cases of this feature), but it allows you to save the metadata to a file and then import it back later.

Delete metadata

When deleting metadata using the “Delete metadata” action in the “Edit” menu, you will be prompted to confirm the deletion of Region of Interests (ROIs) if they are present in the metadata. After this eventual confirmation, the metadata will be deleted, meaning that analysis results, ROIs, and any other information associated with the image will be lost.

Image titles

Image titles may be considered as metadata from a user point of view, even if they are not stored in the metadata of the image (but in an attribute of the image object).

The “Edit” menu allows you to:

- “Add object title to plot”: this action will add a label on top of the image with its title, which might be useful in combination with the “Distribute on a grid” operation (see [Operations on Images](#)) to easily identify the images.
- “Copy titles to clipboard”: this action will copy the titles of the selected images to the clipboard, which might be useful to paste them in a text editor or in a spreadsheet.

Example of the content of the clipboard:

```
g001:
  s001: lorentz(a=1,sigma=1,mu=0,ymin=0)
  s002: derivative(s001)
  s003: wiener(s002)
g002: derivative(g001)
  s004: derivative(s001)
  s005: derivative(s002)
  s006: derivative(s003)
g003: fft(g002)
  s007: fft(s004)
  s008: fft(s005)
  s009: fft(s006)
```

Regions Of Interest (ROI)

The Regions Of Interest (ROI) are image areas that are defined by the user to perform specific operations, processing, or analysis on them.

ROI are taken into account almost in all computing features in DataLab:

- The “Operations” menu features are done only on the ROI if one is defined (except if the operation changes the data shape - like the resize operation - or the pixel size - like the binning operation).
- The “Processing” menu actions are performed only on the ROI if one is defined (except if the destination signal data type is different from the source’s, like in the Fourier analysis features or like the thresholding operations).
- The “Analysis” menu actions are done only on the ROI if one is defined.

Note: ROI are stored as metadata, and thus attached to image.

The “Edit” menu allows you to:

- “Edit regions of interest” : open a dialog box to manage ROI associated with the selected image (add, remove, move, resize, etc.). The ROI definition dialog is exactly the same as ROI extraction (see below).
- “Remove regions of interest” : remove all defined ROI for the selected images.

2.4.3 Operations on Images

This section describes the operations that can be performed on images.

See also:

[Processing Images](#) for more information on image processing features, or [Analysis features on Images](#) for information on analysis features on images.

When the “Image Panel” is selected, the menus and toolbars are updated to provide image-related actions.

The “Operations” menu allows you to perform various operations on the current image or group of images. It also allows you to extract profiles, distribute images on a grid, or resize images.

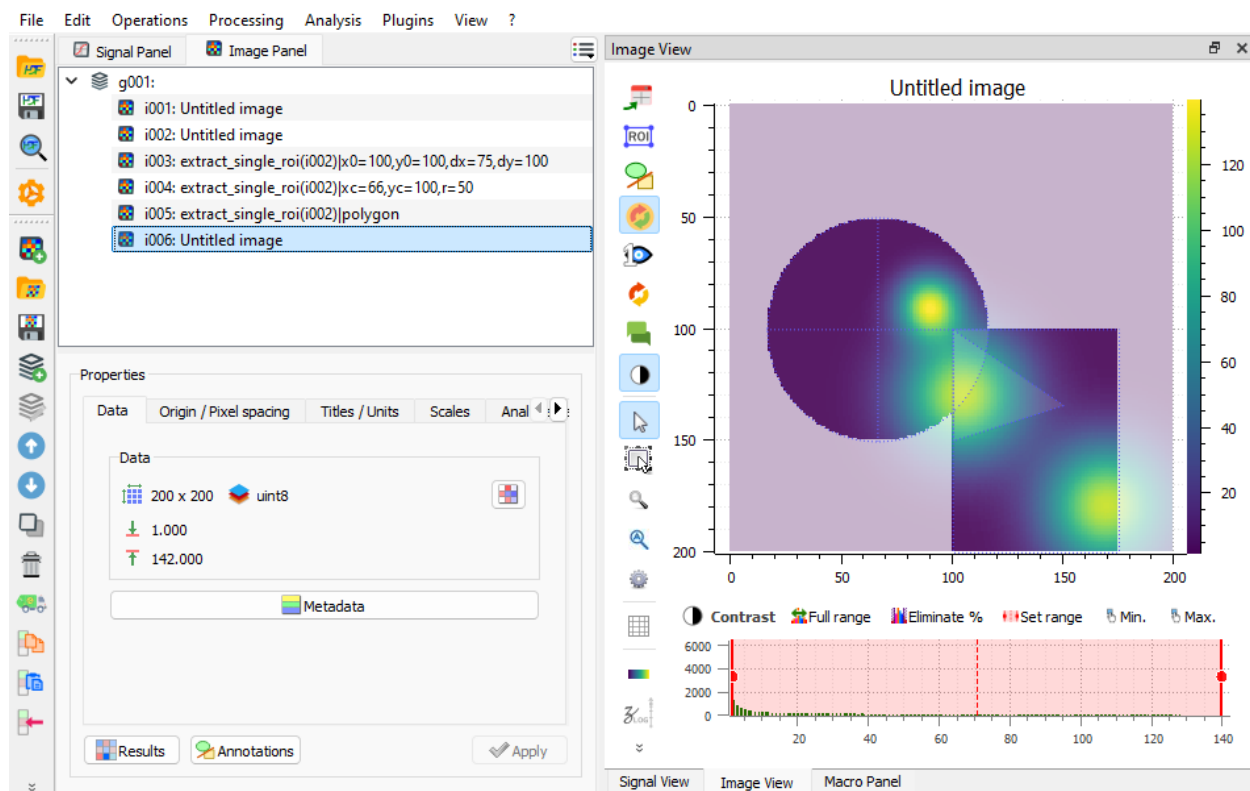


Fig. 35: An image with an ROI.

Basic arithmetic operations

Operation	Description
Sum	$z_M = \sum_{k=0}^{M-1} z_k$
Average	$z_M = \frac{1}{M} \sum_{k=0}^{M-1} z_k$
Difference	$z_2 = z_1 - z_0$
Quadratic difference	$z_2 = \frac{z_1 - z_0}{\sqrt{2}}$
Product	$z_M = \prod_{k=0}^{M-1} z_k$
Division	$z_2 = \frac{z_1}{z_0}$
Inverse	$z_2 = \frac{1}{z_1}$

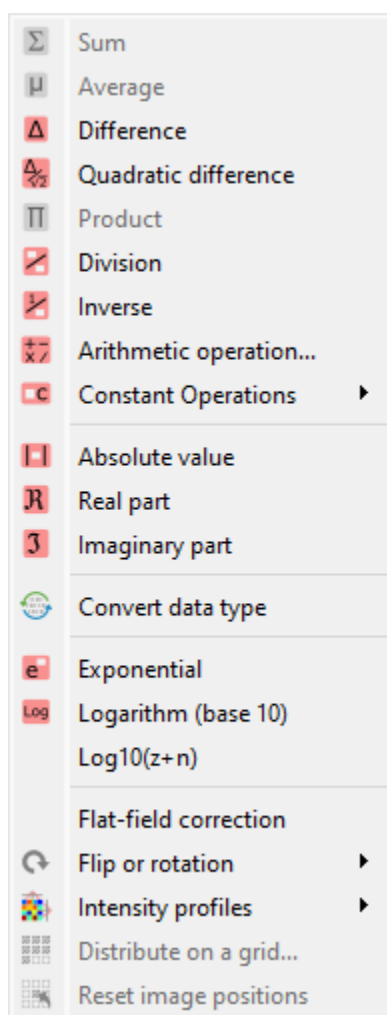


Fig. 36: Screenshot of the “Operations” menu.

Operations with a constant

Create a new image which is the result of a constant operation on each selected image:

Operation	Equation
Addition	$z_k = z_{k-1} + \text{conv}(c)$
Subtraction	$z_k = z_{k-1} - \text{conv}(c)$
Multiplication	$z_k = \text{conv}(z_{k-1} \times c)$
Division	$z_k = \text{conv}\left(\frac{z_{k-1}}{c}\right)$

where c is the constant value and conv is the conversion function which handles data type conversion (keeping the same data type as the input image).

Real and imaginary parts

Operation	Description
Absolute value	$z_k = z_{k-1} $
Real part	$z_k = \Re(z_{k-1})$
Imaginary part	$z_k = \Im(z_{k-1})$

Data type conversion

The “Convert data type” action allows you to convert the data type of the selected images. For integer data types, the conversion is done by clipping the values to the new data type range before effectively converting the data type. For floating point data types, the conversion is straightforward.

Note: Data type conversion uses the `cdl.algorithms.datatypes.clip_astype()` function which relies on `numpy.ndarray.astype()` function with the default parameters (`casting='unsafe'`).

Basic mathematical functions

Function	Description
Exponential	$z_k = \exp(z_{k-1})$
Logarithm (base 10)	$z_k = \log_{10}(z_{k-1})$
Log10(z+n)	$z_k = \log_{10}(z_{k-1} + n)$ (avoid $\log_{10}(0)$ on image background)

Other operations

Flat-field correction

Create a new image which is flat-field correction of the **two** selected images:

$$z_1 = \begin{cases} \frac{z_0}{z_f} \cdot \overline{z_f} & \text{if } z_0 > z_{threshold} \\ z_0 & \text{otherwise} \end{cases}$$

where z_0 is the raw image, z_f is the flat field image, $z_{threshold}$ is an adjustable threshold and $\overline{z_f}$ is the flat field image average value:

$$\overline{z_f} = \frac{1}{N_{row} \cdot N_{col}} \cdot \sum_{i=0}^{N_{row}} \sum_{j=0}^{N_{col}} z_f(i, j)$$

Note: Raw image and flat field image are supposedly already corrected by performing a dark frame subtraction.

Flip or rotation

Create a new image by flipping or rotating the data of the selected image. The image may be flipped horizontally, vertically, or diagonally (transposition). It may be rotated by 90°, 270° or any user-defined value.

Intensity profiles

Line profile

Extract an horizontal or vertical profile from each selected image, and create new signals from these profiles.

Segment profile

Extract a segment profile from each selected image, and create new signals from these profiles.

Average profile

Extract an horizontal or vertical profile averaged over a rectangular area, from each selected image, and create new signals from these profiles.

Radial profile extraction

Extract a radial profile from each selected image, and create new signals from these profiles.

The following parameters are available:

Parameter	Description
Center	Center around which the radial profile is computed: centroid, image center, or user-defined
X	X coordinate of the center (if user-defined), in pixels
Y	Y coordinate of the center (if user-defined), in pixels

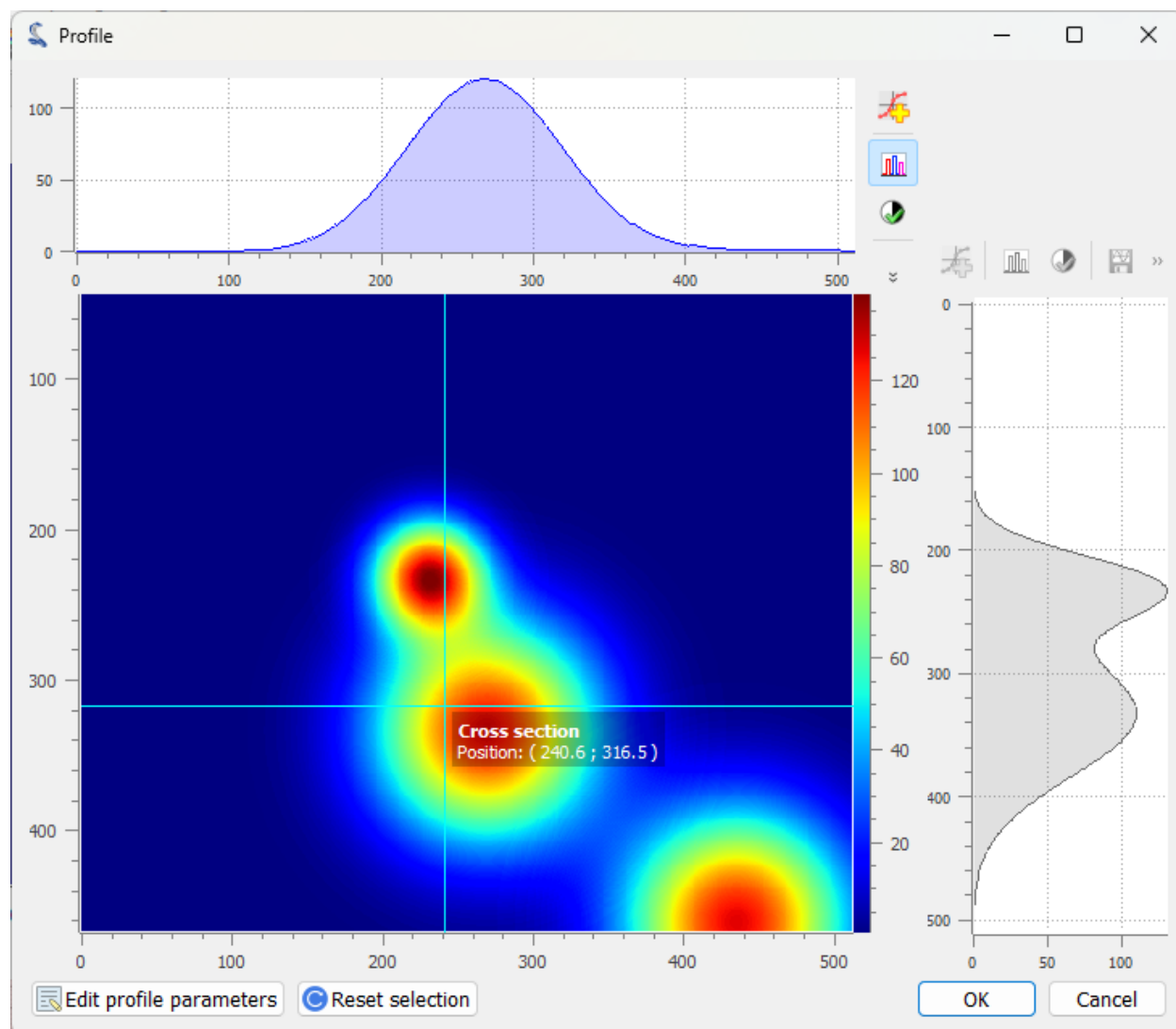


Fig. 37: Line profile dialog. Parameters may also be set manually (“Edit profile parameters” button).

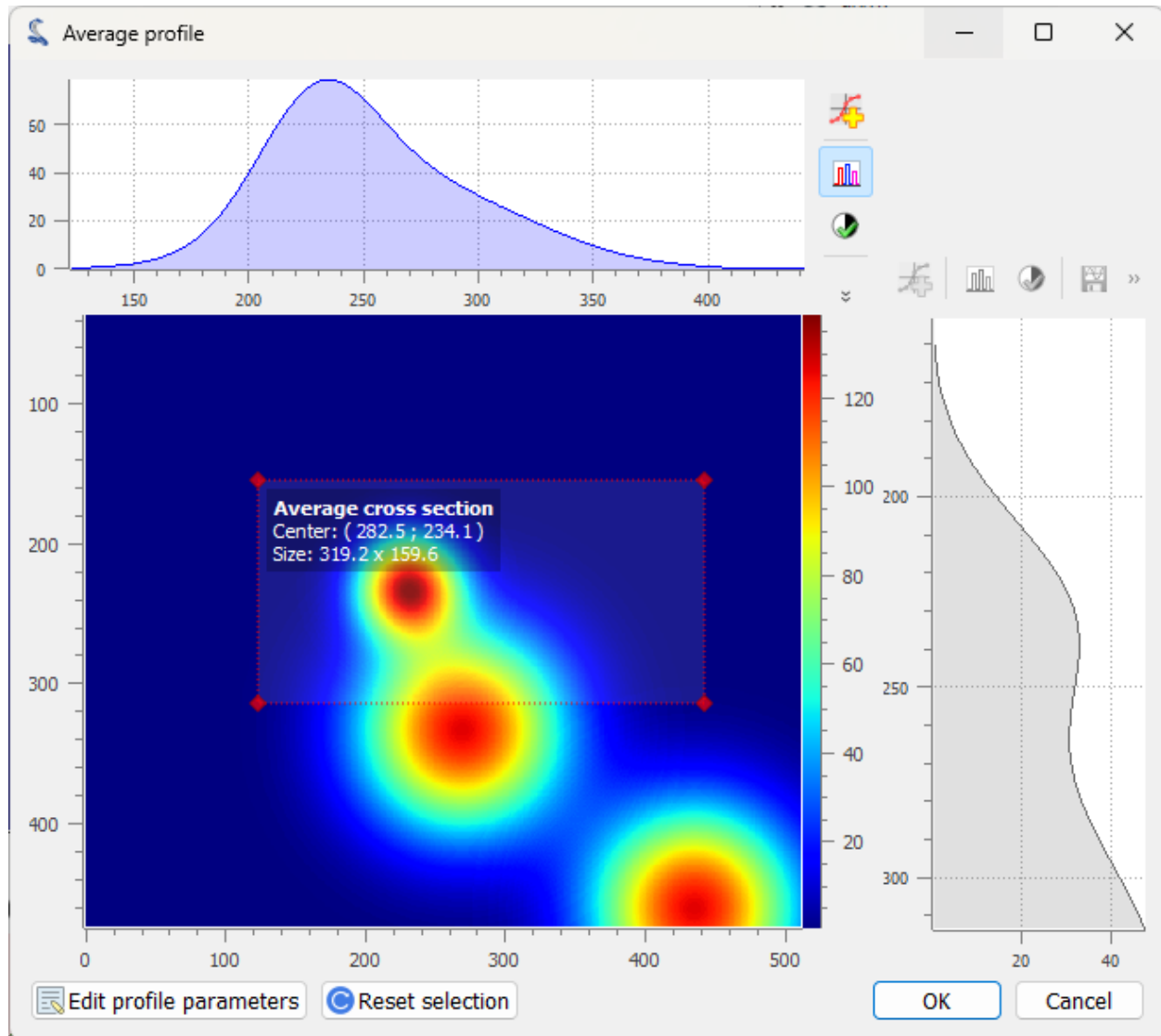


Fig. 38: Average profile dialog: the area is defined by a rectangle shape. Parameters may also be set manually (“Edit profile parameters” button).

Distribute images along a grid

Feature	Description
Distribute on a grid	Distribute selected images on a regular grid
Reset image positions	Reset the positions of the selected images to first image (x0, y0) co-ordinates

2.4.4 Processing Images

This section describes the image processing features available in DataLab.

See also:

[Operations on Images](#) for more information on operations that can be performed on images, or [Analysis features on Images](#) for information on analysis features on images.

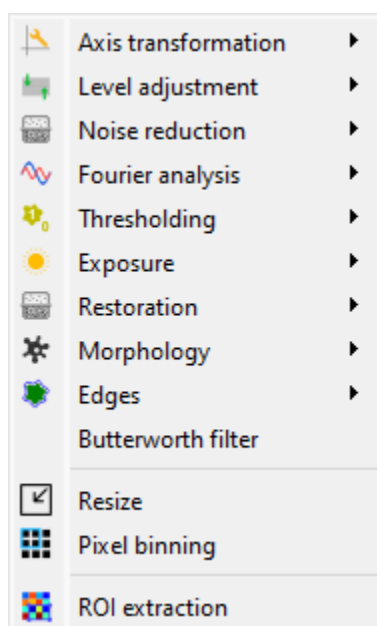


Fig. 39: Screenshot of the “Processing” menu.

When the “Image Panel” is selected, the menus and toolbars are updated to provide image-related actions.

The “Processing” menu allows you to perform various processing on the current image or group of images: it allows you to apply filters, to perform exposure correction, to perform denoising, to perform morphological operations, and so on.

Axis transformation

Linear calibration

Create a new image which is a linear calibration of each selected image with respect to Z axis:

Parameter	Linear calibration
Z-axis	$z_1 = a.z_0 + b$

Swap X/Y axes

Create a new image which is the result of swapping X/Y data.

Level adjustment

Normalize

Create a new image which is the normalized version of each selected image by maximum, amplitude, sum, energy or RMS:

Normalization	Equation
Maximum	$z_1 = \frac{z_0}{z_{max}}$
Amplitude	$z_1 = \frac{z_0}{z_{max} - z_{min}}$
Area	$z_1 = \frac{z_0}{\sum_{i=0}^{N-1} z_i}$
Energy	$z_1 = \frac{z_0}{\sqrt{\sum_{n=0}^N z_0[n] ^2}}$
RMS	$z_1 = \frac{z_0}{\sqrt{\frac{1}{N} \sum_{n=0}^N z_0[n] ^2}}$

Clipping

Apply the clipping to each selected image.

Offset correction

Create a new image which is the result of offset correction on each selected image. This operation is performed by subtracting the image background value which is estimated by the mean value of a user-defined rectangular area.

Noise reduction

Create a new image which is the result of noise reduction on each selected image.

The following filters are available:

Filter	Formula/implementation
Gaussian filter	<code>scipy.ndimage.gaussian_filter</code>
Moving average	<code>scipy.ndimage.uniform_filter</code>
Moving median	<code>scipy.ndimage.median_filter</code>
Wiener filter	<code>scipy.signal.wiener</code>

Fourier analysis

Create a new image which is the result of a Fourier analysis on each selected image.

The following functions are available:

Function	Description	Formula/implementation
FFT	Fast Fourier Transform	<code>numpy.fft.fft2</code>
Inverse FFT	Inverse Fast Fourier Transform	<code>numpy.fft.ifft2</code>
Magnitude spectrum	Optionnal: use logarithmic scale (dB)	$z_1 = FFT(z_0) $ or $z_1 = 20 \log_{10}(FFT(z_0))$ (dB)
Phase spectrum		$z_1 = \angle(FFT(z_0))$
Power spectral density	Optionnal: use logarithmic scale (dB)	$z_1 = FFT(z_0) ^2$ or $z_1 = 10 \log_{10}(FFT(z_0) ^2)$ (dB)

Note: FFT and inverse FFT are performed using frequency shifting if the option is enabled in DataLab settings (see [Settings](#)).

Thresholding

Create a new image which is the result of thresholding on each selected image, eventually based on user-defined parameters (“Parametric thresholding”).

The following parameters are available when selecting “Parametric thresholding”:

Parameter	Description
Threshold method	The thresholding method to use (see table below)
Bins	Number of bins for histogram calculation
Value	Threshold value
Operation	Operation to apply (> or <)

The following thresholding methods are available:

Method	Implementation
Manual	Manual thresholding (user-defined parameters)
ISODATA	<code>skimage.filters.threshold_isodata</code>
Li	<code>skimage.filters.threshold_li</code>
Mean	<code>skimage.filters.threshold_mean</code>
Minimum	<code>skimage.filters.threshold_minimum</code>
Otsu	<code>skimage.filters.threshold_otsu</code>
Triangle	<code>skimage.filters.threshold_triangle</code>
Yen	<code>skimage.filters.threshold_yen</code>

Note: The “All thresholding methods” option allows to perform all thresholding methods on the same image. Combined with the “distribute on a grid” option, this allows to compare the different thresholding methods on the same image.

Exposure

Create a new image which is the result of exposure correction on each selected image.

The following functions are available:

Function	Implementation	Comments
Gamma correction	<code>skimage.exposure.adjust_gamma</code>	
Logarithmic correction	<code>skimage.exposure.adjust_log</code>	
Sigmoid correction	<code>skimage.exposure.adjust_sigmoi</code>	
Histogram equalization	<code>skimage.exposure.equalize_hist</code>	
Adaptive histogram equalization	<code>skimage.exposure.equalize_adap</code>	Contrast Limited Adaptive Histogram Equalization (CLAHE) algorithm
Intensity rescaling	<code>skimage.exposure.rescale_intens</code>	Stretch or shrink image intensity levels

Restoration

Create a new image which is the result of restoration on each selected image.

The following functions are available:

Function	Implementation	Comments
Total variation denoising	<code>skim-age.restoration.denoise_tv_</code>	
Bilateral filter denoising	<code>skim-age.restoration.denoise_bila</code>	
Wavelet denoising	<code>skim-age.restoration.denoise_wav</code>	
White Top-Hat denoising	<code>skim-age.morphology.white_toph</code>	Denoise image by subtracting its white top hat transform

Note: The “All denoising methods” option allows to perform all denoising methods on the same image. Combined with the “distribute on a grid” option, this allows to compare the different denoising methods on the same image.

Morphology

Create a new image which is the result of morphological operations on each selected image, using a disk footprint.

The following functions are available:

Function	Implementation
White Top-Hat (disk)	<code>skimage.morphology.white_tophat</code>
Black Top-Hat (disk)	<code>skimage.morphology.black_tophat</code>
Erosion (disk)	<code>skimage.morphology.erosion</code>
Dilation (disk)	<code>skimage.morphology.dilation</code>
Opening (disk)	<code>skimage.morphology.opening</code>
Closing (disk)	<code>skimage.morphology.closing</code>

Note: The “All morphological operations” option allows to perform all morphological operations on the same image. Combined with the “distribute on a grid” option, this allows to compare the different morphological operations on the same image.

Edges

Create a new image which is the result of edge filtering on each selected image.

The following functions are available:

Function	Implementation
Roberts filter	<code>skimage.filters.roberts</code>
Prewitt filter	<code>skimage.filters.prewitt</code>
Prewitt filter (horizontal)	<code>skimage.filters.prewitt_h</code>
Prewitt filter (vertical)	<code>skimage.filters.prewitt_v</code>
Sobel filter	<code>skimage.filters.sobel</code>
Sobel filter (horizontal)	<code>skimage.filters.sobel_h</code>
Sobel filter (vertical)	<code>skimage.filters.sobel_v</code>
Scharr filter	<code>skimage.filters.scharr</code>
Scharr filter (horizontal)	<code>skimage.filters.scharr_h</code>
Scharr filter (vertical)	<code>skimage.filters.scharr_v</code>
Farid filter	<code>skimage.filters.farid</code>
Farid filter (horizontal)	<code>skimage.filters.farid_h</code>
Farid filter (vertical)	<code>skimage.filters.farid_v</code>
Laplace filter	<code>skimage.filters.laplace</code>
Canny filter	<code>skimage.feature.canny</code>

Note: The “All edges filters” option allows to perform all edge filtering algorithms on the same image. Combined with the “distribute on a grid” option, this allows to compare the different edge filters on the same image.

Butterworth filter

Perform Butterworth filter on an image (implementation based on `skimage.filters.butterworth`)

Resize

Create a new image which is a resized version of each selected image.

Pixel binning

Combine clusters of adjacent pixels, throughout the image, into single pixels. The result can be the sum, average, median, minimum, or maximum value of the cluster.

ROI extraction

Create a new image from a user-defined Region of Interest.

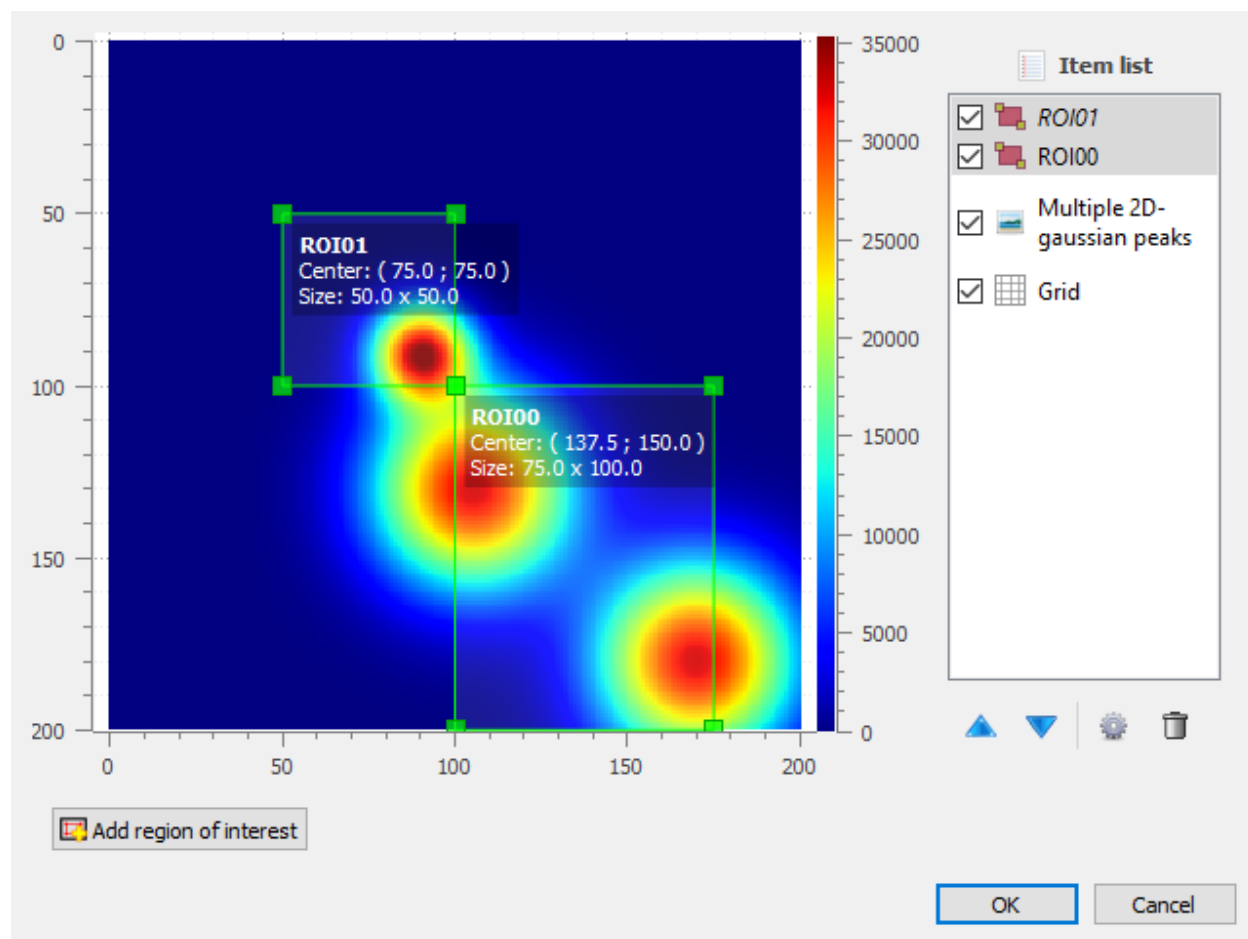


Fig. 40: ROI extraction dialog: the ROI is defined by moving the position and adjusting the size of a rectangle shape.

2.4.5 Analysis features on Images

This section describes the image analysis features available in DataLab.

See also:

Operations on Images for more information on operations that can be performed on images, or *Processing Images* for information on processing features on images.

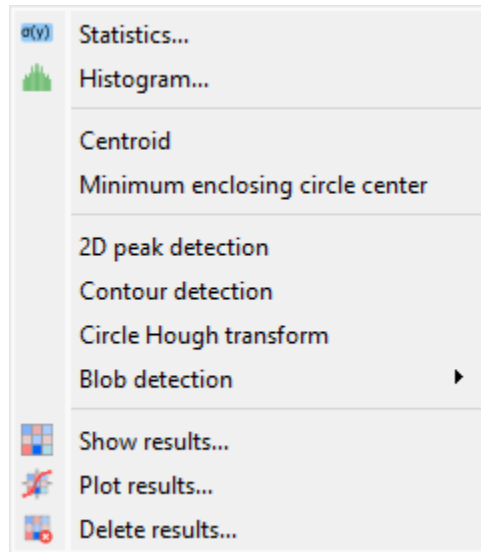


Fig. 41: Screenshot of the “Analysis” menu.

When the “Image Panel” is selected, the menus and toolbars are updated to provide image-related actions.

The “Analysis” menu allows you to perform various computations on the current image or group of images. It also allows you to compute statistics, to compute the centroid, to detect peaks, to detect contours, and so on.

Note: In DataLab vocabulary, an “analysis” is a feature that computes a scalar result from an image. This result is stored as metadata, and thus attached to image. This is different from a “processing” which creates a new image from an existing one.

Statistics

Compute statistics on selected image and show a summary table.

Histogram

Compute histogram of selected image and show it in the Signal Panel.

Parameters are:

Parameter	Description
Bins	Number of bins
Lower limit	Lower limit of the histogram
Upper limit	Upper limit of the histogram

	min(z)	max(z)	<z>	$\sigma(z)$	$\Sigma(z)$	SNR(z)
i000	0	32754	512.558	2852.36	1.28139e+08	5.56494
i000 ROI00	0	32754	512.558	2852.36	6.40697e+07	5.56494
i000 ROI01	0	0	0	0	0	nan
i000 ROI02	0	32754	512.558	2852.36	3.20349e+07	5.56494

Format Resize ☒ Background color

Close

Fig. 42: Example of statistical summary table: each row is associated to an ROI (the first row gives the statistics for the whole data).

Centroid

Compute image centroid using a Fourier transform method (as discussed by [Weisshaar et al.](#)). This method is quite insensitive to background noise.

Minimum enclosing circle center

Compute the circle contour enclosing image values above a threshold level defined as the half-maximum value.

2D peak detection

Automatically find peaks on image using a minimum-maximum filter algorithm.

See also:

See [2D Peak Detection](#) for more details on algorithm and associated parameters.

Contour detection

Automatically extract contours and fit them using a circle or an ellipse, or directly represent them as a polygon.

See also:

See [Contour Detection](#) for more details on algorithm and associated parameters.

Note: Computed scalar results are systematically stored as metadata. Metadata is attached to image and serialized with it when exporting current session in a HDF5 file.

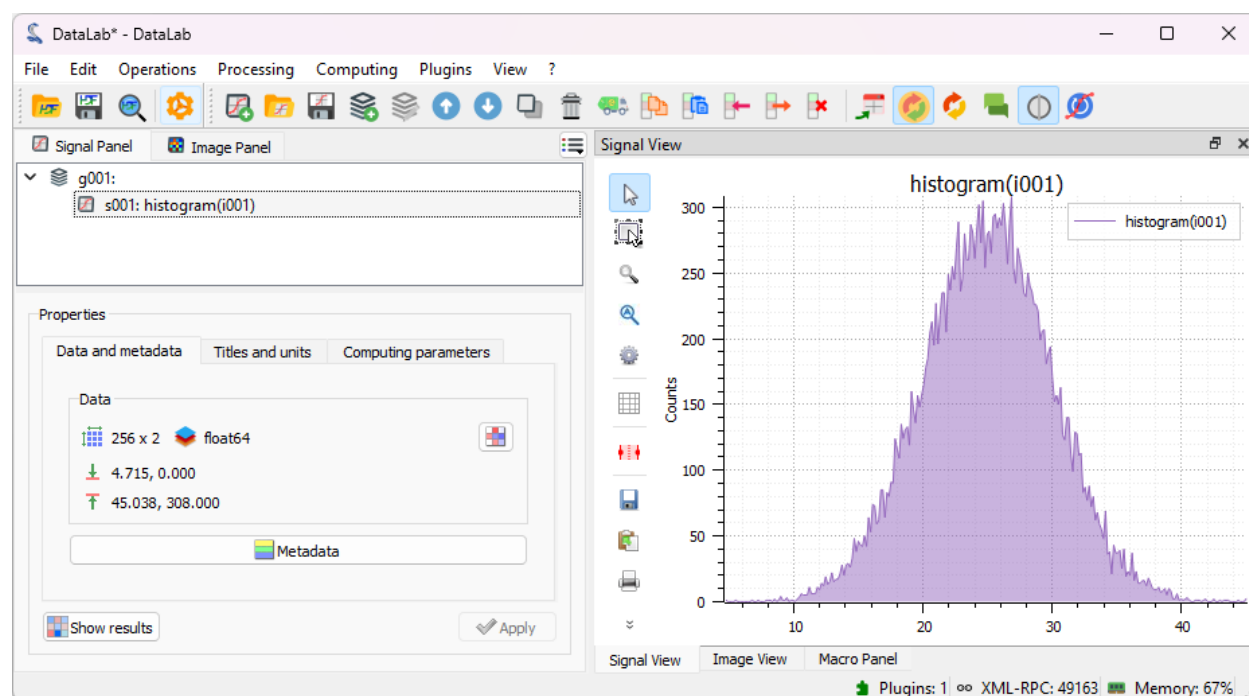


Fig. 43: Example of histogram.

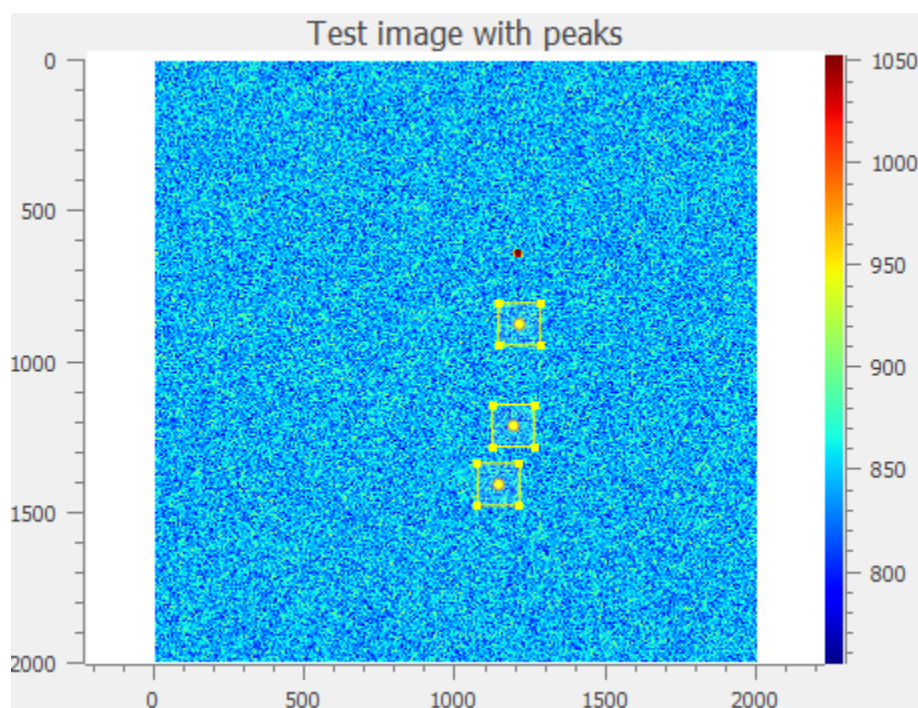


Fig. 44: Example of 2D peak detection.

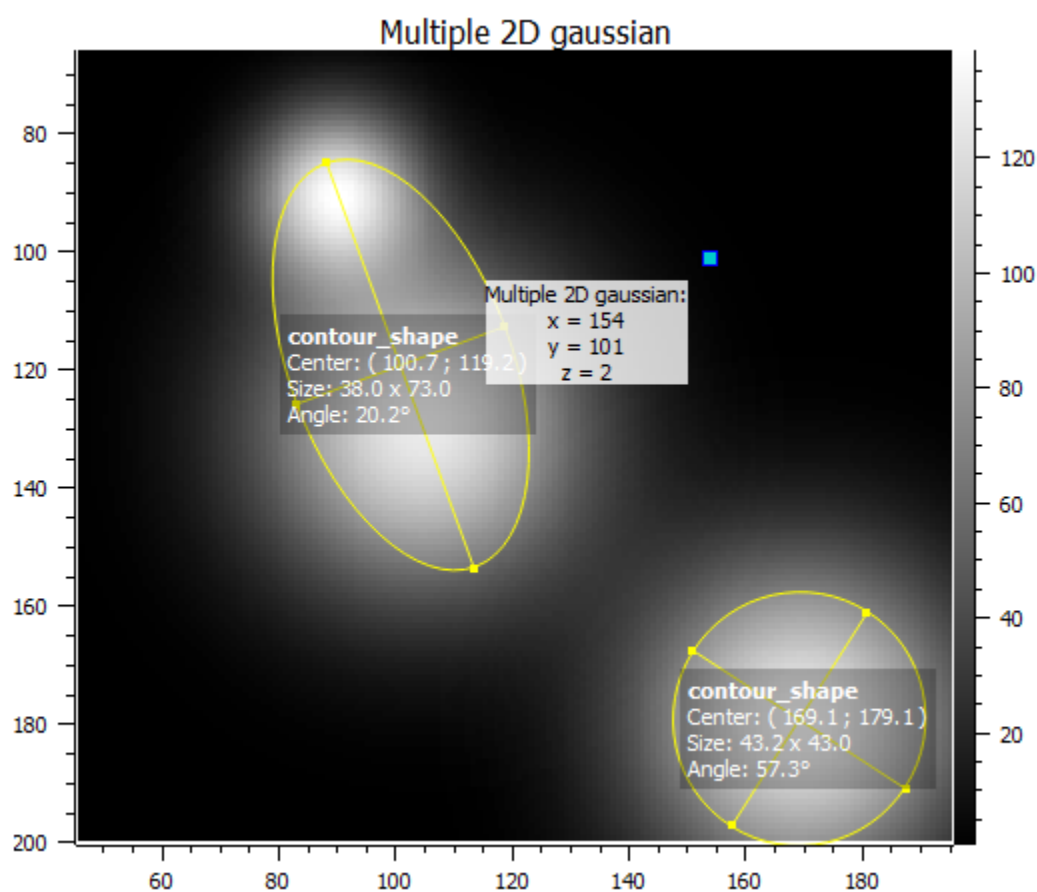


Fig. 45: Example of contour detection.

Circle Hough transform

Detect circular shapes using circle Hough transform (implementation based on `skimage.transform.hough_circle_peaks`).

Blob detection

Blob detection (DOG)

Detect blobs using Difference of Gaussian (DOG) method (implementation based on `skimage.feature.blob_dog`).

Blob detection (DOH)

Detect blobs using Determinant of Hessian (DOH) method (implementation based on `skimage.feature.blob_doh`).

Blob detection (LOG)

Detect blobs using Laplacian of Gaussian (LOG) method (implementation based on `skimage.feature.blob_log`).

Blob detection (OpenCV)

Detect blobs using OpenCV implementation of `SimpleBlobDetector`.

Show results

Show the results of all analyses performed on the selected images. This shows the same table as the one shown after having performed a computation.

Plot results

Plot the results of analyses performed on the selected images, with user-defined X and Y axes (e.g. plot the contour circle radius as a function of the image number).

2.4.6 View options for Images

When the “Image Panel” is selected, the menus and toolbars are updated to provide image-related actions.

The “View” menu allows you to visualize the current image or group of images. It also allows you to show/hide titles, to show/hide the contrast panel, to refresh the visualization, and so on.

View in a new window

Open a new window to visualize the selected images.

This option allows you to show the selected images in a separate window, in which you can visualize the data more comfortably (e.g., by maximizing the window) as well as to add or edit annotations.

When you click on the button “Annotations” in the toolbar of the new window, the annotation editing mode is activated (see the section “Edit annotations” below).

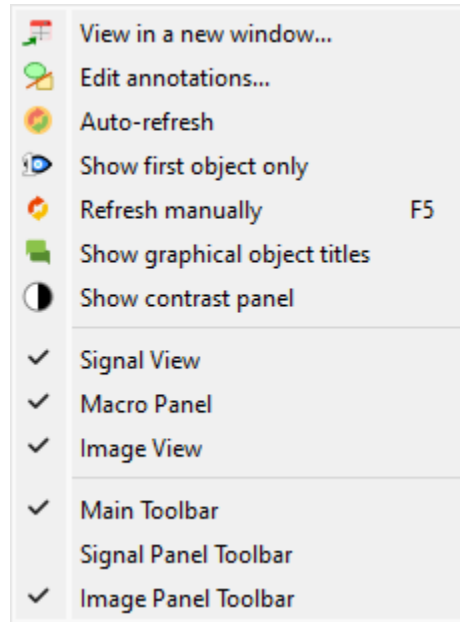


Fig. 46: Screenshot of the “View” menu.

Edit annotations

Open a new window to edit annotations.

This option allows you to edit the annotations of the selected images in a separate window. This is equivalent to select the “View in a new window” option and then click on the “Annotations” button in the toolbar of the new window.

Annotations are used to add text, lines, rectangles, ellipses, and other geometrical shapes to the images. They are useful to highlight regions of interest, to add comments, to mark points, and so on.

Note: The annotations are saved in the metadata of the image, so they are persistent and will be displayed every time you visualize the image.

The typical workflow to edit annotations is as follows:

1. Select the “Edit annotations” option.
2. In the new window, add annotations by clicking on the corresponding buttons at the bottom of the window.
3. Eventually, customize the annotations by changing their properties (e.g., the text, the color, the position, etc.) using the “Parameters” option in the context menu of the annotations.
4. When you are done, click on the “OK” button to save the annotations. This will close the window and the annotations will be saved in the metadata of the image and will be displayed in the main window.

Note: Annotations may be copied from an image to another by using the “copy/paste metadata” features.

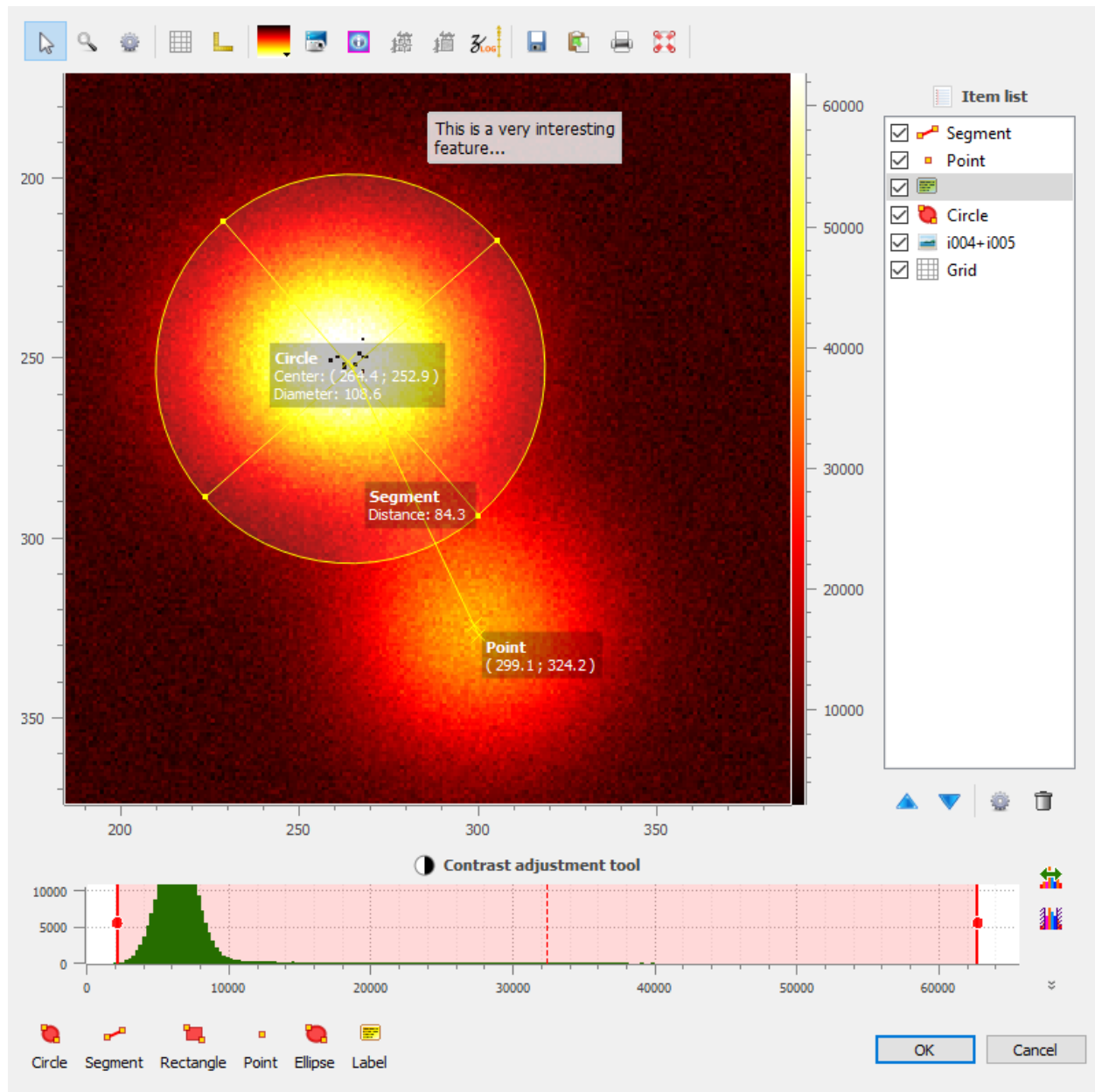


Fig. 47: Annotations may be added in the separate view.

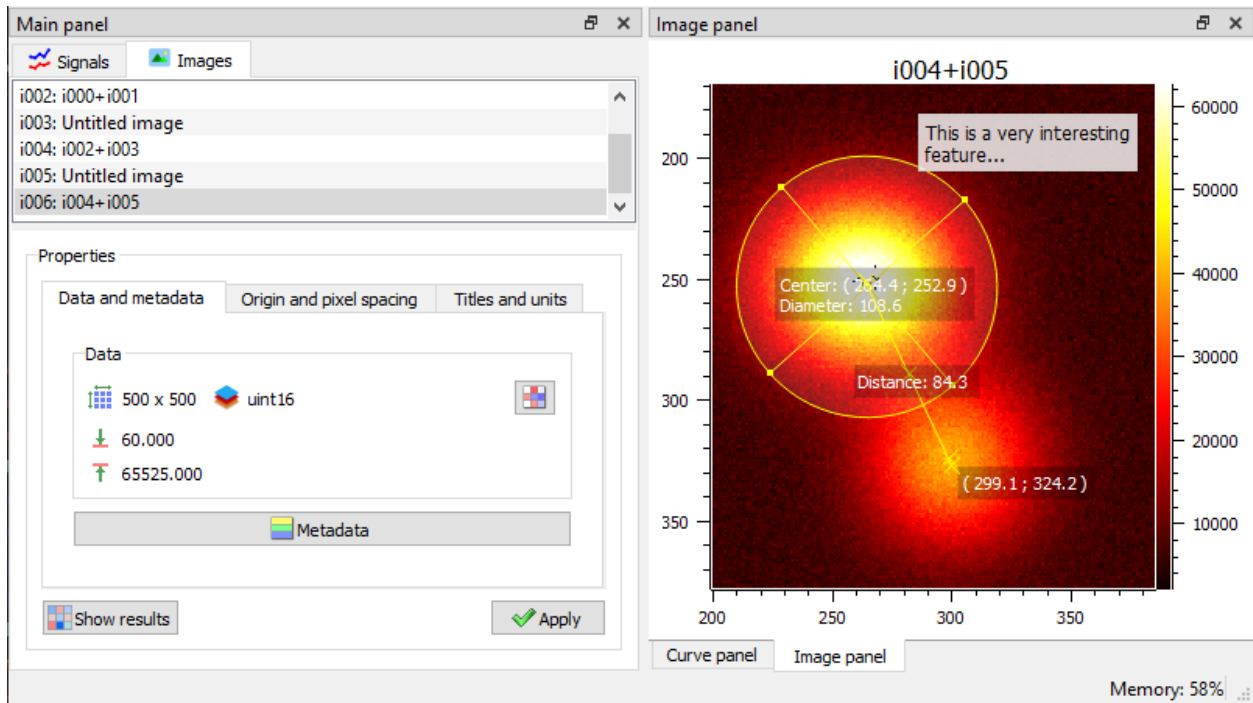


Fig. 48: Annotations are now part of the image metadata.

Auto-refresh

Automatically refresh the visualization when the data changes:

- When enabled (default), the plot view is automatically refreshed when the data changes.
- When disabled, the plot view is not refreshed until you manually refresh it by using the “Refresh manually” menu entry.

Even though the refresh algorithm is optimized, it may still take some time to refresh the plot view when the data changes, especially when the data set is large. Therefore, you may want to disable the auto-refresh feature when you are working with large data sets, and enable it again when you are done. This will avoid unnecessary refreshes.

Refresh manually

Refresh the visualization manually.

This triggers a refresh of the plot view. It is useful when the auto-refresh feature is disabled, or when you want to force a refresh of the plot view.

Show contrast panel

Show/hide contrast adjustment panel.

Show graphical object titles

Show/hide titles of analysis results or annotations.

This option allows you to show or hide the titles of the graphical objects (e.g., the titles of the analysis results or annotations). Hiding the titles can be useful when you want to visualize the data without any distractions, or if there are too many titles and they are overlapping.

2.4.7 2D Peak Detection

DataLab provides a “2D Peak Detection” feature which is based on a minimum-maximum filter algorithm.

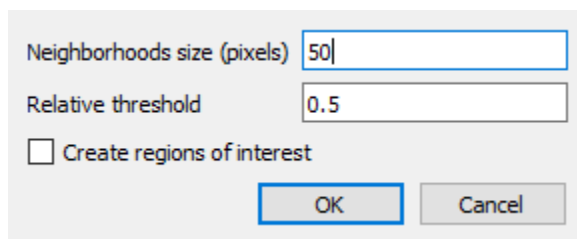


Fig. 49: 2D peak detection parameters.

How to use the feature:

- Create or open an image in DataLab workspace
- Select “2d peak detection” in “Analysis” menu
- Enter parameters “Neighborhoods size” and “Relative threshold”
- Check “Create regions of interest” if you want a ROI defined for each detected peak (this may become useful when using another computation afterwards on each area around peaks, e.g. contour detection)

Results are shown in a table:

- Each row is associated to a detected peak
- First column shows the ROI index (0 if no ROI is defined on input image)
- Second and third columns show peak coordinates

The 2d peak detection algorithm works in the following way:

- First, the minimum and maximum filtered images are computed using a sliding window algorithm with a user-defined size (implementation based on `scipy.ndimage.minimum_filter` and `scipy.ndimage.maximum_filter`)
- Then, the difference between the maximum and minimum filtered images is clipped at a user-defined threshold
- Resulting image features are labeled using `scipy.ndimage.label`
- Peak coordinates are then obtained from labels center
- Duplicates are eventually removed

Results - NumPy array (read only)

	ROI	x	y
Peaks(i000)	0	1366	638
Peaks(i000)	0	1416	1069
Peaks(i000)	0	1018	1135
Peaks(i000)	0	828	1229

Format Resize ☒ Background color

Close

Fig. 50: 2d peak detection results (see test “peak2d_app.py”)

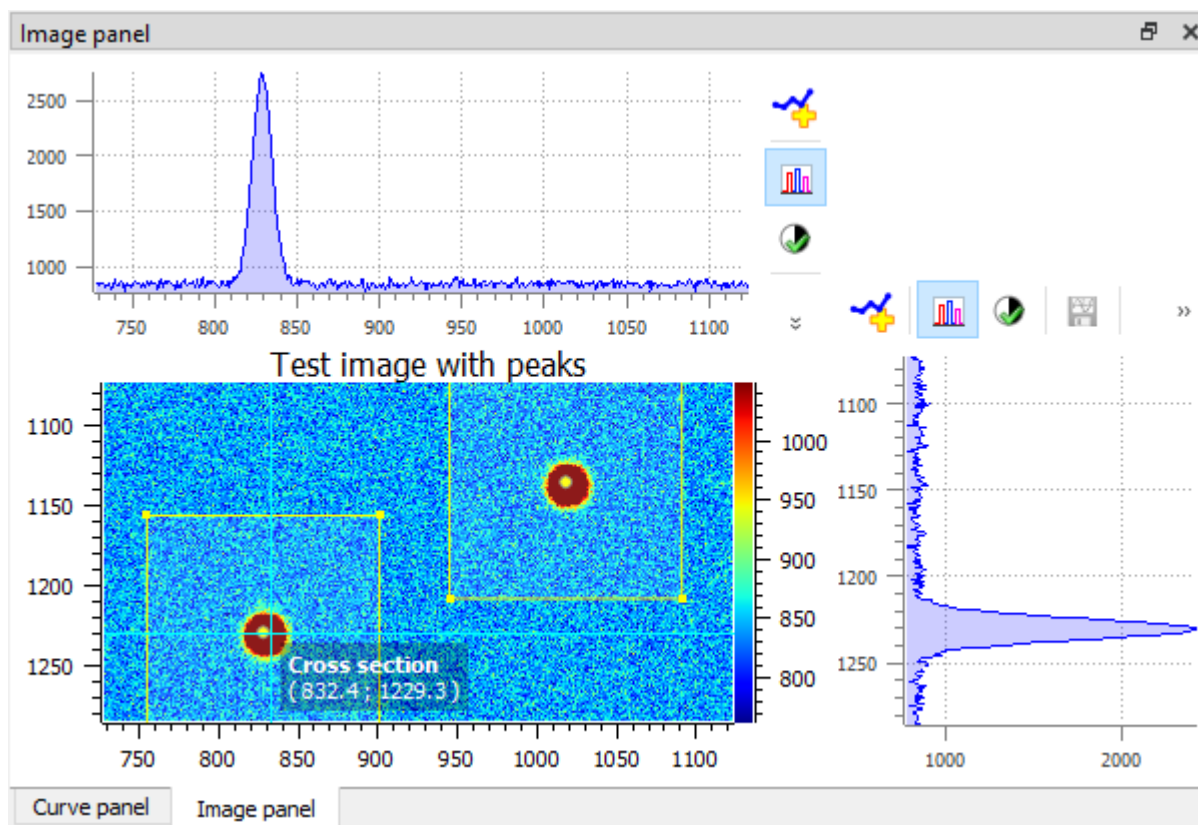


Fig. 51: Example of 2D peak detection.

The 2d peak detection parameters are the following:

- “Neighborhoods size”: size of the sliding window (see above)
- “Relative threshold”: detection threshold

Feature is based on `get_2d_peaks_coords` function from `cdl.algorithms` module:

```
def get_2d_peaks_coords(
    data: np.ndarray, size: int | None = None, level: float = 0.5
) -> np.ndarray:
    """Detect peaks in image data, return coordinates.

    If neighborhoods size is None, default value is the highest value
    between 50 pixels and the 1/40th of the smallest image dimension.

    Detection threshold level is relative to difference
    between data maximum and minimum values.

    Args:
        data: Input data
        size: Neighborhood size (default: None)
        level: Relative level (default: 0.5)

    Returns:
        Coordinates of peaks
    """
    if size is None:
        size = max(min(data.shape) // 40, 50)
    data_max = spi.maximum_filter(data, size)
    data_min = spi.minimum_filter(data, size)
    data_diff = data_max - data_min
    diff = (data_max - data_min) > get_absolute_level(data_diff, level)
    maxima = data == data_max
    maxima[diff == 0] = 0
    labeled, _num_objects = spi.label(maxima)
    slices = spi.find_objects(labeled)
    coords = []
    for dy, dx in slices:
        x_center = int(0.5 * (dx.start + dx.stop - 1))
        y_center = int(0.5 * (dy.start + dy.stop - 1))
        coords.append((x_center, y_center))
    if len(coords) > 1:
        # Eventually removing duplicates
        dist = distance_matrix(coords)
        for index in reversed(np.unique(np.where((dist < size) & (dist > 0))[1])):
            coords.pop(index)
    return np.array(coords)
```

2.4.8 Contour Detection

DataLab provides a “Contour Detection” feature which is based on the [marching cubes algorithm](#).

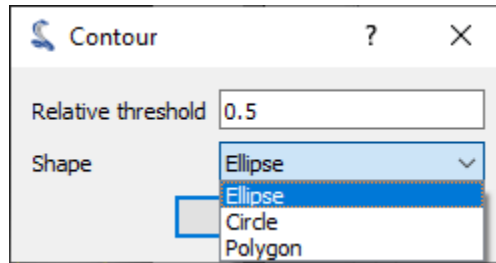


Fig. 52: Contour detection parameters.

How to use the feature:

- Create or open an image in DataLab workspace
- Eventually create a ROI around the target area
- Select “Contour detection” in “Analysis” menu
- Enter parameter “Shape” (“Ellipse”, “Circle” or “Polygon”)

Results - NumPy array (read only)

	ROI	x0	y0	x1	y1	x2
i001: contour_shape	0	110	150.125	109	150.375	108
i001: contour_shape	0	160.75	199	160	198.625	159

Format Resize ☒ Background color Close

Fig. 53: Contour detection results (see test “contour_app.py”)

Results are shown in a table:

- Each row is associated to a contour
- First column shows the ROI index (0 if no ROI is defined on input image)
- Other columns show contour coordinates: 4 columns for circles (coordinates of diameter), 8 columns for ellipses (coordinates of diameters)

The contour detection algorithm works in the following way:

- First, iso-valued contours are computed (implementation based on [skimage.measure.find_contours.find_contours](#))

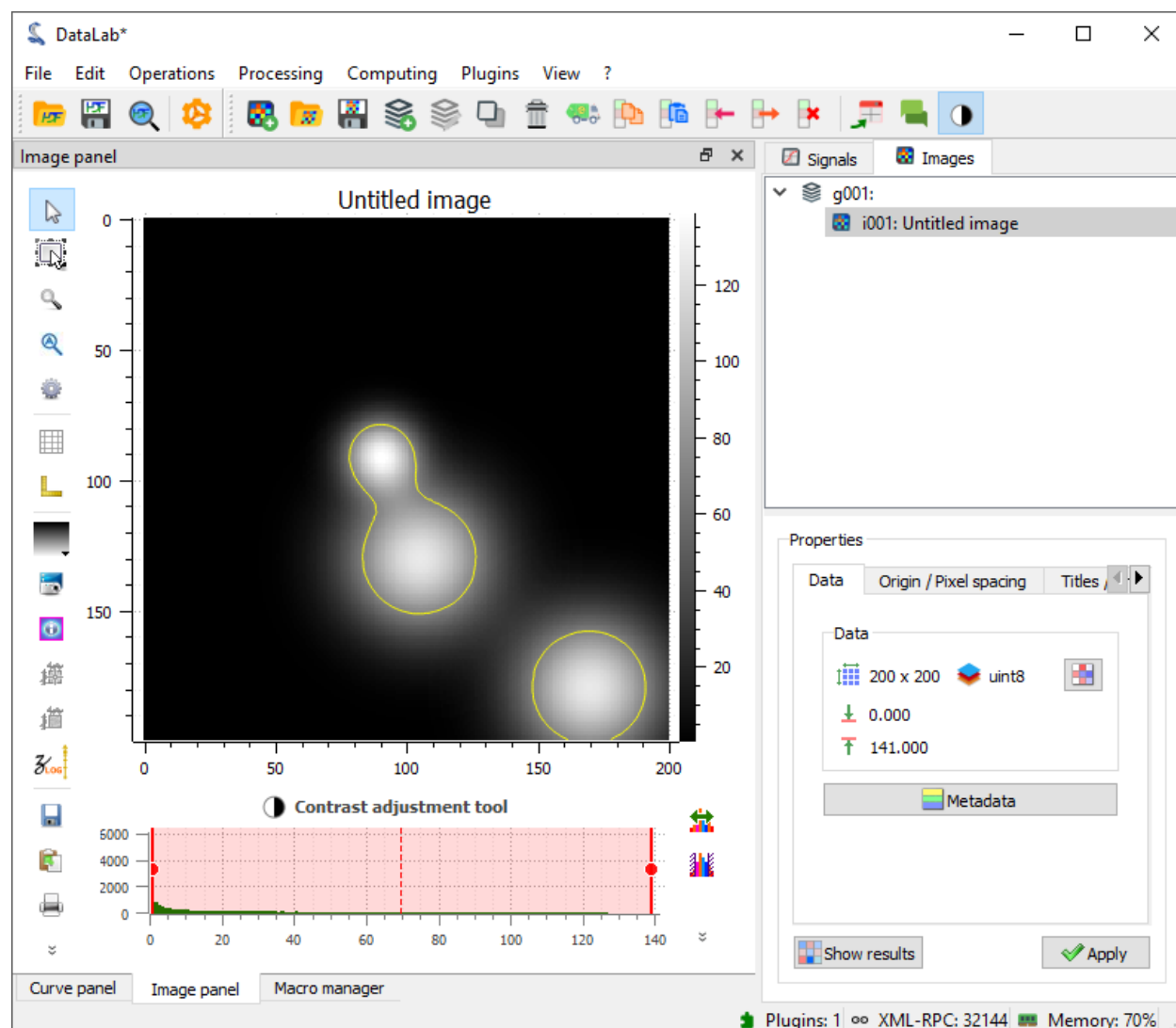


Fig. 54: Example of contour detection.

- Then, each contour is fitted to the closest ellipse (or circle)

Feature is based on `get_contour_shapes` function from `cdl.algorithms` module:

```
def get_contour_shapes(
    data: np.ndarray | ma.MaskedArray,
    shape: Literal["circle", "ellipse", "polygon"] = "ellipse",
    level: float = 0.5,
) -> np.ndarray:
    """Find iso-valued contours in a 2D array, above relative level (.5 means
    →FWHM),
    then fit contours with shape ('ellipse' or 'circle')

    Args:
        data: Input data
        shape: Shape to fit. Default is 'ellipse'
        level: Relative level (default: 0.5)

    Returns:
        """
        Coordinates of shapes
        """
        # pylint: disable=too-many-locals
        assert shape in ("circle", "ellipse", "polygon")
        contours = measure.find_contours(data, level=get_absolute_level(data,
        →level))
        coords = []
        for contour in contours:
            # `contour` is a (N, 2) array (rows, cols): we need to check if all
            →those
            # coordinates are masked: if so, we skip this contour
            if isinstance(data, ma.MaskedArray) and np.all(
                data.mask[contour[:, 0].astype(int), contour[:, 1].astype(int)]
            ):
                continue
            if shape == "circle":
                model = measure.CircleModel()
                if model.estimate(contour):
                    yc, xc, r = model.params
                    if r <= 1.0:
                        continue
                    coords.append([xc, yc, r])
            elif shape == "ellipse":
                model = measure.EllipseModel()
                if model.estimate(contour):
                    yc, xc, b, a, theta = model.params
                    if a <= 1.0 or b <= 1.0:
                        continue
                    coords.append([xc, yc, a, b, theta])
            elif shape == "polygon":
                # `contour` is a (N, 2) array (rows, cols): we need to convert it
                # to a list of x, y coordinates flattened in a single list
                coords.append(contour[:, :-1].flatten())
            else:
                raise NotImplementedError(f"Invalid contour model {model}")
```

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```
if shape == "polygon":
    # `coords` is a list of arrays of shape (N, 2) where N is the number of
    ↪points
    # that can vary from one array to another, so we need to padd with
    ↪NaNs each
    # array to get a regular array:
    max_len = max(coord.shape[0] for coord in coords)
    arr = np.full((len(coords), max_len), np.nan)
    for i_row, coord in enumerate(coords):
        arr[i_row, : coord.shape[0]] = coord
    return arr
return np.array(coords)
```

The public Application Programming Interface (API) of DataLab offers a set of functions to access the DataLab features. Those functions are available in various submodules of the *cdl* package. The following table lists the available submodules and their purpose:

Submodule	Purpose
<i>cdl.algorithms</i>	Algorithms for data analysis, which operates on NumPy arrays
<i>cdl.param</i>	Convenience module to access the DataLab sets of parameters (instances of <code>guidata.dataset.DataSet</code> objects)
<i>cdl.obj</i>	Convenience module to access the DataLab objects (<i>cdl.obj.SignalObj</i> or <i>cdl.obj.ImageObj</i>) and related functions
<i>cdl.computation</i>	Computation functions, which operate on DataLab objects (<i>cdl.obj.SignalObj</i> or <i>cdl.obj.ImageObj</i>)
<i>cdl.proxy</i>	Proxy objects to access the DataLab interface from a Python script or a remote application

3.1 Algorithms (*cdl.algorithms*)

This package contains the algorithms used by the DataLab project. Those algorithms operate directly on NumPy arrays and are designed to be used in the DataLab pipeline, but can be used independently as well.

See also:

The *cdl.algorithms* package is the main entry point for the DataLab algorithms when manipulating NumPy arrays. See the *cdl.computation* package for algorithms that operate directly on DataLab objects (i.e. *cdl.obj.SignalObj* and *cdl.obj.ImageObj*).

The algorithms are organized in subpackages according to their purpose. The following subpackages are available:

- *cdl.algorithms.signal*: Signal processing algorithms
- *cdl.algorithms.image*: Image processing algorithms
- *cdl.algorithms.datatypes*: Data type conversion algorithms
- *cdl.algorithms.coordinates*: Coordinate conversion algorithms

3.1.1 Signal Processing Algorithms

`cdl.algorithms.signal.normalize(yin: ndarray, parameter: Literal['maximum', 'amplitude', 'area', 'energy', 'rms'] = 'maximum') → ndarray`

Normalize input array to a given parameter.

Parameters

- **yin** – Input array
- **parameter** – Normalization parameter. Defaults to “maximum”

Returns

Normalized array

`cdl.algorithms.signal.fft1d(x: ndarray, y: ndarray, shift: bool = True) → tuple[ndarray, ndarray]`

Compute FFT on X,Y data.

Parameters

- **x** – X data
- **y** – Y data
- **shift** – Shift the zero frequency to the center of the spectrum. Defaults to True.

Returns

X data, Y data (tuple)

`cdl.algorithms.signal.ifft1d(x: ndarray, y: ndarray, shift: bool = True) → tuple[ndarray, ndarray]`

Compute iFFT on X,Y data.

Parameters

- **x** – X data
- **y** – Y data
- **shift** – Shift the zero frequency to the center of the spectrum. Defaults to True.

Returns

X data, Y data (tuple)

`cdl.algorithms.signal.magnitude_spectrum(x: ndarray, y: ndarray, log_scale: bool = False) → tuple[ndarray, ndarray]`

Compute magnitude spectrum.

Parameters

- **x** – X data
- **y** – Y data
- **log_scale** – Use log scale. Defaults to False.

Returns

Magnitude spectrum (X data, Y data)

`cdl.algorithms.signal.phase_spectrum(x: ndarray, y: ndarray) → tuple[ndarray, ndarray]`

Compute phase spectrum.

Parameters

- **x** – X data

- **y** – Y data

Returns

Phase spectrum in degrees (X data, Y data)

`cdl.algorithms.signal.psd(x: ndarray, y: ndarray, log_scale: bool = False) → tuple[ndarray, ndarray]`

Compute Power Spectral Density (PSD), using the Welch method.

Parameters

- **x** – X data
- **y** – Y data
- **log_scale** – Use log scale. Defaults to False.

Returns

X data, Y data (tuple)

Return type

Power Spectral Density (PSD)

`cdl.algorithms.signal.sort_frequencies(x: ndarray, y: ndarray) → ndarray`

Sort from X,Y data by computing FFT(y).

Parameters

- **x** – X data
- **y** – Y data

Returns

Sorted frequencies in ascending order

`cdl.algorithms.signal.peak_indices(y, thres: float = 0.3, min_dist: int = 1, thres_abs: bool = False) → ndarray`

Peak detection routine.

Finds the numeric index of the peaks in y by taking its first order difference. By using *thres* and *min_dist* parameters, it is possible to reduce the number of detected peaks. y must be signed.

Parameters

- **y** (*ndarray (signed)*) – 1D amplitude data to search for peaks.
- **thres** (*float between [0., 1.]*) – Normalized threshold. Only the peaks with amplitude higher than the threshold will be detected.
- **min_dist** (*int*) – Minimum distance between each detected peak. The peak with the highest amplitude is preferred to satisfy this constraint.
- **thres_abs** (*boolean*) – If True, the thres value will be interpreted as an absolute value, instead of a normalized threshold.

Returns

Array containing the numeric indices of the peaks that were detected

Return type

ndarray

`cdl.algorithms.signal.xpeak(x: ndarray, y: ndarray) → float`

Return default peak X-position (assuming a single peak).

Parameters

- **x** – X data
- **y** – Y data

Returns

Peak X-position

```
cdl.algorithms.signal.interpolate(x: ndarray, y: ndarray, xnew: ndarray, method: Literal['linear', 'spline',  
                                         'quadratic', 'cubic', 'barycentric', 'pchip'], fill_value: float | None =  
                                         None) → ndarray
```

Interpolate data.

Parameters

- **x** – X data
- **y** – Y data
- **xnew** – New X data
- **method** – Interpolation method
- **fill_value** – Fill value. Defaults to None. This value is used to fill in for requested points outside of the X data range. It is only used if the method argument is 'linear', 'cubic' or 'pchip'.

Returns

Interpolated Y data

```
cdl.algorithms.signal.windowing(y: ndarray, method: Literal['barthann', 'bartlett', 'blackman',  
                                                           'blackman-harris', 'bohman', 'boxcar', 'cosine', 'exponential', 'flat-top',  
                                                           'hamming', 'hanning', 'lanczos', 'nuttall', 'parzen', 'rectangular', 'taylor',  
                                                           'tukey', 'kaiser', 'gaussian'] = 'hamming', alpha: float = 0.5, beta: float =  
                                                           14.0, sigma: float = 7.0) → ndarray
```

Apply windowing to the input data.

Parameters

- **x** – X data
- **y** – Y data
- **method** – Windowing function. Defaults to “hamming”.
- **alpha** – Tukey window parameter. Defaults to 0.5.
- **beta** – Kaiser window parameter. Defaults to 14.0.
- **sigma** – Gaussian window parameter. Defaults to 7.0.

Returns

Windowed Y data

```
class cdl.algorithms.signal.FitModel
```

Curve fitting model base class

```
abstract classmethod func(x, amp, sigma, x0, y0)
```

Return fitting function

```
classmethod get_amp_from_amplitude(amplitude, sigma)
```

Return amp from function amplitude and sigma

```

classmethod amplitude(amp, sigma)
    Return function amplitude

abstract classmethod fwhm(amp, sigma)
    Return function FWHM

classmethod half_max_segment(amp, sigma, x0, y0)
    Return segment coordinates for y=half-maximum intersection

class cdl.algorithms.signal.GaussianModel
    1-dimensional Gaussian fit model

    classmethod func(x, amp, sigma, x0, y0)
        Return fitting function

    classmethod get_amp_from_amplitude(amplitude, sigma)
        Return amp from function amplitude and sigma

    classmethod amplitude(amp, sigma)
        Return function amplitude

    classmethod fwhm(amp, sigma)
        Return function FWHM

class cdl.algorithms.signal.LorentzianModel
    1-dimensional Lorentzian fit model

    classmethod func(x, amp, sigma, x0, y0)
        Return fitting function

    classmethod get_amp_from_amplitude(amplitude, sigma)
        Return amp from function amplitude and sigma

    classmethod amplitude(amp, sigma)
        Return function amplitude

    classmethod fwhm(amp, sigma)
        Return function FWHM

class cdl.algorithms.signal.VoigtModel
    1-dimensional Voigt fit model

    classmethod func(x, amp, sigma, x0, y0)
        Return fitting function

    classmethod fwhm(amp, sigma)
        Return function FWHM

cdl.algorithms.signal.find_zero_crossings(y: ndarray) → ndarray
    Find the left indices of the zero-crossing intervals in the given array.

    Parameters
        y – Input array.

    Returns
        An array of indices where zero-crossings occur.

```

`cdl.algorithms.signal.find_x_at_value(x: ndarray, y: ndarray, value: float) → ndarray`

Find the x value where the y value is the closest to the given value using linear interpolation to deduce the precise x value.

Parameters

- **x** – X data
- **y** – Y data
- **value** – Value to find

Returns

An array of x values where the y value is the closest to the given value (empty array if no zero crossing is found)

`cdl.algorithms.signal.bandwidth(data: ndarray, level: float = 3.0) → tuple[float, float, float, float]`

Compute the bandwidth of the signal at a given level.

Parameters

- **data** – X,Y data
- **level** – Level in dB at which the bandwidth is computed. Defaults to 3.0.

Returns

segment coordinates

Return type

Bandwidth of the signal at the given level

`cdl.algorithms.signal.contrast(y: ndarray) → float`

Compute contrast

Parameters

y – Input array

Returns

Contrast

`cdl.algorithms.signal.sinusoidal_model(x: ndarray, a: float, f: float, phi: float, offset: float) → ndarray`

Sinusoidal model function.

`cdl.algorithms.signal.sinusoidal_fit(x: ndarray, y: ndarray) → tuple[tuple[float, float, float, float], float]`

Fit a sinusoidal model to the input data.

Parameters

- **x** – X data
- **y** – Y data

Returns

A tuple containing the fit parameters (amplitude, frequency, phase, offset) and the residuals

`cdl.algorithms.signal.sinus_frequency(x: ndarray, y: ndarray) → float`

Compute the frequency of a sinusoidal signal.

Parameters

- **x** – x signal data
- **y** – y signal data

Returns

Frequency of the sinusoidal signal

`cdl.algorithms.signal.enob(x: ndarray, y: ndarray, full_scale: float = 1.0) → float`

Compute Effective Number of Bits (ENOB).

Parameters

- **x** – x signal data
- **y** – y signal data
- **full_scale** – Full scale(V). Defaults to 1.0.

Returns

Effective Number of Bits (ENOB)

`cdl.algorithms.signal.sinad(x: ndarray, y: ndarray, full_scale: float = 1.0, unit: Literal['dBc', 'dBFS'] = 'dBc') → float`

Compute Signal-to-Noise and Distortion Ratio (SINAD).

Parameters

- **x** – x signal data
- **y** – y signal data
- **full_scale** – Full scale(V). Defaults to 1.0.
- **unit** – Unit of the input data. Valid values are 'dBc' and 'dBFS'. Defaults to 'dBc'.

Returns

Signal-to-Noise and Distortion Ratio (SINAD)

`cdl.algorithms.signal.thd(x: ndarray, y: ndarray, full_scale: float = 1.0, unit: Literal['dBc', 'dBFS'] = 'dBc', nb_harm: int = 5) → float`

Compute Total Harmonic Distortion (THD).

Parameters

- **x** – x signal data
- **y** – y signal data
- **full_scale** – Full scale(V). Defaults to 1.0.
- **unit** – Unit of the input data. Valid values are 'dBc' and 'dBFS'. Defaults to 'dBc'.
- **nb_harm** – Number of harmonics to consider. Defaults to 5.

Returns

Total Harmonic Distortion (THD)

`cdl.algorithms.signal.sfdr(x: ndarray, y: ndarray, full_scale: float = 1.0, unit: Literal['dBc', 'dBFS'] = 'dBc') → float`

Compute Spurious-Free Dynamic Range (SFDR).

Parameters

- **x** – x signal data
- **y** – y signal data
- **full_scale** – Full scale(V). Defaults to 1.0.
- **unit** – Unit of the input data. Valid values are 'dBc' and 'dBFS'. Defaults to 'dBc'.

Returns

Spurious-Free Dynamic Range (SFDR)

```
cdl.algorithms.signal.snr(x: ndarray, y: ndarray, full_scale: float = 1.0, unit: Literal['dBc', 'dBFS'] = 'dBc')  
    → float
```

Compute Signal-to-Noise Ratio (SNR).

Parameters

- **x** – x signal data
- **y** – y signal data
- **full_scale** – Full scale(V). Defaults to 1.0.
- **unit** – Unit of the input data. Valid values are ‘dBc’ and ‘dBFS’. Defaults to ‘dBc’.

Returns

Signal-to-Noise Ratio (SNR)

```
cdl.algorithms.signal.sampling_period(x: ndarray) → float
```

Compute sampling period

Parameters**x** – X data**Returns**

Sampling period

```
cdl.algorithms.signal.sampling_rate(x: ndarray) → float
```

Compute mean sampling rate

Parameters**x** – X data**Returns**

Sampling rate

```
cdl.algorithms.signal.fwhm(data: ndarray, method: Literal['zero-crossing', 'gauss', 'lorentz', 'voigt'] =  
    'zero-crossing', xmin: float | None = None, xmax: float | None = None) →  
    tuple[float, float, float, float]
```

Compute Full Width at Half Maximum (FWHM) of the input data

Parameters

- **data** – X,Y data
- **method** – Calculation method. Two types of methods are supported: a zero-crossing method and fitting methods (based on various models: Gauss, Lorentz, Voigt). Defaults to “zero-crossing”.
- **xmin** – Lower X bound for the fitting. Defaults to None (no lower bound, i.e. the fitting starts from the first point).
- **xmax** – Upper X bound for the fitting. Defaults to None (no upper bound, i.e. the fitting ends at the last point)

Returns

FWHM segment coordinates

```
cdl.algorithms.signal.fw1e2(data: ndarray) → tuple[float, float, float, float]
```

Compute Full Width at 1/e of the input data (using a Gaussian model fitting).

Parameters**data** – X,Y data**Returns**FW at $1/e^2$ segment coordinates`cdl.algorithms.signal.allan_variance(x: ndarray, y: ndarray, tau_values: ndarray) → ndarray`

Calculate the Allan variance for given time and measurement values at specified tau values.

Parameters

- **x** – Time array
- **y** – Measured values array
- **tau_values** – Allan deviation time values

Returns

Allan variance values

`cdl.algorithms.signal.allan_deviation(x: ndarray, y: ndarray, tau_values: ndarray) → ndarray`

Calculate the Allan deviation for given time and measurement values at specified tau values.

Parameters

- **x** – Time array
- **y** – Measured values array
- **tau_values** – Allan deviation time values

Returns

Allan deviation values

`cdl.algorithms.signal.overlapping_allan_variance(x: ndarray, y: ndarray, tau_values: ndarray) → ndarray`

Calculate the Overlapping Allan variance for given time and measurement values.

Parameters

- **x** – Time array
- **y** – Measured values array
- **tau_values** – Allan deviation time values

Returns

Overlapping Allan variance values

`cdl.algorithms.signal.modified_allan_variance(x: ndarray, y: ndarray, tau_values: ndarray) → ndarray`

Calculate the Modified Allan variance for given time and measurement values.

Parameters

- **x** – Time array
- **y** – Measured values array
- **tau_values** – Modified Allan deviation time values

Returns

Modified Allan variance values

`cdl.algorithms.signal.hadamard_variance(x: ndarray, y: ndarray, tau_values: ndarray) → ndarray`

Calculate the Hadamard variance for given time and measurement values.

Parameters

- **x** – Time array
- **y** – Measured values array
- **tau_values** – Hadamard deviation time values

Returns

Hadamard variance values

`cdl.algorithms.signal.total_variance(x: ndarray, y: ndarray, tau_values: ndarray) → ndarray`

Calculate the Total variance for given time and measurement values.

Parameters

- **x** – Time array
- **y** – Measured values array
- **tau_values** – Total variance time values

Returns

Total variance values

`cdl.algorithms.signal.time_deviation(x: ndarray, y: ndarray, tau_values: ndarray) → ndarray`

Calculate the Time Deviation (TDEV) for given time and measurement values.

Parameters

- **x** – Time array
- **y** – Measured values array
- **tau_values** – Time deviation time values

Returns

Time deviation values

3.1.2 Image Processing Algorithms

`cdl.algorithms.image.scale_data_to_min_max(data: ndarray, zmin: float | int, zmax: float | int) → ndarray`

Scale array *data* to fit [zmin, zmax] dynamic range

Parameters

- **data** – Input data
- **zmin** – Minimum value of output data
- **zmax** – Maximum value of output data

Returns

Scaled data

`cdl.algorithms.image.normalize(data: ndarray, parameter: Literal['maximum', 'amplitude', 'area', 'energy', 'rms']) = 'maximum' → ndarray`

Normalize input array to a given parameter.

Parameters

- **data** – Input data
- **parameter** – Normalization parameter (default: “maximum”)

Returns

Normalized array

`cdl.algorithms.image.fft2d(z: ndarray, shift: bool = True) → ndarray`

Compute FFT of complex array *z*

Parameters

- **z** – Input data
- **shift** – Shift zero frequency to center (default: True)

Returns

FFT of input data

`cdl.algorithms.image.ifft2d(z: ndarray, shift: bool = True) → ndarray`

Compute inverse FFT of complex array *z*

Parameters

- **z** – Input data
- **shift** – Shift zero frequency to center (default: True)

Returns

Inverse FFT of input data

`cdl.algorithms.image.magnitude_spectrum(z: ndarray, log_scale: bool = False) → ndarray`

Compute magnitude spectrum of complex array *z*

Parameters

- **z** – Input data
- **log_scale** – Use log scale (default: False)

Returns

Magnitude spectrum of input data

`cdl.algorithms.image.phase_spectrum(z: ndarray) → ndarray`

Compute phase spectrum of complex array *z*

Parameters

z – Input data

Returns

Phase spectrum of input data (in degrees)

`cdl.algorithms.image.psd(z: ndarray, log_scale: bool = False) → ndarray`

Compute power spectral density of complex array *z*

Parameters

- **z** – Input data
- **log_scale** – Use log scale (default: False)

Returns

Power spectral density of input data

`cdl.algorithms.image.binning(data: ndarray, sx: int, sy: int, operation: Literal['sum', 'average', 'median', 'min', 'max'], dtype=None) → ndarray`

Perform image pixel binning

Parameters

- **data** – Input data
- **sx** – Binning size along x (number of pixels to bin together)
- **sy** – Binning size along y (number of pixels to bin together)
- **operation** – Binning operation
- **dtype** – Output data type (default: None, i.e. same as input)

Returns

Binned data

`cdl.algorithms.image.flatfield(rawdata: ndarray, flatdata: ndarray, threshold: float | None = None) → ndarray`

Compute flat-field correction

Parameters

- **rawdata** – Raw data
- **flatdata** – Flat-field data
- **threshold** – Threshold for flat-field correction (default: None)

Returns

Flat-field corrected data

`cdl.algorithms.image.get_centroid_fourier(data: ndarray) → tuple[float, float]`

Return image centroid using Fourier algorithm

Parameters

data – Input data

Returns

Centroid coordinates (row, col)

`cdl.algorithms.image.get_absolute_level(data: ndarray, level: float) → float`

Return absolute level

Parameters

- **data** – Input data
- **level** – Relative level (0.0 to 1.0)

Returns

Absolute level

`cdl.algorithms.image.get_enclosing_circle(data: ndarray, level: float = 0.5) → tuple[int, int, float]`

Return (x, y, radius) for the circle contour enclosing image values above threshold relative level (.5 means FWHM)

Parameters

- **data** – Input data
- **level** – Relative level (default: 0.5)

Returns

A tuple (x, y, radius)

Raises

ValueError – No contour was found

`cdl.algorithms.image.get_radial_profile(data: ndarray, center: tuple[int, int]) → tuple[ndarray, ndarray]`

Return radial profile of image data

Parameters

- **data** – Input data (2D array)
- **center** – Coordinates of the center of the profile (x, y)

Returns

Radial profile (X, Y) where X is the distance from the center (1D array) and Y is the average value of pixels at this distance (1D array)

`cdl.algorithms.image.distance_matrix(coords: list) → ndarray`

Return distance matrix from coords

Parameters

coords – List of coordinates

Returns

Distance matrix

`cdl.algorithms.image.get_2d_peaks_coords(data: ndarray, size: int | None = None, level: float = 0.5) → ndarray`

Detect peaks in image data, return coordinates.

If neighborhoods size is None, default value is the highest value between 50 pixels and the 1/40th of the smallest image dimension.

Detection threshold level is relative to difference between data maximum and minimum values.

Parameters

- **data** – Input data
- **size** – Neighborhood size (default: None)
- **level** – Relative level (default: 0.5)

Returns

Coordinates of peaks

`cdl.algorithms.image.get_contour_shapes(data: ndarray | MaskedArray, shape: Literal['circle', 'ellipse', 'polygon'] = 'ellipse', level: float = 0.5) → ndarray`

Find iso-valued contours in a 2D array, above relative level (.5 means FWHM), then fit contours with shape ('ellipse' or 'circle')

Parameters

- **data** – Input data
- **shape** – Shape to fit. Default is 'ellipse'
- **level** – Relative level (default: 0.5)

Returns

Coordinates of shapes

```
cdl.algorithms.image.get_hough_circle_peaks(data: ndarray, min_radius: float | None = None,
                                             max_radius: float | None = None, nb_radius: int | None =
                                             None, min_distance: int = 1) → ndarray
```

Detect peaks in image from circle Hough transform, return circle coordinates.

Parameters

- **data** – Input data
- **min_radius** – Minimum radius (default: None)
- **max_radius** – Maximum radius (default: None)
- **nb_radius** – Number of radii (default: None)
- **min_distance** – Minimum distance between circles (default: 1)

Returns

Coordinates of circles

```
cdl.algorithms.image.find_blobs_dog(data: ndarray, min_sigma: float = 1, max_sigma: float = 30, overlap:
float = 0.5, threshold_rel: float = 0.2, exclude_border: bool = True)
→ ndarray
```

Finds blobs in the given grayscale image using the Difference of Gaussians (DoG) method.

Parameters

- **data** – The grayscale input image.
- **min_sigma** – The minimum blob radius in pixels.
- **max_sigma** – The maximum blob radius in pixels.
- **overlap** – The minimum overlap between two blobs in pixels. For instance, if two blobs are detected with radii of 10 and 12 respectively, and the **overlap** is set to 0.5, then the area of the smaller blob will be ignored and only the area of the larger blob will be returned.
- **threshold_rel** – The absolute lower bound for scale space maxima. Local maxima smaller than **threshold_rel** are ignored. Reduce this to detect blobs with less intensities.
- **exclude_border** – If **True**, exclude blobs from detection if they are too close to the border of the image. Border size is **min_sigma**.

Returns

Coordinates of blobs

```
cdl.algorithms.image.find_blobs_doh(data: ndarray, min_sigma: float = 1, max_sigma: float = 30, overlap:
float = 0.5, log_scale: bool = False, threshold_rel: float = 0.2) →
ndarray
```

Finds blobs in the given grayscale image using the Determinant of Hessian (DoH) method.

Parameters

- **data** – The grayscale input image.
- **min_sigma** – The minimum blob radius in pixels.
- **max_sigma** – The maximum blob radius in pixels.
- **overlap** – The minimum overlap between two blobs in pixels. For instance, if two blobs are detected with radii of 10 and 12 respectively, and the **overlap** is set to 0.5, then the area of the smaller blob will be ignored and only the area of the larger blob will be returned.
- **log_scale** – If **True**, the radius of each blob is returned as `sqrt(sigma)` for each detected blob.

- **threshold_rel** – The absolute lower bound for scale space maxima. Local maxima smaller than **threshold_rel** are ignored. Reduce this to detect blobs with less intensities.

Returns

Coordinates of blobs

```
cdl.algorithms.image.find_blobs_log(data: ndarray, min_sigma: float = 1, max_sigma: float = 30, overlap:
float = 0.5, log_scale: bool = False, threshold_rel: float = 0.2,
exclude_border: bool = True) → ndarray
```

Finds blobs in the given grayscale image using the Laplacian of Gaussian (LoG) method.

Parameters

- **data** – The grayscale input image.
- **min_sigma** – The minimum blob radius in pixels.
- **max_sigma** – The maximum blob radius in pixels.
- **overlap** – The minimum overlap between two blobs in pixels. For instance, if two blobs are detected with radii of 10 and 12 respectively, and the **overlap** is set to 0.5, then the area of the smaller blob will be ignored and only the area of the larger blob will be returned.
- **log_scale** – If True, the radius of each blob is returned as `sqrt(sigma)` for each detected blob.
- **threshold_rel** – The absolute lower bound for scale space maxima. Local maxima smaller than **threshold_rel** are ignored. Reduce this to detect blobs with less intensities.
- **exclude_border** – If True, exclude blobs from detection if they are too close to the border of the image. Border size is **min_sigma**.

Returns

Coordinates of blobs

```
cdl.algorithms.image.remove_overlapping_disks(coords: ndarray) → ndarray
```

Remove overlapping disks among coordinates

Parameters

coords – The coordinates of the disks

Returns

The coordinates of the disks with overlapping disks removed

```
cdl.algorithms.image.find_blobs_opencv(data: ndarray, min_threshold: float | None = None,
max_threshold: float | None = None, min_repeatability: int | None = None,
min_dist_between_blobs: float | None = None,
filter_by_color: bool | None = None, blob_color: int | None = None,
filter_by_area: bool | None = None, min_area: float | None = None, max_area: float | None = None,
filter_by_circularity: bool | None = None, min_circularity: float | None = None,
max_circularity: float | None = None, filter_by_inertia: bool | None = None,
min_inertia_ratio: float | None = None, max_inertia_ratio: float | None = None,
filter_by_convexity: bool | None = None, min_convexity: float | None = None,
max_convexity: float | None = None) → ndarray
```

Finds blobs in the given grayscale image using OpenCV's SimpleBlobDetector.

Parameters

- **data** – The grayscale input image.

- **min_threshold** – The minimum blob intensity.
- **max_threshold** – The maximum blob intensity.
- **min_repeatability** – The minimum number of times a blob is detected before it is reported.
- **min_dist_between_blobs** – The minimum distance between blobs.
- **filter_by_color** – If True, blobs are filtered by color.
- **blob_color** – The color of the blobs to filter by.
- **filter_by_area** – If True, blobs are filtered by area.
- **min_area** – The minimum blob area.
- **max_area** – The maximum blob area.
- **filter_by_circularity** – If True, blobs are filtered by circularity.
- **min_circularity** – The minimum blob circularity.
- **max_circularity** – The maximum blob circularity.
- **filter_by_inertia** – If True, blobs are filtered by inertia.
- **min_inertia_ratio** – The minimum blob inertia ratio.
- **max_inertia_ratio** – The maximum blob inertia ratio.
- **filter_by_convexity** – If True, blobs are filtered by convexity.
- **min_convexity** – The minimum blob convexity.
- **max_convexity** – The maximum blob convexity.

Returns

Coordinates of blobs

3.1.3 Data Type Conversion Algorithms

`cdl.algorithms.datatypes.is_integer_dtype(dtype: dtype) → bool`

Return True if data type is an integer type

Parameters

dtype – Data type to check

Returns

True if data type is an integer type

`cdl.algorithms.datatypes.is_complex_dtype(dtype: dtype) → bool`

Return True if data type is a complex type

Parameters

dtype – Data type to check

Returns

True if data type is a complex type

`cdl.algorithms.datatypes.clip_astype(data: ndarray, dtype: dtype) → ndarray`

Convert array to a new data type, after having clipped values to the new data type's range if it is an integer type. If data type is not integer, this is equivalent to `data.astype(dtype)`.

Parameters

- **data** – Array to convert
- **dtype** – Data type to convert to

Returns

Array converted to new data type

3.1.4 Coordinate Conversion Algorithms

`cdl.algorithms.coordinates.circle_to_diameter(xc: float, yc: float, r: float) → tuple[float, float, float, float]`

Convert circle center and radius to X diameter coordinates

Parameters

- **xc** – Circle center X coordinate
- **yc** – Circle center Y coordinate
- **r** – Circle radius

Returns

Circle X diameter coordinates

Return type

tuple

`cdl.algorithms.coordinates.array_circle_to_diameter(data: ndarray) → ndarray`

Convert circle center and radius to X diameter coordinates (array version)

Parameters

data – Circle center and radius, in the form of a 2D array (N, 3)

Returns

Circle X diameter coordinates, in the form of a 2D array (N, 4)

`cdl.algorithms.coordinates.circle_to_center_radius(x0: float, y0: float, x1: float, y1: float) → tuple[float, float, float]`

Convert circle X diameter coordinates to center and radius

Parameters

- **x0** – Diameter start X coordinate
- **y0** – Diameter start Y coordinate
- **x1** – Diameter end X coordinate
- **y1** – Diameter end Y coordinate

Returns

Circle center and radius

Return type

tuple

`cdl.algorithms.coordinates.array_circle_to_center_radius(data: ndarray) → ndarray`

Convert circle X diameter coordinates to center and radius (array version)

Parameters

data – Circle X diameter coordinates, in the form of a 2D array (N, 4)

Returns

Circle center and radius, in the form of a 2D array (N, 3)

`cdl.algorithms.coordinates.ellipse_to_diameters(xc: float, yc: float, a: float, b: float, theta: float) → tuple[float, float, float, float, float, float, float, float]`

Convert ellipse center, axes and angle to X/Y diameters coordinates

Parameters

- **xc** – Ellipse center X coordinate
- **yc** – Ellipse center Y coordinate
- **a** – Ellipse half larger axis
- **b** – Ellipse half smaller axis
- **theta** – Ellipse angle

Returns

Ellipse X/Y diameters (major/minor axes) coordinates

`cdl.algorithms.coordinates.array_ellipse_to_diameters(data: ndarray) → ndarray`

Convert ellipse center, axes and angle to X/Y diameters coordinates (array version)

Parameters

data – Ellipse center, axes and angle, in the form of a 2D array (N, 5)

Returns

Ellipse X/Y diameters (major/minor axes) coordinates,
in the form of a 2D array (N, 8)

`cdl.algorithms.coordinates.ellipse_to_center_axes_angle(x0: float, y0: float, x1: float, y1: float, x2: float, y2: float, x3: float, y3: float) → tuple[float, float, float, float, float]`

Convert ellipse X/Y diameters coordinates to center, axes and angle

Parameters

- **x0** – major axis start X coordinate
- **y0** – major axis start Y coordinate
- **x1** – major axis end X coordinate
- **y1** – major axis end Y coordinate
- **x2** – minor axis start X coordinate
- **y2** – minor axis start Y coordinate
- **x3** – minor axis end X coordinate
- **y3** – minor axis end Y coordinate

Returns

Ellipse center, axes and angle

`cdl.algorithms.coordinates.array_ellipse_to_center_axes_angle(data: ndarray) → ndarray`

Convert ellipse X/Y diameters coordinates to center, axes and angle (array version)

Parameters

data – Ellipse X/Y diameters coordinates, in the form of a 2D array (N, 8)

Returns

Ellipse center, axes and angle, in the form of a 2D array (N, 5)

`cdl.algorithms.coordinates.cartesian2polar(x: ndarray, y: ndarray, unit: Literal['rad', 'deg'] = 'rad') → tuple[ndarray, ndarray]`

Convert Cartesian coordinates to polar coordinates.

Parameters

- **x** – Cartesian x-coordinate.
- **y** – Cartesian y-coordinate.
- **unit** – Unit of the angle ('rad' or 'deg').

Returns

Polar coordinates (r, theta) where r is the radius and theta is the angle.

`cdl.algorithms.coordinates.polar2cartesian(r: ndarray, theta: ndarray, unit: Literal['rad', 'deg'] = 'rad') → tuple[ndarray, ndarray]`

Convert polar coordinates to Cartesian coordinates.

Parameters

- **r** – Polar radius.
- **theta** – Polar angle.
- **unit** – Unit of the angle ('rad' or 'deg').

Returns

Cartesian coordinates (x, y) where x is the x-coordinate and y is the y-coordinate.

Note: Negative radius values are not supported. They will be set to 0.

3.2 Parameters (cdl.param)

The `cdl.param` module aims at providing all the dataset parameters that are used by the `cdl.computation` and `cdl.core.gui.processor` packages.

Those datasets are defined in other modules:

- `cdl.computation.base`
- `cdl.computation.image`
- `cdl.computation.signal`

The `cdl.param` module is thus a convenient way to import all the sets of parameters at once.

As a matter of fact, the following import statement is equivalent to the previous one:

```
# Original import statement
from cdl.computation.base import MovingAverageParam
from cdl.computation.signal import PolynomialFitParam
from cdl.computation.image.exposure import EqualizeHistParam

# Equivalent import statement
from cdl.param import MovingAverageParam, PolynomialFitParam, EqualizeHistParam
```

3.2.1 Introduction to *DataSet* parameters

The datasets listed in the following sections are used to define the parameters necessary for the various computations and processing operations available in DataLab.

Each dataset is a subclass of `guidata.dataset.datatypes.DataSet` and thus needs to be instantiated before being used.

Here is a complete example of how to instantiate a dataset and access its parameters with the `cdl.param.BinningParam` dataset:

```
class cdl.param.BinningParam
    Binning parameters

sx
    Cluster size (X). Number of adjacent pixels to be combined together along x-axis. Integer higher
    than 2. Default: 2.
    Type
        guidata.dataset.dataitems.IntItem

sy
    Cluster size (Y). Number of adjacent pixels to be combined together along y-axis. Integer higher
    than 2. Default: 2.
    Type
        guidata.dataset.dataitems.IntItem

operation
    Single choice from: 'sum', 'average', 'median', 'min', 'max'. Default: 'sum'.
    Type
        guidata.dataset.dataitems.ChoiceItem

dtype_str
    Data type. Output image data type. Single choice from: 'dtype', 'float32', 'float64', 'com-
    plex128', 'int32', 'int16', 'uint16', 'uint8'. Default: 'dtype'.
    Type
        guidata.dataset.dataitems.ChoiceItem

change_pixel_size
    Change pixel size so that overall image size remains the same. Default: False.
    Type
        guidata.dataset.dataitems.BoolItem

classmethod create(sx: int, sy: int, operation: str, dtype_str: str, change_pixel_size: bool) →
    cdl.computation.image.BinningParam

    Returns a new instance of BinningParam with the fields set to the given values.

Parameters
    • sx (int) – Cluster size (X). Number of adjacent pixels to be combined together
      along x-axis. Integer higher than 2. Default: 2.
    • sy (int) – Cluster size (Y). Number of adjacent pixels to be combined together
      along y-axis. Integer higher than 2. Default: 2.
    • operation (str) – Single choice from: 'sum', 'average', 'median', 'min', 'max'.
      Default: 'sum'.
    • dtype_str (str) – Data type. Output image data type. Single choice from:
      'dtype', 'float32', 'float64', 'complex128', 'int32', 'int16', 'uint16', 'uint8'. De-
      fault: 'dtype'.
    • change_pixel_size (bool) – Change pixel size so that overall image size re-
      mains the same. Default: False.
```

Returns

New instance of `BinningParam`.

Note: To instantiate a new `BinningParam` dataset, you can use the classmethod `BinningParam.create()` like this:

```
BinningParam.create(sx=2, sy=2, operation='sum', dtype_str='dtype', change_
    pixel_size=False)
```

You can also first instantiate a default `BinningParam` and then set the fields like this:

```
param = BinningParam()
param.sx = 2
param.sy = 2
param.operation = 'sum'
param.dtype_str = 'dtype'
param.change_pixel_size = False
```

3.2.2 Common parameters

class `cdl.param.ArithmeticParam`

Arithmetic parameters

operator

Single choice from: '+', '-', '×', '/'. Default: '+'.
 Type
`guidata.dataset.dataitems.ChoiceItem`

factor

Default: 1.0.
 Type
`guidata.dataset.dataitems.FloatItem`

constant

Default: 0.0.
 Type
`guidata.dataset.dataitems.FloatItem`

operation

Default: ‘.’.
 Type
`guidata.dataset.dataitems.StringItem`

restore_dtype

Result. Default: True.
 Type
`guidata.dataset.dataitems.BoolItem`

classmethod **create**(*operator: str, factor: float, constant: float, operation: str, restore_dtype: bool*) → *cdl.computation.base.ArithmeticParam*

Returns a new instance of `ArithmeticParam` with the fields set to the given values.

Parameters

- **operator** (*str*) – Single choice from: '+', '-', '×', '/'. Default: '+'.
- **factor** (*float*) – Default: 1.0.
- **constant** (*float*) – Default: 0.0.
- **operation** (*str*) – Default: ''.
- **restore_dtype** (*bool*) – Result. Default: True.

Returns

New instance of `ArithmeticParam`.

get_operation() → *str*

Return the operation string

update_operation(*_item, _value*)

Update the operation item

class `cdl.param.ClipParam`

Data clipping parameters

lower

Lower clipping value. Default: None.

Type

guidata.dataset.dataitems.FloatItem

upper

Upper clipping value. Default: None.

Type

guidata.dataset.dataitems.FloatItem

classmethod **create**(*lower: float, upper: float*) → *cdl.computation.base.ClipParam*

Returns a new instance of `ClipParam` with the fields set to the given values.

Parameters

- **lower** (*float*) – Lower clipping value. Default: None.
- **upper** (*float*) – Upper clipping value. Default: None.

Returns

New instance of `ClipParam`.

class `cdl.param.ConstantParam`

Parameter used to set a constant value to used in operations

value

Constant value. Default: None.

Type

guidata.dataset.dataitems.FloatItem

classmethod `create(value: float) → cdl.computation.base.ConstantParam`

Returns a new instance of `ConstantParam` with the fields set to the given values.

Parameters

value (*float*) – Constant value. Default: None.

Returns

New instance of `ConstantParam`.

class `cdl.param.FFTParam`

FFT parameters

shift

Shift zero frequency to center. Default: None.

Type

`guidata.dataset.dataitems.BoolItem`

classmethod `create(shift: bool) → cdl.computation.base.FFTParam`

Returns a new instance of `FFTParam` with the fields set to the given values.

Parameters

shift (*bool*) – Shift zero frequency to center. Default: None.

Returns

New instance of `FFTParam`.

class `cdl.param.GaussianParam`

Gaussian filter parameters

sigma

. Default: 1.0.

Type

`guidata.dataset.dataitems.FloatItem`

classmethod `create(sigma: float) → cdl.computation.base.GaussianParam`

Returns a new instance of `GaussianParam` with the fields set to the given values.

Parameters

sigma (*float*) – . Default: 1.0.

Returns

New instance of `GaussianParam`.

class `cdl.param.HistogramParam`

Histogram parameters

bins

Number of bins. Integer higher than 1. Default: 256.

Type

`guidata.dataset.dataitems.IntItem`

lower

Lower limit. Default: None.

Type

`guidata.dataset.dataitems.FloatItem`

upper

Upper limit. Default: None.

Type

`guidata.dataset.dataitems.FloatItem`

classmethod `create(bins: int, lower: float, upper: float) → cdl.computation.base.HistogramParam`

Returns a new instance of `HistogramParam` with the fields set to the given values.

Parameters

- **bins** (*int*) – Number of bins. Integer higher than 1. Default: 256.
- **lower** (*float*) – Lower limit. Default: None.
- **upper** (*float*) – Upper limit. Default: None.

Returns

New instance of `HistogramParam`.

get_suffix(*data: ndarray*) → *str*

Return suffix for the histogram computation

Parameters

data – data array

class `cdl.param.MovingAverageParam`

Moving average parameters

n

Size of the moving window. Integer higher than 1. Default: 3.

Type

`guidata.dataset.dataitems.IntItem`

mode

Mode of the filter: - 'reflect': reflect the data at the boundary - 'constant': pad with a constant value - 'nearest': pad with the nearest value - 'mirror': reflect the data at the boundary with the data itself - 'wrap': circular boundary. Single choice from: 'reflect', 'constant', 'nearest', 'mirror', 'wrap'. Default: 'reflect'.

Type

`guidata.dataset.dataitems.ChoiceItem`

classmethod `create(n: int, mode: str) → cdl.computation.base.MovingAverageParam`

Returns a new instance of `MovingAverageParam` with the fields set to the given values.

Parameters

- **n** (*int*) – Size of the moving window. Integer higher than 1. Default: 3.
- **mode** (*str*) – Mode of the filter: - 'reflect': reflect the data at the boundary - 'constant': pad with a constant value - 'nearest': pad with the nearest value - 'mirror': reflect the data at the boundary with the data itself - 'wrap': circular boundary. Single choice from: 'reflect', 'constant', 'nearest', 'mirror', 'wrap'. Default: 'reflect'.

Returns

New instance of `MovingAverageParam`.

class `cdl.param.MovingMedianParam`

Moving median parameters

n

Size of the moving window. Integer higher than 1, odd. Default: 3.

Type`guidata.dataset.dataitems.IntItem`**mode**

Mode of the filter: - 'reflect': reflect the data at the boundary - 'constant': pad with a constant value - 'nearest': pad with the nearest value - 'mirror': reflect the data at the boundary with the data itself - 'wrap': circular boundary. Single choice from: 'reflect', 'constant', 'nearest', 'mirror', 'wrap'. Default: 'nearest'.

Type`guidata.dataset.dataitems.ChoiceItem`**classmethod** `create(n: int, mode: str) → cdl.computation.base.MovingMedianParam`Returns a new instance of `MovingMedianParam` with the fields set to the given values.**Parameters**

- **n** (*int*) – Size of the moving window. Integer higher than 1, odd. Default: 3.
- **mode** (*str*) – Mode of the filter: - 'reflect': reflect the data at the boundary - 'constant': pad with a constant value - 'nearest': pad with the nearest value - 'mirror': reflect the data at the boundary with the data itself - 'wrap': circular boundary. Single choice from: 'reflect', 'constant', 'nearest', 'mirror', 'wrap'. Default: 'nearest'.

ReturnsNew instance of `MovingMedianParam`.**class** `cdl.param.NormalizeParam`

Normalize parameters

method

Normalize with respect to. Single choice from: 'maximum', 'amplitude', 'area', 'energy', 'rms'. Default: 'maximum'.

Type`guidata.dataset.dataitems.ChoiceItem`**classmethod** `create(method: str) → cdl.computation.base.NormalizeParam`Returns a new instance of `NormalizeParam` with the fields set to the given values.**Parameters**

- **method** (*str*) – Normalize with respect to. Single choice from: 'maximum', 'amplitude', 'area', 'energy', 'rms'. Default: 'maximum'.

ReturnsNew instance of `NormalizeParam`.**class** `cdl.param.SpectrumParam`

Spectrum parameters

log

Default: False.

Type`guidata.dataset.dataitems.BoolItem`**classmethod** `create(log: bool) → cdl.computation.base.SpectrumParam`Returns a new instance of `SpectrumParam` with the fields set to the given values.

Parameters

log (*bool*) – Default: False.

Returns

New instance of `SpectrumParam`.

3.2.3 Signal parameters

class `cdl.param.AllanVarianceParam`

Allan variance parameters

max_tau

Max . Integer higher than 1, unit: pts. Default: 100.

Type

`guidata.dataset.dataitems.IntItem`

classmethod `create(max_tau: int) → cdl.computation.signal.AllanVarianceParam`

Returns a new instance of `AllanVarianceParam` with the fields set to the given values.

Parameters

max_tau (*int*) – Max . Integer higher than 1, unit: pts. Default: 100.

Returns

New instance of `AllanVarianceParam`.

class `cdl.param.AngleUnitParam`

Choice of angle unit.

unit

Angle unit. Single choice from: 'rad', 'deg'. Default: 'rad'.

Type

`guidata.dataset.dataitems.ChoiceItem`

classmethod `create(unit: str) → cdl.computation.signal.AngleUnitParam`

Returns a new instance of `AngleUnitParam` with the fields set to the given values.

Parameters

unit (*str*) – Angle unit. Single choice from: 'rad', 'deg'. Default: 'rad'.

Returns

New instance of `AngleUnitParam`.

class `cdl.param.BandPassFilterParam`

Band-pass filter parameters

method

Filter method. Single choice from: 'bessel', 'butter', 'cheby1', 'cheby2', 'ellip'. Default: 'bessel'.

Type

`guidata.dataset.dataitems.ChoiceItem`

order

Filter order. Integer higher than 1. Default: 3.

Type

`guidata.dataset.dataitems.IntItem`

f_cut0

Low cutoff frequency. Float higher than 0, non zero, unit: hz. Default: None.

Type

`guidata.dataset.dataitems.FloatItem`

f_cut1

High cutoff frequency. Float higher than 0, non zero, unit: hz. Default: None.

Type

`guidata.dataset.dataitems.FloatItem`

rp

Passband ripple. Float higher than 0, non zero, unit: db. Default: 1.

Type

`guidata.dataset.dataitems.FloatItem`

rs

Stopband attenuation. Float higher than 0, non zero, unit: db. Default: 1.

Type

`guidata.dataset.dataitems.FloatItem`

classmethod **create**(*method: str, order: int, f_cut0: float, f_cut1: float, rp: float, rs: float*) → `cdl.computation.signal.BandPassFilterParam`

Returns a new instance of `BandPassFilterParam` with the fields set to the given values.

Parameters

- **method** (*str*) – Filter method. Single choice from: ‘bessel’, ‘butter’, ‘cheby1’, ‘cheby2’, ‘ellip’. Default: ‘bessel’.
- **order** (*int*) – Filter order. Integer higher than 1. Default: 3.
- **f_cut0** (*float*) – Low cutoff frequency. Float higher than 0, non zero, unit: hz. Default: None.
- **f_cut1** (*float*) – High cutoff frequency. Float higher than 0, non zero, unit: hz. Default: None.
- **rp** (*float*) – Passband ripple. Float higher than 0, non zero, unit: db. Default: 1.
- **rs** (*float*) – Stopband attenuation. Float higher than 0, non zero, unit: db. Default: 1.

Returns

New instance of `BandPassFilterParam`.

class `cdl.param.BandStopFilterParam`

Band-stop filter parameters

method

Filter method. Single choice from: ‘bessel’, ‘butter’, ‘cheby1’, ‘cheby2’, ‘ellip’. Default: ‘bessel’.

Type

`guidata.dataset.dataitems.ChoiceItem`

order

Filter order. Integer higher than 1. Default: 3.

Type

`guidata.dataset.dataitems.IntItem`

f_cut0

Low cutoff frequency. Float higher than 0, non zero, unit: hz. Default: None.

Type

`guidata.dataset.dataitems.FloatItem`

f_cut1

High cutoff frequency. Float higher than 0, non zero, unit: hz. Default: None.

Type

`guidata.dataset.dataitems.FloatItem`

rp

Passband ripple. Float higher than 0, non zero, unit: db. Default: 1.

Type

`guidata.dataset.dataitems.FloatItem`

rs

Stopband attenuation. Float higher than 0, non zero, unit: db. Default: 1.

Type

`guidata.dataset.dataitems.FloatItem`

classmethod `create(method: str, order: int, f_cut0: float, f_cut1: float, rp: float, rs: float) → cdl.computation.signal.BandStopFilterParam`

Returns a new instance of `BandStopFilterParam` with the fields set to the given values.

Parameters

- **method** (*str*) – Filter method. Single choice from: ‘bessel’, ‘butter’, ‘cheby1’, ‘cheby2’, ‘ellip’. Default: ‘bessel’.
- **order** (*int*) – Filter order. Integer higher than 1. Default: 3.
- **f_cut0** (*float*) – Low cutoff frequency. Float higher than 0, non zero, unit: hz. Default: None.
- **f_cut1** (*float*) – High cutoff frequency. Float higher than 0, non zero, unit: hz. Default: None.
- **rp** (*float*) – Passband ripple. Float higher than 0, non zero, unit: db. Default: 1.
- **rs** (*float*) – Stopband attenuation. Float higher than 0, non zero, unit: db. Default: 1.

Returns

New instance of `BandStopFilterParam`.

class `cdl.param.DataTypeSParam`

Convert signal data type parameters

dtype_str

Destination data type. Output image data type. Single choice from: ‘float32’, ‘float64’, ‘complex128’. Default: ‘float32’.

Type

`guidata.dataset.dataitems.ChoiceItem`

classmethod `create(dtype_str: str) → cdl.computation.signal.DataTypeSParam`

Returns a new instance of `DataTypeSParam` with the fields set to the given values.

Parameters

dtype_str (*str*) – Destination data type. Output image data type. Single choice from: ‘float32’, ‘float64’, ‘complex128’. Default: ‘float32’.

Returns

New instance of `DataTypeSParam`.

class `cdl.param.DetrendingParam`

Detrending parameters

method

Detrending method. Single choice from: ‘linear’, ‘constant’. Default: ‘linear’.

Type

`guidata.dataset.dataitems.ChoiceItem`

classmethod `create`(*method: str*) → `cdl.computation.signal.DetrendingParam`

Returns a new instance of `DetrendingParam` with the fields set to the given values.

Parameters

method (*str*) – Detrending method. Single choice from: ‘linear’, ‘constant’. Default: ‘linear’.

Returns

New instance of `DetrendingParam`.

class `cdl.param.DynamicParam`

Parameters for dynamic range computation (ENOB, SNR, SINAD, THD, SFDR)

full_scale

Float higher than 0.0, unit: v. Default: 0.16.

Type

`guidata.dataset.dataitems.FloatItem`

unit

Unit for sinad. Single choice from: ‘dBc’, ‘dBFS’. Default: ‘dBc’.

Type

`guidata.dataset.dataitems.ChoiceItem`

nb_harm

Number of harmonics. Number of harmonics to consider for thd. Integer higher than 1. Default: 5.

Type

`guidata.dataset.dataitems.IntItem`

classmethod `create`(*full_scale: float, unit: str, nb_harm: int*) → `cdl.computation.signal.DynamicParam`

Returns a new instance of `DynamicParam` with the fields set to the given values.

Parameters

- **full_scale** (*float*) – Float higher than 0.0, unit: v. Default: 0.16.
- **unit** (*str*) – Unit for sinad. Single choice from: ‘dBc’, ‘dBFS’. Default: ‘dBc’.
- **nb_harm** (*int*) – Number of harmonics. Number of harmonics to consider for thd. Integer higher than 1. Default: 5.

Returns

New instance of `DynamicParam`.

class `cdl.param.FindAbscissaParam`

Parameter dataset for abscissa finding

y

Ordinate. Default: 0.

Type

`guidata.dataset.dataitems.FloatItem`

classmethod `create(y: float) → cdl.computation.signal.FindAbscissaParam`

Returns a new instance of `FindAbscissaParam` with the fields set to the given values.

Parameters

y (*float*) – Ordinate. Default: 0.

Returns

New instance of `FindAbscissaParam`.

class `cdl.param.FWHMParam`

FWHM parameters

method

Single choice from: ‘zero-crossing’, ‘gauss’, ‘lorentz’, ‘voigt’. Default: ‘zero-crossing’.

Type

`guidata.dataset.dataitems.ChoiceItem`

xmin

X_{MIN} . Lower x boundary (empty for no limit, i.e. Start of the signal). Default: None.

Type

`guidata.dataset.dataitems.FloatItem`

xmax

X_{MAX} . Upper x boundary (empty for no limit, i.e. End of the signal). Default: None.

Type

`guidata.dataset.dataitems.FloatItem`

classmethod `create(method: str, xmin: float, xmax: float) → cdl.computation.signal.FWHMParam`

Returns a new instance of `FWHMParam` with the fields set to the given values.

Parameters

- **method** (*str*) – Single choice from: ‘zero-crossing’, ‘gauss’, ‘lorentz’, ‘voigt’. Default: ‘zero-crossing’.
- **xmin** (*float*) – X_{MIN} . Lower x boundary (empty for no limit, i.e. Start of the signal). Default: None.
- **xmax** (*float*) – X_{MAX} . Upper x boundary (empty for no limit, i.e. End of the signal). Default: None.

Returns

New instance of `FWHMParam`.

class `cdl.param.HighPassFilterParam`

High-pass filter parameters

method

Filter method. Single choice from: ‘bessel’, ‘butter’, ‘cheby1’, ‘cheby2’, ‘ellip’. Default: ‘bessel’.

Type

`guidata.dataset.dataitems.ChoiceItem`

order

Filter order. Integer higher than 1. Default: 3.

Type

`guidata.dataset.dataitems.IntItem`

f_cut0

Low cutoff frequency. Float higher than 0, non zero, unit: hz. Default: None.

Type

`guidata.dataset.dataitems.FloatItem`

f_cut1

High cutoff frequency. Float higher than 0, non zero, unit: hz. Default: None.

Type

`guidata.dataset.dataitems.FloatItem`

rp

Passband ripple. Float higher than 0, non zero, unit: db. Default: 1.

Type

`guidata.dataset.dataitems.FloatItem`

rs

Stopband attenuation. Float higher than 0, non zero, unit: db. Default: 1.

Type

`guidata.dataset.dataitems.FloatItem`

classmethod **create**(*method: str, order: int, f_cut0: float, f_cut1: float, rp: float, rs: float*) → *cdl.computation.signal.HighPassFilterParam*

Returns a new instance of `HighPassFilterParam` with the fields set to the given values.

Parameters

- **method** (*str*) – Filter method. Single choice from: ‘bessel’, ‘butter’, ‘cheby1’, ‘cheby2’, ‘ellip’. Default: ‘bessel’.
- **order** (*int*) – Filter order. Integer higher than 1. Default: 3.
- **f_cut0** (*float*) – Low cutoff frequency. Float higher than 0, non zero, unit: hz. Default: None.
- **f_cut1** (*float*) – High cutoff frequency. Float higher than 0, non zero, unit: hz. Default: None.
- **rp** (*float*) – Passband ripple. Float higher than 0, non zero, unit: db. Default: 1.
- **rs** (*float*) – Stopband attenuation. Float higher than 0, non zero, unit: db. Default: 1.

Returns

New instance of `HighPassFilterParam`.

class `cdl.param.InterpolationParam`

Interpolation parameters

method

Interpolation method. Single choice from: 'linear', 'spline', 'quadratic', 'cubic', 'barycentric', 'pchip'. Default: 'linear'.

Type

`guidata.dataset.dataitems.ChoiceItem`

fill_value

Value to use for points outside the interpolation domain (used only with linear, cubic and pchip methods). Default: None.

Type

`guidata.dataset.dataitems.FloatItem`

classmethod `create(method: str, fill_value: float) → cdl.computation.signal.InterpolationParam`

Returns a new instance of `InterpolationParam` with the fields set to the given values.

Parameters

- **method** (*str*) – Interpolation method. Single choice from: 'linear', 'spline', 'quadratic', 'cubic', 'barycentric', 'pchip'. Default: 'linear'.
- **fill_value** (*float*) – Value to use for points outside the interpolation domain (used only with linear, cubic and pchip methods). Default: None.

Returns

New instance of `InterpolationParam`.

class `cdl.param.LowPassFilterParam`

Low-pass filter parameters

method

Filter method. Single choice from: 'bessel', 'butter', 'cheby1', 'cheby2', 'ellip'. Default: 'bessel'.

Type

`guidata.dataset.dataitems.ChoiceItem`

order

Filter order. Integer higher than 1. Default: 3.

Type

`guidata.dataset.dataitems.IntItem`

f_cut0

Low cutoff frequency. Float higher than 0, non zero, unit: hz. Default: None.

Type

`guidata.dataset.dataitems.FloatItem`

f_cut1

High cutoff frequency. Float higher than 0, non zero, unit: hz. Default: None.

Type

`guidata.dataset.dataitems.FloatItem`

rp

Passband ripple. Float higher than 0, non zero, unit: db. Default: 1.

Type

`guidata.dataset.dataitems.FloatItem`

rs

Stopband attenuation. Float higher than 0, non zero, unit: db. Default: 1.

Type

`guidata.dataset.dataitems.FloatItem`

classmethod create(*method: str, order: int, f_cut0: float, f_cut1: float, rp: float, rs: float*) → *cdl.computation.signal.LowPassFilterParam*

Returns a new instance of `LowPassFilterParam` with the fields set to the given values.

Parameters

- **method** (*str*) – Filter method. Single choice from: ‘bessel’, ‘butter’, ‘cheby1’, ‘cheby2’, ‘ellip’. Default: ‘bessel’.
- **order** (*int*) – Filter order. Integer higher than 1. Default: 3.
- **f_cut0** (*float*) – Low cutoff frequency. Float higher than 0, non zero, unit: hz. Default: None.
- **f_cut1** (*float*) – High cutoff frequency. Float higher than 0, non zero, unit: hz. Default: None.
- **rp** (*float*) – Passband ripple. Float higher than 0, non zero, unit: db. Default: 1.
- **rs** (*float*) – Stopband attenuation. Float higher than 0, non zero, unit: db. Default: 1.

Returns

New instance of `LowPassFilterParam`.

class `cdl.param.PeakDetectionParam`

Peak detection parameters

threshold

Integer between 0 and 100, unit: %. Default: 30.

Type

`guidata.dataset.dataitems.IntItem`

min_dist

Minimum distance. Integer higher than 1, unit: points. Default: 1.

Type

`guidata.dataset.dataitems.IntItem`

classmethod create(*threshold: int, min_dist: int*) → *cdl.computation.signal.PeakDetectionParam*

Returns a new instance of `PeakDetectionParam` with the fields set to the given values.

Parameters

- **threshold** (*int*) – Integer between 0 and 100, unit: %. Default: 30.
- **min_dist** (*int*) – Minimum distance. Integer higher than 1, unit: points. Default: 1.

Returns

New instance of `PeakDetectionParam`.

class `cdl.param.PolynomialFitParam`

Polynomial fitting parameters

degree

Integer between 1 and 10. Default: 3.

Type

`guidata.dataset.dataitems.IntItem`

classmethod `create(degree: int) → cdl.computation.signal.PolynomialFitParam`

Returns a new instance of `PolynomialFitParam` with the fields set to the given values.

Parameters

degree (*int*) – Integer between 1 and 10. Default: 3.

Returns

New instance of `PolynomialFitParam`.

class `cdl.param.PowerParam`

Power parameters

power

Default: 2.0.

Type

`guidata.dataset.dataitems.FloatItem`

classmethod `create(power: float) → cdl.computation.signal.PowerParam`

Returns a new instance of `PowerParam` with the fields set to the given values.

Parameters

power (*float*) – Default: 2.0.

Returns

New instance of `PowerParam`.

class `cdl.param.ResamplingParam`

Resample parameters

method

Interpolation method. Single choice from: 'linear', 'spline', 'quadratic', 'cubic', 'barycentric', 'pchip'.
Default: 'linear'.

Type

`guidata.dataset.dataitems.ChoiceItem`

fill_value

Value to use for points outside the interpolation domain (used only with linear, cubic and pchip methods).
Default: None.

Type

`guidata.dataset.dataitems.FloatItem`

xmin

X_{\min} . Default: None.

Type

`guidata.dataset.dataitems.FloatItem`

xmax

X_{\max} . Default: None.

Type

`guidata.dataset.dataitems.FloatItem`

mode

Single choice from: 'dx', 'nbpts'. Default: 'nbpts'.

Type

`guidata.dataset.dataitems.ChoiceItem`

dx

X. Default: None.

Type

`guidata.dataset.dataitems.FloatItem`

nbpts

Number of points. Default: None.

Type

`guidata.dataset.dataitems.IntItem`

classmethod **create**(*method: str, fill_value: float, xmin: float, xmax: float, mode: str, dx: float, nbpts: int*)
→ *cdl.computation.signal.ResamplingParam*

Returns a new instance of `ResamplingParam` with the fields set to the given values.

Parameters

- **method** (*str*) – Interpolation method. Single choice from: 'linear', 'spline', 'quadratic', 'cubic', 'barycentric', 'pchip'. Default: 'linear'.
- **fill_value** (*float*) – Value to use for points outside the interpolation domain (used only with linear, cubic and pchip methods). Default: None.
- **xmin** (*float*) – X_{\min} . Default: None.
- **xmax** (*float*) – X_{\max} . Default: None.
- **mode** (*str*) – Single choice from: 'dx', 'nbpts'. Default: 'nbpts'.
- **dx** (*float*) – X. Default: None.
- **nbpts** (*int*) – Number of points. Default: None.

Returns

New instance of `ResamplingParam`.

class `cdl.param.WindowingParam`

Windowing parameters

method

Single choice from: 'barthann', 'bartlett', 'blackman', 'blackman-harris', 'bohman', 'boxcar', 'cosine', 'exponential', 'flat-top', 'gaussian', 'hamming', 'hanning', 'kaiser', 'lanczos', 'nuttall', 'parzen', 'rectangular', 'taylor', 'tukey'. Default: 'hamming'.

Type

`guidata.dataset.dataitems.ChoiceItem`

alpha

Shape parameter of the tukey windowing function. Default: 0.5.

Type

`guidata.dataset.dataitems.FloatItem`

beta

Shape parameter of the kaiser windowing function. Default: 14.0.

Type

`guidata.dataset.dataitems.FloatItem`

sigma

Shape parameter of the gaussian windowing function. Default: 0.5.

Type

`guidata.dataset.dataitems.FloatItem`

classmethod **create**(*method: str, alpha: float, beta: float, sigma: float*) → *cdl.computation.signal.WindowingParam*

Returns a new instance of `WindowingParam` with the fields set to the given values.

Parameters

- **method** (*str*) – Single choice from: ‘barthann’, ‘bartlett’, ‘blackman’, ‘blackman-harris’, ‘bohman’, ‘boxcar’, ‘cosine’, ‘exponential’, ‘flat-top’, ‘gaussian’, ‘hamming’, ‘hanning’, ‘kaiser’, ‘lanczos’, ‘nuttall’, ‘parzen’, ‘rectangular’, ‘taylor’, ‘tukey’. Default: ‘hamming’.
- **alpha** (*float*) – Shape parameter of the tukey windowing function. Default: 0.5.
- **beta** (*float*) – Shape parameter of the kaiser windowing function. Default: 14.0.
- **sigma** (*float*) – Shape parameter of the gaussian windowing function. Default: 0.5.

Returns

New instance of `WindowingParam`.

class `cdl.param.XYCalibrateParam`

Signal calibration parameters

axis

Calibrate. Single choice from: ‘x’, ‘y’. Default: ‘y’.

Type

`guidata.dataset.dataitems.ChoiceItem`

a

Default: 1.0.

Type

`guidata.dataset.dataitems.FloatItem`

b

Default: 0.0.

Type

`guidata.dataset.dataitems.FloatItem`

classmethod **create**(*axis: str, a: float, b: float*) → *cdl.computation.signal.XYCalibrateParam*

Returns a new instance of `XYCalibrateParam` with the fields set to the given values.

Parameters

- **axis** (*str*) – Calibrate. Single choice from: ‘x’, ‘y’. Default: ‘y’.
- **a** (*float*) – Default: 1.0.
- **b** (*float*) – Default: 0.0.

Returns

New instance of XYCalibrateParam.

3.2.4 Image parameters

Base image parameters

class `cdl.param.AverageProfileParam`

Average horizontal or vertical profile parameters

direction

Single choice from: 'horizontal', 'vertical'. Default: 'horizontal'.

Type

`guidata.dataset.dataitems.ChoiceItem`

row1

Integer higher than 0. Default: 0.

Type

`guidata.dataset.dataitems.IntItem`

row2

Integer higher than -1. Default: -1.

Type

`guidata.dataset.dataitems.IntItem`

col1

Column 1. Integer higher than 0. Default: 0.

Type

`guidata.dataset.dataitems.IntItem`

col2

Column 2. Integer higher than -1. Default: -1.

Type

`guidata.dataset.dataitems.IntItem`

classmethod `create(direction: str, row1: int, row2: int, col1: int, col2: int) →`
`cdl.computation.image.AverageProfileParam`

Returns a new instance of `AverageProfileParam` with the fields set to the given values.

Parameters

- **direction** (*str*) – Single choice from: 'horizontal', 'vertical'. Default: 'horizontal'.
- **row1** (*int*) – Integer higher than 0. Default: 0.
- **row2** (*int*) – Integer higher than -1. Default: -1.
- **col1** (*int*) – Column 1. Integer higher than 0. Default: 0.
- **col2** (*int*) – Column 2. Integer higher than -1. Default: -1.

Returns

New instance of `AverageProfileParam`.

class `cdl.param.BinningParam`

Binning parameters

sx

Cluster size (X). Number of adjacent pixels to be combined together along x-axis. Integer higher than 2. Default: 2.

Type`guidata.dataset.dataitems.IntItem`**sy**

Cluster size (Y). Number of adjacent pixels to be combined together along y-axis. Integer higher than 2. Default: 2.

Type`guidata.dataset.dataitems.IntItem`**operation**

Single choice from: 'sum', 'average', 'median', 'min', 'max'. Default: 'sum'.

Type`guidata.dataset.dataitems.ChoiceItem`**dtype_str**

Data type. Output image data type. Single choice from: 'dtype', 'float32', 'float64', 'complex128', 'int32', 'int16', 'uint16', 'uint8'. Default: 'dtype'.

Type`guidata.dataset.dataitems.ChoiceItem`**change_pixel_size**

Change pixel size so that overall image size remains the same. Default: False.

Type`guidata.dataset.dataitems.BoolItem`

classmethod `create(sx: int, sy: int, operation: str, dtype_str: str, change_pixel_size: bool) → cdl.computation.image.BinningParam`

Returns a new instance of `BinningParam` with the fields set to the given values.

Parameters

- **sx** (*int*) – Cluster size (X). Number of adjacent pixels to be combined together along x-axis. Integer higher than 2. Default: 2.
- **sy** (*int*) – Cluster size (Y). Number of adjacent pixels to be combined together along y-axis. Integer higher than 2. Default: 2.
- **operation** (*str*) – Single choice from: 'sum', 'average', 'median', 'min', 'max'. Default: 'sum'.
- **dtype_str** (*str*) – Data type. Output image data type. Single choice from: 'dtype', 'float32', 'float64', 'complex128', 'int32', 'int16', 'uint16', 'uint8'. Default: 'dtype'.
- **change_pixel_size** (*bool*) – Change pixel size so that overall image size remains the same. Default: False.

Returns

New instance of `BinningParam`.

class `cdl.param.ButterworthParam`

Butterworth filter parameters

cut_off

Cut-off frequency ratio. Cut-off frequency ratio. Float between 0.0 and 0.5. Default: 0.005.

Type

`guidata.dataset.dataitems.FloatItem`

high_pass

If true, apply high-pass filter instead of low-pass. Default: False.

Type

`guidata.dataset.dataitems.BoolItem`

order

Order of the butterworth filter. Integer higher than 1. Default: 2.

Type

`guidata.dataset.dataitems.IntItem`

classmethod `create(cut_off: float, high_pass: bool, order: int) →`

`cdl.computation.image.ButterworthParam`

Returns a new instance of `ButterworthParam` with the fields set to the given values.

Parameters

- **cut_off** (*float*) – Cut-off frequency ratio. Cut-off frequency ratio. Float between 0.0 and 0.5. Default: 0.005.
- **high_pass** (*bool*) – If true, apply high-pass filter instead of low-pass. Default: False.
- **order** (*int*) – Order of the butterworth filter. Integer higher than 1. Default: 2.

Returns

New instance of `ButterworthParam`.

class `cdl.param.DataTypeIParam`

Convert image data type parameters

dtype_str

Destination data type. Output image data type. Single choice from: 'float32', 'float64', 'complex128', 'int32', 'int16', 'uint16', 'uint8'. Default: 'float32'.

Type

`guidata.dataset.dataitems.ChoiceItem`

classmethod `create(dtype_str: str) → cdl.computation.image.DataTypeIParam`

Returns a new instance of `DataTypeIParam` with the fields set to the given values.

Parameters

dtype_str (*str*) – Destination data type. Output image data type. Single choice from: 'float32', 'float64', 'complex128', 'int32', 'int16', 'uint16', 'uint8'. Default: 'float32'.

Returns

New instance of `DataTypeIParam`.

class `cdl.param.FlatFieldParam`

Flat-field parameters

threshold

Default: 0.0.

Type

`guidata.dataset.dataitems.FloatItem`

classmethod `create(threshold: float) → cdl.computation.image.FlatFieldParam`

Returns a new instance of `FlatFieldParam` with the fields set to the given values.

Parameters

threshold (*float*) – Default: 0.0.

Returns

New instance of `FlatFieldParam`.

class `cdl.param.GridParam`

Grid parameters

direction

Distribute over. Single choice from: 'col', 'row'. Default: 'col'.

Type

`guidata.dataset.dataitems.ChoiceItem`

cols

Columns. Integer, non zero. Default: 1.

Type

`guidata.dataset.dataitems.IntItem`

rows

Integer, non zero. Default: 1.

Type

`guidata.dataset.dataitems.IntItem`

colspac

Column spacing. Float higher than 0.0. Default: 0.0.

Type

`guidata.dataset.dataitems.FloatItem`

rowspac

Row spacing. Float higher than 0.0. Default: 0.0.

Type

`guidata.dataset.dataitems.FloatItem`

classmethod `create(direction: str, cols: int, rows: int, colspac: float, rowspac: float) → cdl.computation.image.GridParam`

Returns a new instance of `GridParam` with the fields set to the given values.

Parameters

- **direction** (*str*) – Distribute over. Single choice from: 'col', 'row'. Default: 'col'.
- **cols** (*int*) – Columns. Integer, non zero. Default: 1.
- **rows** (*int*) – Integer, non zero. Default: 1.
- **colspac** (*float*) – Column spacing. Float higher than 0.0. Default: 0.0.
- **rowspac** (*float*) – Row spacing. Float higher than 0.0. Default: 0.0.

Returns

New instance of GridParam.

class `cdl.param.HoughCircleParam`

Circle Hough transform parameters

min_radius

Radius_{min}. Integer higher than 0, non zero, unit: pixels. Default: None.

Type

`guidata.dataset.dataitems.IntItem`

max_radius

Radius_{max}. Integer higher than 0, non zero, unit: pixels. Default: None.

Type

`guidata.dataset.dataitems.IntItem`

min_distance

Minimal distance. Integer higher than 0. Default: None.

Type

`guidata.dataset.dataitems.IntItem`

classmethod `create(min_radius: int, max_radius: int, min_distance: int) → cdl.computation.image.HoughCircleParam`

Returns a new instance of HoughCircleParam with the fields set to the given values.

Parameters

- **min_radius** (*int*) – Radius_{min}. Integer higher than 0, non zero, unit: pixels. Default: None.
- **max_radius** (*int*) – Radius_{max}. Integer higher than 0, non zero, unit: pixels. Default: None.
- **min_distance** (*int*) – Minimal distance. Integer higher than 0. Default: None.

Returns

New instance of HoughCircleParam.

class `cdl.param.LineProfileParam`

Horizontal or vertical profile parameters

direction

Single choice from: 'horizontal', 'vertical'. Default: 'horizontal'.

Type

`guidata.dataset.dataitems.ChoiceItem`

row

Integer higher than 0. Default: 0.

Type

`guidata.dataset.dataitems.IntItem`

col

Column. Integer higher than 0. Default: 0.

Type

`guidata.dataset.dataitems.IntItem`

classmethod `create(direction: str, row: int, col: int) → cdl.computation.image.LineProfileParam`

Returns a new instance of `LineProfileParam` with the fields set to the given values.

Parameters

- **direction** (*str*) – Single choice from: ‘horizontal’, ‘vertical’. Default: ‘horizontal’.
- **row** (*int*) – Integer higher than 0. Default: 0.
- **col** (*int*) – Column. Integer higher than 0. Default: 0.

Returns

New instance of `LineProfileParam`.

class `cdl.param.LogP1Param`

Log10 parameters

n

Default: None.

Type

`guidata.dataset.dataitems.FloatItem`

classmethod `create(n: float) → cdl.computation.image.LogP1Param`

Returns a new instance of `LogP1Param` with the fields set to the given values.

Parameters

n (*float*) – Default: None.

Returns

New instance of `LogP1Param`.

class `cdl.param.RadialProfileParam`

Radial profile parameters

center

Center position. Single choice from: ‘centroid’, ‘center’, ‘user’. Default: ‘centroid’.

Type

`guidata.dataset.dataitems.ChoiceItem`

x0

X_{Center} . Float, unit: pixel. Default: None.

Type

`guidata.dataset.dataitems.FloatItem`

y0

X_{Center} . Float, unit: pixel. Default: None.

Type

`guidata.dataset.dataitems.FloatItem`

classmethod `create(center: str, x0: float, y0: float) → cdl.computation.image.RadialProfileParam`

Returns a new instance of `RadialProfileParam` with the fields set to the given values.

Parameters

- **center** (*str*) – Center position. Single choice from: ‘centroid’, ‘center’, ‘user’. Default: ‘centroid’.
- **x0** (*float*) – X_{Center} . Float, unit: pixel. Default: None.

- **y0** (*float*) – X_{Center} . Float, unit: pixel. Default: None.

Returns

New instance of RadialProfileParam.

update_from_image(*obj*: ImageObj) → None

Update parameters from image

choice_callback(*item*, *value*)

Callback for choice item

class cdl.param.ResizeParam

Resize parameters

zoom

Default: None.

Type

guidata.dataset.dataitems.FloatItem

mode

Single choice from: 'constant', 'nearest', 'reflect', 'wrap'. Default: 'constant'.

Type

guidata.dataset.dataitems.ChoiceItem

cval

Value used for points outside the boundaries of the input if mode is 'constant'. Default: 0.0.

Type

guidata.dataset.dataitems.FloatItem

prefilter

Default: True.

Type

guidata.dataset.dataitems.BoolItem

order

Spline interpolation order. Integer between 0 and 5. Default: 3.

Type

guidata.dataset.dataitems.IntItem

classmethod **create**(*zoom*: float, *mode*: str, *cval*: float, *prefilter*: bool, *order*: int) →
cdl.computation.image.ResizeParam

Returns a new instance of ResizeParam with the fields set to the given values.

Parameters

- **zoom** (*float*) – Default: None.
- **mode** (*str*) – Single choice from: 'constant', 'nearest', 'reflect', 'wrap'. Default: 'constant'.
- **cval** (*float*) – Value used for points outside the boundaries of the input if mode is 'constant'. Default: 0.0.
- **prefilter** (*bool*) – Default: True.
- **order** (*int*) – Spline interpolation order. Integer between 0 and 5. Default: 3.

Returns

New instance of ResizeParam.

class `cdl.param.RotateParam`

Rotate parameters

angle

Angle (°). Default: None.

Type

`guidata.dataset.dataitems.FloatItem`

mode

Single choice from: 'constant', 'nearest', 'reflect', 'wrap'. Default: 'constant'.

Type

`guidata.dataset.dataitems.ChoiceItem`

cval

Value used for points outside the boundaries of the input if mode is 'constant'. Default: 0.0.

Type

`guidata.dataset.dataitems.FloatItem`

reshape

Reshape the output array so that the input array is contained completely in the output. Default: False.

Type

`guidata.dataset.dataitems.BoolItem`

prefilter

Default: True.

Type

`guidata.dataset.dataitems.BoolItem`

order

Spline interpolation order. Integer between 0 and 5. Default: 3.

Type

`guidata.dataset.dataitems.IntItem`

classmethod `create`(*angle: float, mode: str, cval: float, reshape: bool, prefilter: bool, order: int*) → `cdl.computation.image.RotateParam`

Returns a new instance of `RotateParam` with the fields set to the given values.

Parameters

- **angle** (*float*) – Angle (°). Default: None.
- **mode** (*str*) – Single choice from: 'constant', 'nearest', 'reflect', 'wrap'. Default: 'constant'.
- **cval** (*float*) – Value used for points outside the boundaries of the input if mode is 'constant'. Default: 0.0.
- **reshape** (*bool*) – Reshape the output array so that the input array is contained completely in the output. Default: False.
- **prefilter** (*bool*) – Default: True.
- **order** (*int*) – Spline interpolation order. Integer between 0 and 5. Default: 3.

Returns

New instance of `RotateParam`.

class `cdl.param.SegmentProfileParam`

Segment profile parameters

row1

Start row. Integer higher than 0. Default: 0.

Type`guidata.dataset.dataitems.IntItem`**col1**

Start column. Integer higher than 0. Default: 0.

Type`guidata.dataset.dataitems.IntItem`**row2**

End row. Integer higher than 0. Default: 0.

Type`guidata.dataset.dataitems.IntItem`**col2**

End column. Integer higher than 0. Default: 0.

Type`guidata.dataset.dataitems.IntItem`

classmethod **create**(*row1: int, col1: int, row2: int, col2: int*) →
`cdl.computation.image.SegmentProfileParam`

Returns a new instance of `SegmentProfileParam` with the fields set to the given values.**Parameters**

- **row1** (*int*) – Start row. Integer higher than 0. Default: 0.
- **col1** (*int*) – Start column. Integer higher than 0. Default: 0.
- **row2** (*int*) – End row. Integer higher than 0. Default: 0.
- **col2** (*int*) – End column. Integer higher than 0. Default: 0.

ReturnsNew instance of `SegmentProfileParam`.**class** `cdl.param.ZCalibrateParam`

Image linear calibration parameters

a

Default: 1.0.

Type`guidata.dataset.dataitems.FloatItem`**b**

Default: 0.0.

Type`guidata.dataset.dataitems.FloatItem`

classmethod `create(a: float, b: float) → cdl.computation.image.ZCalibrateParam`

Returns a new instance of `ZCalibrateParam` with the fields set to the given values.

Parameters

- **a** (*float*) – Default: 1.0.
- **b** (*float*) – Default: 0.0.

Returns

New instance of `ZCalibrateParam`.

Detection parameters

class `cdl.param.BlobDOGParam`

Blob detection using Difference of Gaussian method

min_sigma

min. The minimum standard deviation for gaussian kernel. Keep this low to detect smaller blobs. Float higher than 0, non zero, unit: pixels. Default: 1.0.

Type

`guidata.dataset.dataitems.FloatItem`

max_sigma

max. The maximum standard deviation for gaussian kernel. Keep this high to detect larger blobs. Float higher than 0, non zero, unit: pixels. Default: 30.0.

Type

`guidata.dataset.dataitems.FloatItem`

threshold_rel

Relative threshold. Minimum intensity of blobs. Float between 0.0 and 1.0. Default: 0.2.

Type

`guidata.dataset.dataitems.FloatItem`

overlap

If two blobs overlap by a fraction greater than this value, the smaller blob is eliminated. Float between 0.0 and 1.0. Default: 0.5.

Type

`guidata.dataset.dataitems.FloatItem`

exclude_border

If true, exclude blobs from the border of the image. Default: True.

Type

`guidata.dataset.dataitems.BoolItem`

classmethod `create(min_sigma: float, max_sigma: float, threshold_rel: float, overlap: float, exclude_border: bool) → cdl.computation.image.detection.BlobDOGParam`

Returns a new instance of `BlobDOGParam` with the fields set to the given values.

Parameters

- **min_sigma** (*float*) – min. The minimum standard deviation for gaussian kernel. Keep this low to detect smaller blobs. Float higher than 0, non zero, unit: pixels. Default: 1.0.

- **max_sigma** (*float*) – _{max}. The maximum standard deviation for gaussian kernel. Keep this high to detect larger blobs. Float higher than 0, non zero, unit: pixels. Default: 30.0.
- **threshold_rel** (*float*) – Relative threshold. Minimum intensity of blobs. Float between 0.0 and 1.0. Default: 0.2.
- **overlap** (*float*) – If two blobs overlap by a fraction greater than this value, the smaller blob is eliminated. Float between 0.0 and 1.0. Default: 0.5.
- **exclude_border** (*bool*) – If true, exclude blobs from the border of the image. Default: True.

Returns

New instance of BlobDOGParam.

class `cdl.param.BlobDOHParam`

Blob detection using Determinant of Hessian method

min_sigma

_{min}. The minimum standard deviation for gaussian kernel. Keep this low to detect smaller blobs. Float higher than 0, non zero, unit: pixels. Default: 1.0.

Type

`guidata.dataset.dataitems.FloatItem`

max_sigma

_{max}. The maximum standard deviation for gaussian kernel. Keep this high to detect larger blobs. Float higher than 0, non zero, unit: pixels. Default: 30.0.

Type

`guidata.dataset.dataitems.FloatItem`

threshold_rel

Relative threshold. Minimum intensity of blobs. Float between 0.0 and 1.0. Default: 0.2.

Type

`guidata.dataset.dataitems.FloatItem`

overlap

If two blobs overlap by a fraction greater than this value, the smaller blob is eliminated. Float between 0.0 and 1.0. Default: 0.5.

Type

`guidata.dataset.dataitems.FloatItem`

log_scale

If set intermediate values of standard deviations are interpolated using a logarithmic scale to the base 10. If not, linear interpolation is used. Default: False.

Type

`guidata.dataset.dataitems.BoolItem`

classmethod **create**(*min_sigma: float, max_sigma: float, threshold_rel: float, overlap: float, log_scale: bool*) → `cdl.computation.image.detection.BlobDOHParam`

Returns a new instance of BlobDOHParam with the fields set to the given values.

Parameters

- **min_sigma** (*float*) – _{min}. The minimum standard deviation for gaussian kernel. Keep this low to detect smaller blobs. Float higher than 0, non zero, unit: pixels. Default: 1.0.

- **max_sigma** (*float*) – _{max}. The maximum standard deviation for gaussian kernel. Keep this high to detect larger blobs. Float higher than 0, non zero, unit: pixels. Default: 30.0.
- **threshold_rel** (*float*) – Relative threshold. Minimum intensity of blobs. Float between 0.0 and 1.0. Default: 0.2.
- **overlap** (*float*) – If two blobs overlap by a fraction greater than this value, the smaller blob is eliminated. Float between 0.0 and 1.0. Default: 0.5.
- **log_scale** (*bool*) – If set intermediate values of standard deviations are interpolated using a logarithmic scale to the base 10. If not, linear interpolation is used. Default: False.

Returns

New instance of BlobDOHParam.

class `cdl.param.BlobLOGParam`

Blob detection using Laplacian of Gaussian method

min_sigma

_{min}. The minimum standard deviation for gaussian kernel. Keep this low to detect smaller blobs. Float higher than 0, non zero, unit: pixels. Default: 1.0.

Type

`guidata.dataset.dataitems.FloatItem`

max_sigma

_{max}. The maximum standard deviation for gaussian kernel. Keep this high to detect larger blobs. Float higher than 0, non zero, unit: pixels. Default: 30.0.

Type

`guidata.dataset.dataitems.FloatItem`

threshold_rel

Relative threshold. Minimum intensity of blobs. Float between 0.0 and 1.0. Default: 0.2.

Type

`guidata.dataset.dataitems.FloatItem`

overlap

If two blobs overlap by a fraction greater than this value, the smaller blob is eliminated. Float between 0.0 and 1.0. Default: 0.5.

Type

`guidata.dataset.dataitems.FloatItem`

log_scale

If set intermediate values of standard deviations are interpolated using a logarithmic scale to the base 10. If not, linear interpolation is used. Default: False.

Type

`guidata.dataset.dataitems.BoolItem`

exclude_border

If true, exclude blobs from the border of the image. Default: True.

Type

`guidata.dataset.dataitems.BoolItem`

classmethod **create**(*min_sigma: float, max_sigma: float, threshold_rel: float, overlap: float, log_scale: bool, exclude_border: bool*) → `cdl.computation.image.detection.BlobLOGParam`

Returns a new instance of BlobLOGParam with the fields set to the given values.

Parameters

- **min_sigma** (*float*) – _{min}. The minimum standard deviation for gaussian kernel. Keep this low to detect smaller blobs. Float higher than 0, non zero, unit: pixels. Default: 1.0.
- **max_sigma** (*float*) – _{max}. The maximum standard deviation for gaussian kernel. Keep this high to detect larger blobs. Float higher than 0, non zero, unit: pixels. Default: 30.0.
- **threshold_rel** (*float*) – Relative threshold. Minimum intensity of blobs. Float between 0.0 and 1.0. Default: 0.2.
- **overlap** (*float*) – If two blobs overlap by a fraction greater than this value, the smaller blob is eliminated. Float between 0.0 and 1.0. Default: 0.5.
- **log_scale** (*bool*) – If set intermediate values of standard deviations are interpolated using a logarithmic scale to the base 10. If not, linear interpolation is used. Default: False.
- **exclude_border** (*bool*) – If true, exclude blobs from the border of the image. Default: True.

Returns

New instance of BlobLOGParam.

class `cdl.param.BlobOpenCVParam`

Blob detection using OpenCV

min_threshold

Min. threshold. The minimum threshold between local maxima and minima. This parameter does not affect the quality of the blobs, only the quantity. Lower thresholds result in larger numbers of blobs. Float higher than 0.0. Default: 10.0.

Type

`guidata.dataset.dataitems.FloatItem`

max_threshold

Max. threshold. The maximum threshold between local maxima and minima. This parameter does not affect the quality of the blobs, only the quantity. Lower thresholds result in larger numbers of blobs. Float higher than 0.0. Default: 200.0.

Type

`guidata.dataset.dataitems.FloatItem`

min_repeatability

Min. repeatability. The minimum number of times a blob needs to be detected in a sequence of images to be considered valid. Integer higher than 1. Default: 2.

Type

`guidata.dataset.dataitems.IntItem`

min_dist_between_blobs

Min. distance between blobs. The minimum distance between two blobs. If blobs are found closer together than this distance, the smaller blob is removed. Float higher than 0.0, non zero. Default: 10.0.

Type

`guidata.dataset.dataitems.FloatItem`

filter_by_color

If true, the image is filtered by color instead of intensity. Default: True.

Type

`guidata.dataset.dataitems.BoolItem`

blob_color

The color of the blobs to detect (0 for dark blobs, 255 for light blobs). Default: 0.

Type

`guidata.dataset.dataitems.IntItem`

filter_by_area

If true, the image is filtered by blob area. Default: True.

Type

`guidata.dataset.dataitems.BoolItem`

min_area

Min. area. The minimum blob area. Float higher than 0.0. Default: 25.0.

Type

`guidata.dataset.dataitems.FloatItem`

max_area

Max. area. The maximum blob area. Float higher than 0.0. Default: 500.0.

Type

`guidata.dataset.dataitems.FloatItem`

filter_by_circularity

If true, the image is filtered by blob circularity. Default: False.

Type

`guidata.dataset.dataitems.BoolItem`

min_circularity

Min. circularity. The minimum circularity of the blobs. Float between 0.0 and 1.0. Default: 0.8.

Type

`guidata.dataset.dataitems.FloatItem`

max_circularity

Max. circularity. The maximum circularity of the blobs. Float between 0.0 and 1.0. Default: 1.0.

Type

`guidata.dataset.dataitems.FloatItem`

filter_by_inertia

If true, the image is filtered by blob inertia. Default: False.

Type

`guidata.dataset.dataitems.BoolItem`

min_inertia_ratio

Min. inertia ratio. The minimum inertia ratio of the blobs. Float between 0.0 and 1.0. Default: 0.6.

Type

`guidata.dataset.dataitems.FloatItem`

max_inertia_ratio

Max. inertia ratio. The maximum inertia ratio of the blobs. Float between 0.0 and 1.0. Default: 1.0.

Type

`guidata.dataset.dataitems.FloatItem`

filter_by_convexity

If true, the image is filtered by blob convexity. Default: False.

Type

`guidata.dataset.dataitems.BoolItem`

min_convexity

Min. convexity. The minimum convexity of the blobs. Float between 0.0 and 1.0. Default: 0.8.

Type

`guidata.dataset.dataitems.FloatItem`

max_convexity

Max. convexity. The maximum convexity of the blobs. Float between 0.0 and 1.0. Default: 1.0.

Type

`guidata.dataset.dataitems.FloatItem`

classmethod create(*min_threshold: float, max_threshold: float, min_repeatability: int, min_dist_between_blobs: float, filter_by_color: bool, blob_color: int, filter_by_area: bool, min_area: float, max_area: float, filter_by_circularity: bool, min_circularity: float, max_circularity: float, filter_by_inertia: bool, min_inertia_ratio: float, max_inertia_ratio: float, filter_by_convexity: bool, min_convexity: float, max_convexity: float*) → `cdl.computation.image.detection.BlobOpenCVParam`

Returns a new instance of `BlobOpenCVParam` with the fields set to the given values.

Parameters

- **min_threshold** (*float*) – Min. threshold. The minimum threshold between local maxima and minima. This parameter does not affect the quality of the blobs, only the quantity. Lower thresholds result in larger numbers of blobs. Float higher than 0.0. Default: 10.0.
- **max_threshold** (*float*) – Max. threshold. The maximum threshold between local maxima and minima. This parameter does not affect the quality of the blobs, only the quantity. Lower thresholds result in larger numbers of blobs. Float higher than 0.0. Default: 200.0.
- **min_repeatability** (*int*) – Min. repeatability. The minimum number of times a blob needs to be detected in a sequence of images to be considered valid. Integer higher than 1. Default: 2.
- **min_dist_between_blobs** (*float*) – Min. distance between blobs. The minimum distance between two blobs. If blobs are found closer together than this distance, the smaller blob is removed. Float higher than 0.0, non zero. Default: 10.0.
- **filter_by_color** (*bool*) – If true, the image is filtered by color instead of intensity. Default: True.
- **blob_color** (*int*) – The color of the blobs to detect (0 for dark blobs, 255 for light blobs). Default: 0.
- **filter_by_area** (*bool*) – If true, the image is filtered by blob area. Default: True.
- **min_area** (*float*) – Min. area. The minimum blob area. Float higher than 0.0. Default: 25.0.
- **max_area** (*float*) – Max. area. The maximum blob area. Float higher than 0.0. Default: 500.0.
- **filter_by_circularity** (*bool*) – If true, the image is filtered by blob circularity. Default: False.

- **min_circularity** (*float*) – Min. circularity. The minimum circularity of the blobs. Float between 0.0 and 1.0. Default: 0.8.
- **max_circularity** (*float*) – Max. circularity. The maximum circularity of the blobs. Float between 0.0 and 1.0. Default: 1.0.
- **filter_by_inertia** (*bool*) – If true, the image is filtered by blob inertia. Default: False.
- **min_inertia_ratio** (*float*) – Min. inertia ratio. The minimum inertia ratio of the blobs. Float between 0.0 and 1.0. Default: 0.6.
- **max_inertia_ratio** (*float*) – Max. inertia ratio. The maximum inertia ratio of the blobs. Float between 0.0 and 1.0. Default: 1.0.
- **filter_by_convexity** (*bool*) – If true, the image is filtered by blob convexity. Default: False.
- **min_convexity** (*float*) – Min. convexity. The minimum convexity of the blobs. Float between 0.0 and 1.0. Default: 0.8.
- **max_convexity** (*float*) – Max. convexity. The maximum convexity of the blobs. Float between 0.0 and 1.0. Default: 1.0.

Returns

New instance of BlobOpenCVPParam.

class `cdl.param.ContourShapeParam`

Contour shape parameters

threshold

Relative threshold. Detection threshold, relative to difference between data maximum and minimum. Float between 0.1 and 0.9. Default: 0.5.

Type

`guidata.dataset.dataitems.FloatItem`

shape

Single choice from: 'ellipse', 'circle', 'polygon'. Default: 'ellipse'.

Type

`guidata.dataset.dataitems.ChoiceItem`

classmethod `create(threshold: float, shape: str) → cdl.computation.image.detection.ContourShapeParam`

Returns a new instance of ContourShapeParam with the fields set to the given values.

Parameters

- **threshold** (*float*) – Relative threshold. Detection threshold, relative to difference between data maximum and minimum. Float between 0.1 and 0.9. Default: 0.5.
- **shape** (*str*) – Single choice from: 'ellipse', 'circle', 'polygon'. Default: 'ellipse'.

Returns

New instance of ContourShapeParam.

class `cdl.param.Peak2DDetectionParam`

Peak detection parameters

threshold

Relative threshold. Detection threshold, relative to difference between data maximum and minimum. Float between 0.1 and 0.9. Default: 0.5.

Type`guidata.dataset.dataitems.FloatItem`**size**

Neighborhoods size. Size of the sliding window used in maximum/minimum filtering algorithm. Integer higher than 1, unit: pixels. Default: 10.

Type`guidata.dataset.dataitems.IntItem`**create_rois**

Default: True.

Type`guidata.dataset.dataitems.BoolItem`

classmethod **create**(*threshold: float, size: int, create_rois: bool*) →
cdl.computation.image.detection.Peak2DDetectionParam

Returns a new instance of `Peak2DDetectionParam` with the fields set to the given values.

Parameters

- **threshold** (*float*) – Relative threshold. Detection threshold, relative to difference between data maximum and minimum. Float between 0.1 and 0.9. Default: 0.5.
- **size** (*int*) – Neighborhoods size. Size of the sliding window used in maximum/minimum filtering algorithm. Integer higher than 1, unit: pixels. Default: 10.
- **create_rois** (*bool*) – Default: True.

Returns

New instance of `Peak2DDetectionParam`.

Edge detection parameters

class `cdl.param.CannyParam`

Canny filter parameters

sigma

Standard deviation of the gaussian filter. Float higher than 0, non zero, unit: pixels. Default: 1.0.

Type`guidata.dataset.dataitems.FloatItem`**low_threshold**

Lower bound for hysteresis thresholding (linking edges). Float higher than 0. Default: 0.1.

Type`guidata.dataset.dataitems.FloatItem`**high_threshold**

Upper bound for hysteresis thresholding (linking edges). Float higher than 0. Default: 0.9.

Type`guidata.dataset.dataitems.FloatItem`**use_quantiles**

If true then treat `low_threshold` and `high_threshold` as quantiles of the edge magnitude image, rather than absolute edge magnitude values. If true then the thresholds must be in the range [0, 1]. Default: True.

Type`guidata.dataset.dataitems.BoolItem`**mode**

Single choice from: 'reflect', 'constant', 'nearest', 'mirror', 'wrap'. Default: 'constant'.

Type`guidata.dataset.dataitems.ChoiceItem`**cval**

Value to fill past edges of input if mode is constant. Default: 0.0.

Type`guidata.dataset.dataitems.FloatItem`

classmethod **create**(*sigma: float, low_threshold: float, high_threshold: float, use_quantiles: bool, mode: str, cval: float*) → `cdl.computation.image.edges.CannyParam`

Returns a new instance of `CannyParam` with the fields set to the given values.

Parameters

- **sigma** (*float*) – Standard deviation of the gaussian filter. Float higher than 0, non zero, unit: pixels. Default: 1.0.
- **low_threshold** (*float*) – Lower bound for hysteresis thresholding (linking edges). Float higher than 0. Default: 0.1.
- **high_threshold** (*float*) – Upper bound for hysteresis thresholding (linking edges). Float higher than 0. Default: 0.9.
- **use_quantiles** (*bool*) – If true then treat `low_threshold` and `high_threshold` as quantiles of the edge magnitude image, rather than absolute edge magnitude values. If true then the thresholds must be in the range [0, 1]. Default: True.
- **mode** (*str*) – Single choice from: 'reflect', 'constant', 'nearest', 'mirror', 'wrap'. Default: 'constant'.
- **cval** (*float*) – Value to fill past edges of input if mode is constant. Default: 0.0.

Returns

New instance of `CannyParam`.

Exposure correction parameters

class `cdl.param.AdjustGammaParam`

Gamma adjustment parameters

gamma

Gamma correction factor (higher values give more contrast). Float higher than 0.0. Default: 1.0.

Type`guidata.dataset.dataitems.FloatItem`**gain**

Gain factor (higher values give more contrast). Float higher than 0.0. Default: 1.0.

Type`guidata.dataset.dataitems.FloatItem`

classmethod `create(gamma: float, gain: float) → cdl.computation.image.exposure.AdjustGammaParam`

Returns a new instance of `AdjustGammaParam` with the fields set to the given values.

Parameters

- **gamma** (*float*) – Gamma correction factor (higher values give more contrast). Float higher than 0.0. Default: 1.0.
- **gain** (*float*) – Gain factor (higher values give more contrast). Float higher than 0.0. Default: 1.0.

Returns

New instance of `AdjustGammaParam`.

class `cdl.param.AdjustLogParam`

Logarithmic adjustment parameters

gain

Gain factor (higher values give more contrast). Float higher than 0.0. Default: 1.0.

Type

`guidata.dataset.dataitems.FloatItem`

inv

If true, apply inverse logarithmic transformation. Default: False.

Type

`guidata.dataset.dataitems.BoolItem`

classmethod `create(gain: float, inv: bool) → cdl.computation.image.exposure.AdjustLogParam`

Returns a new instance of `AdjustLogParam` with the fields set to the given values.

Parameters

- **gain** (*float*) – Gain factor (higher values give more contrast). Float higher than 0.0. Default: 1.0.
- **inv** (*bool*) – If true, apply inverse logarithmic transformation. Default: False.

Returns

New instance of `AdjustLogParam`.

class `cdl.param.AdjustSigmoidParam`

Sigmoid adjustment parameters

cutoff

Cutoff value (higher values give more contrast). Float between 0.0 and 1.0. Default: 0.5.

Type

`guidata.dataset.dataitems.FloatItem`

gain

Gain factor (higher values give more contrast). Float higher than 0.0. Default: 10.0.

Type

`guidata.dataset.dataitems.FloatItem`

inv

If true, apply inverse sigmoid transformation. Default: False.

Type

`guidata.dataset.dataitems.BoolItem`

classmethod `create(cutoff: float, gain: float, inv: bool) →`
`cdl.computation.image.exposure.AdjustSigmoidParam`

Returns a new instance of `AdjustSigmoidParam` with the fields set to the given values.

Parameters

- **cutoff** (*float*) – Cutoff value (higher values give more contrast). Float between 0.0 and 1.0. Default: 0.5.
- **gain** (*float*) – Gain factor (higher values give more contrast). Float higher than 0.0. Default: 10.0.
- **inv** (*bool*) – If true, apply inverse sigmoid transformation. Default: False.

Returns

New instance of `AdjustSigmoidParam`.

class `cdl.param.EqualizeAdaptHistParam`

Adaptive histogram equalization parameters

nbins

Number of bins. Number of bins for image histogram. Integer higher than 1. Default: 256.

Type

`guidata.dataset.dataitems.IntItem`

clip_limit

Clipping limit. Clipping limit (higher values give more contrast). Float between 0.0 and 1.0. Default: 0.01.

Type

`guidata.dataset.dataitems.FloatItem`

classmethod `create(nbins: int, clip_limit: float) →`
`cdl.computation.image.exposure.EqualizeAdaptHistParam`

Returns a new instance of `EqualizeAdaptHistParam` with the fields set to the given values.

Parameters

- **nbins** (*int*) – Number of bins. Number of bins for image histogram. Integer higher than 1. Default: 256.
- **clip_limit** (*float*) – Clipping limit. Clipping limit (higher values give more contrast). Float between 0.0 and 1.0. Default: 0.01.

Returns

New instance of `EqualizeAdaptHistParam`.

class `cdl.param.EqualizeHistParam`

Histogram equalization parameters

nbins

Number of bins. Number of bins for image histogram. Integer higher than 1. Default: 256.

Type

`guidata.dataset.dataitems.IntItem`

classmethod `create(nbins: int) →` `cdl.computation.image.exposure.EqualizeHistParam`

Returns a new instance of `EqualizeHistParam` with the fields set to the given values.

Parameters

- **nbins** (*int*) – Number of bins. Number of bins for image histogram. Integer higher than 1. Default: 256.

Returns

New instance of `EqualizeHistParam`.

class `cdl.param.RescaleIntensityParam`

Intensity rescaling parameters

in_range

Input range. Min and max intensity values of input image ('image' refers to input image min/max levels, 'dtype' refers to input image data type range). Single choice from: 'image', 'dtype', 'float32', 'float64', 'complex128', 'int32', 'int16', 'uint16', 'uint8'. Default: 'image'.

Type

`guidata.dataset.dataitems.ChoiceItem`

out_range

Output range. Min and max intensity values of output image ('image' refers to input image min/max levels, 'dtype' refers to input image data type range).. Single choice from: 'image', 'dtype', 'float32', 'float64', 'complex128', 'int32', 'int16', 'uint16', 'uint8'. Default: 'dtype'.

Type

`guidata.dataset.dataitems.ChoiceItem`

classmethod `create(in_range: str, out_range: str) →`

`cdl.computation.image.exposure.RescaleIntensityParam`

Returns a new instance of `RescaleIntensityParam` with the fields set to the given values.

Parameters

- **in_range** (*str*) – Input range. Min and max intensity values of input image ('image' refers to input image min/max levels, 'dtype' refers to input image data type range). Single choice from: 'image', 'dtype', 'float32', 'float64', 'complex128', 'int32', 'int16', 'uint16', 'uint8'. Default: 'image'.
- **out_range** (*str*) – Output range. Min and max intensity values of output image ('image' refers to input image min/max levels, 'dtype' refers to input image data type range).. Single choice from: 'image', 'dtype', 'float32', 'float64', 'complex128', 'int32', 'int16', 'uint16', 'uint8'. Default: 'dtype'.

Returns

New instance of `RescaleIntensityParam`.

Morphological parameters

class `cdl.param.MorphologyParam`

White Top-Hat parameters

radius

Footprint (disk) radius. Integer higher than 1. Default: 1.

Type

`guidata.dataset.dataitems.IntItem`

classmethod `create(radius: int) → cdl.computation.image.morphology.MorphologyParam`

Returns a new instance of `MorphologyParam` with the fields set to the given values.

Parameters

- **radius** (*int*) – Footprint (disk) radius. Integer higher than 1. Default: 1.

Returns

New instance of `MorphologyParam`.

Restoration parameters**class** `cdl.param.DenoiseBilateralParam`

Bilateral filter denoising parameters

sigma_spatial

spatial. Standard deviation for range distance. A larger value results in averaging of pixels with larger spatial differences. Float higher than 0, non zero, unit: pixels. Default: 1.0.

Type

`guidata.dataset.dataitems.FloatItem`

mode

Single choice from: 'constant', 'edge', 'symmetric', 'reflect', 'wrap'. Default: 'constant'.

Type

`guidata.dataset.dataitems.ChoiceItem`

cval

Used in conjunction with mode 'constant', the value outside the image boundaries. Default: 0.

Type

`guidata.dataset.dataitems.FloatItem`

classmethod `create(sigma_spatial: float, mode: str, cval: float) →`
`cdl.computation.image.restoration.DenoiseBilateralParam`

Returns a new instance of `DenoiseBilateralParam` with the fields set to the given values.

Parameters

- **sigma_spatial** (*float*) – spatial. Standard deviation for range distance. A larger value results in averaging of pixels with larger spatial differences. Float higher than 0, non zero, unit: pixels. Default: 1.0.
- **mode** (*str*) – Single choice from: 'constant', 'edge', 'symmetric', 'reflect', 'wrap'. Default: 'constant'.
- **cval** (*float*) – Used in conjunction with mode 'constant', the value outside the image boundaries. Default: 0.

Returns

New instance of `DenoiseBilateralParam`.

class `cdl.param.DenoiseTVParam`

Total Variation denoising parameters

weight

Denoising weight. The greater weight, the more denoising (at the expense of fidelity to input). Float higher than 0, non zero. Default: 0.1.

Type

`guidata.dataset.dataitems.FloatItem`

eps

Epsilon. Relative difference of the value of the cost function that determines the stop criterion. The algorithm stops when: $(e_{(n-1)} - e_n) < \text{eps} * e_0$. Float higher than 0, non zero. Default: 0.0002.

Type`guidata.dataset.dataitems.FloatItem`**max_num_iter**

Max. iterations. Maximal number of iterations used for the optimization. Integer higher than 0, non zero. Default: 200.

Type`guidata.dataset.dataitems.IntItem`

classmethod create(*weight: float, eps: float, max_num_iter: int*) →
`cdl.computation.image.restoration.DenoiseTVParam`

Returns a new instance of `DenoiseTVParam` with the fields set to the given values.

Parameters

- **weight** (*float*) – Denoising weight. The greater weight, the more denoising (at the expense of fidelity to input). Float higher than 0, non zero. Default: 0.1.
- **eps** (*float*) – Epsilon. Relative difference of the value of the cost function that determines the stop criterion. The algorithm stops when: $(e_{(n-1)} - e_n) < \text{eps} * e_0$. Float higher than 0, non zero. Default: 0.0002.
- **max_num_iter** (*int*) – Max. iterations. Maximal number of iterations used for the optimization. Integer higher than 0, non zero. Default: 200.

Returns

New instance of `DenoiseTVParam`.

class cdl.param.DenoiseWaveletParam

Wavelet denoising parameters

wavelet

Single choice from: 'bior1.1', 'bior1.3', 'bior1.5', 'bior2.2', 'bior2.4', 'bior2.6', 'bior2.8', 'bior3.1', 'bior3.3', 'bior3.5', 'bior3.7', 'bior3.9', 'bior4.4', 'bior5.5', 'bior6.8', 'cgau1', 'cgau2', 'cgau3', 'cgau4', 'cgau5', 'cgau6', 'cgau7', 'cgau8', 'cmor', 'coif1', 'coif2', 'coif3', 'coif4', 'coif5', 'coif6', 'coif7', 'coif8', 'coif9', 'coif10', 'coif11', 'coif12', 'coif13', 'coif14', 'coif15', 'coif16', 'coif17', 'db1', 'db2', 'db3', 'db4', 'db5', 'db6', 'db7', 'db8', 'db9', 'db10', 'db11', 'db12', 'db13', 'db14', 'db15', 'db16', 'db17', 'db18', 'db19', 'db20', 'db21', 'db22', 'db23', 'db24', 'db25', 'db26', 'db27', 'db28', 'db29', 'db30', 'db31', 'db32', 'db33', 'db34', 'db35', 'db36', 'db37', 'db38', 'dmey', 'fbasp', 'gaus1', 'gaus2', 'gaus3', 'gaus4', 'gaus5', 'gaus6', 'gaus7', 'gaus8', 'haar', 'mexh', 'morl', 'rbio1.1', 'rbio1.3', 'rbio1.5', 'rbio2.2', 'rbio2.4', 'rbio2.6', 'rbio2.8', 'rbio3.1', 'rbio3.3', 'rbio3.5', 'rbio3.7', 'rbio3.9', 'rbio4.4', 'rbio5.5', 'rbio6.8', 'shan', 'sym2', 'sym3', 'sym4', 'sym5', 'sym6', 'sym7', 'sym8', 'sym9', 'sym10', 'sym11', 'sym12', 'sym13', 'sym14', 'sym15', 'sym16', 'sym17', 'sym18', 'sym19', 'sym20'. Default: 'sym9'.

Type`guidata.dataset.dataitems.ChoiceItem`**mode**

Single choice from: 'soft', 'hard'. Default: 'soft'.

Type`guidata.dataset.dataitems.ChoiceItem`**method**

Single choice from: 'BayesShrink', 'VisuShrink'. Default: 'VisuShrink'.

Type`guidata.dataset.dataitems.ChoiceItem`

classmethod `create(wavelet: str, mode: str, method: str) →`

`cdl.computation.image.restoration.DenoiseWaveletParam`

Returns a new instance of `DenoiseWaveletParam` with the fields set to the given values.

Parameters

- **wavelet** (*str*) – Single choice from: ‘bior1.1’, ‘bior1.3’, ‘bior1.5’, ‘bior2.2’, ‘bior2.4’, ‘bior2.6’, ‘bior2.8’, ‘bior3.1’, ‘bior3.3’, ‘bior3.5’, ‘bior3.7’, ‘bior3.9’, ‘bior4.4’, ‘bior5.5’, ‘bior6.8’, ‘cgau1’, ‘cgau2’, ‘cgau3’, ‘cgau4’, ‘cgau5’, ‘cgau6’, ‘cgau7’, ‘cgau8’, ‘cmor’, ‘coif1’, ‘coif2’, ‘coif3’, ‘coif4’, ‘coif5’, ‘coif6’, ‘coif7’, ‘coif8’, ‘coif9’, ‘coif10’, ‘coif11’, ‘coif12’, ‘coif13’, ‘coif14’, ‘coif15’, ‘coif16’, ‘coif17’, ‘db1’, ‘db2’, ‘db3’, ‘db4’, ‘db5’, ‘db6’, ‘db7’, ‘db8’, ‘db9’, ‘db10’, ‘db11’, ‘db12’, ‘db13’, ‘db14’, ‘db15’, ‘db16’, ‘db17’, ‘db18’, ‘db19’, ‘db20’, ‘db21’, ‘db22’, ‘db23’, ‘db24’, ‘db25’, ‘db26’, ‘db27’, ‘db28’, ‘db29’, ‘db30’, ‘db31’, ‘db32’, ‘db33’, ‘db34’, ‘db35’, ‘db36’, ‘db37’, ‘db38’, ‘dmey’, ‘fbsp’, ‘gaus1’, ‘gaus2’, ‘gaus3’, ‘gaus4’, ‘gaus5’, ‘gaus6’, ‘gaus7’, ‘gaus8’, ‘haar’, ‘mexh’, ‘morl’, ‘rbio1.1’, ‘rbio1.3’, ‘rbio1.5’, ‘rbio2.2’, ‘rbio2.4’, ‘rbio2.6’, ‘rbio2.8’, ‘rbio3.1’, ‘rbio3.3’, ‘rbio3.5’, ‘rbio3.7’, ‘rbio3.9’, ‘rbio4.4’, ‘rbio5.5’, ‘rbio6.8’, ‘shan’, ‘sym2’, ‘sym3’, ‘sym4’, ‘sym5’, ‘sym6’, ‘sym7’, ‘sym8’, ‘sym9’, ‘sym10’, ‘sym11’, ‘sym12’, ‘sym13’, ‘sym14’, ‘sym15’, ‘sym16’, ‘sym17’, ‘sym18’, ‘sym19’, ‘sym20’. Default: ‘sym9’.
- **mode** (*str*) – Single choice from: ‘soft’, ‘hard’. Default: ‘soft’.
- **method** (*str*) – Single choice from: ‘BayesShrink’, ‘VisuShrink’. Default: ‘VisuShrink’.

Returns

New instance of `DenoiseWaveletParam`.

Threshold parameters

class `cdl.param.ThresholdParam`

Histogram threshold parameters

method

Threshold method. Single choice from: ‘manual’, ‘isodata’, ‘li’, ‘mean’, ‘minimum’, ‘otsu’, ‘triangle’, ‘yen’. Default: ‘manual’.

Type

`guidata.dataset.dataitems.ChoiceItem`

bins

Number of bins. Integer higher than 1. Default: 256.

Type

`guidata.dataset.dataitems.IntItem`

value

Threshold value. Default: 0.0.

Type

`guidata.dataset.dataitems.FloatItem`

operation

Single choice from: ‘>’, ‘<’. Default: ‘>’.

Type

`guidata.dataset.dataitems.ChoiceItem`

classmethod `create(method: str, bins: int, value: float, operation: str) → cdl.computation.image.threshold.ThresholdParam`

Returns a new instance of `ThresholdParam` with the fields set to the given values.

Parameters

- **method** (*str*) – Threshold method. Single choice from: ‘manual’, ‘isodata’, ‘li’, ‘mean’, ‘minimum’, ‘otsu’, ‘triangle’, ‘yen’. Default: ‘manual’.
- **bins** (*int*) – Number of bins. Integer higher than 1. Default: 256.
- **value** (*float*) – Threshold value. Default: 0.0.
- **operation** (*str*) – Single choice from: ‘>’, ‘<’. Default: ‘>’.

Returns

New instance of `ThresholdParam`.

3.3 Object model (cdl.obj)

The `cdl.obj` module aims at providing all the necessary classes and functions to create and manipulate DataLab signal and image objects.

Those classes and functions are defined in other modules:

- `cdl.core.model.base`
- `cdl.core.model.image`
- `cdl.core.model.signal`
- `cdl.core.io`

The `cdl.obj` module is thus a convenient way to import all the objects at once. As a matter of fact, the following import statement is equivalent to the previous one:

```
# Original import statement
from cdl.core.model.signal import SignalObj
from cdl.core.model.image import ImageObj

# Equivalent import statement
from cdl.obj import SignalObj, ImageObj
```

3.3.1 Common objects

class `cdl.obj.ResultProperties(title: str, array: ndarray, labels: list[str] | None, item_json: str = "")`

Object representing properties serializable in signal/image metadata.

Result *array* is a NumPy 2-D array: each row is a list of properties, optionnally associated to a ROI (first column value).

ROI index is starting at 0 (or is simply 0 if there is no ROI).

Parameters

- **title** – properties title
- **array** – properties array

- **labels** – properties labels (one label per column of result array)
- **item_json** – JSON string of label item associated to this obj

Note: The *array* argument can be a list of lists or a NumPy array. For instance, the following are equivalent:

- `array = [[1, 2], [3, 4]]`
- `array = np.array([[1, 2], [3, 4]])`

Or for only one line (one single result), the following are equivalent:

- `array = [1, 2]`
 - `array = [[1, 2]]`
 - `array = np.array([[1, 2]])`
-

property category: `str`

Return result category

property headers: `list[str] | None`

Return result headers (one header per column of result array)

property shown_array: `ndarray`

Return array of shown results, i.e. including complementary array (if any)

Returns

Array of shown results

update_obj_metadata_from_item(*obj*: *BaseObj*, *item*: *LabelItem* | *None*) → *None*

Update object metadata with label item

Parameters

- **obj** – object (signal/image)
- **item** – label item

property label_contents: `tuple[tuple[int, str], ...]`

Return label contents, i.e. a tuple of couples of (index, text) where index is the column of raw_data and text is the associated label format string

create_label_item(*obj*: *BaseObj*) → *LabelItem* | *None*

Create label item

Parameters

obj – object (signal/image)

Returns

Label item

Note: The signal or image object is required as argument to create the label item because the label text may contain format strings that need to be filled with the object properties. For instance, the label text may contain the signal or image units.

get_label_item(*obj*: *BaseObj*) → *LabelItem* | *None*

Return label item associated to this result

Parameters**obj** – object (signal/image)**Returns**

Label item

Note: The signal or image object is required as argument to eventually create the label item if it has not been created yet. See [create_label_item\(\)](#).

class `cdl.obj.ResultShape`(*title: str, array: ndarray, shape: Literal['rectangle', 'circle', 'ellipse', 'segment', 'marker', 'point', 'polygon'], item_json: str = "", add_label: bool = False*)

Object representing a geometrical shape serializable in signal/image metadata.

Result *array* is a NumPy 2-D array: each row is a result, optionnally associated to a ROI (first column value).

ROI index is starting at 0 (or is simply 0 if there is no ROI).

Parameters

- **title** – result shape title
- **array** – shape coordinates (multiple shapes: one shape per row), first column is ROI index (0 if there is no ROI)
- **shape** – shape kind
- **item_json** – JSON string of label item associated to this obj
- **add_label** – if True, add a label item (and the geometrical shape) to plot (default to False)

Raises

AssertionError – invalid argument

Note: The *array* argument can be a list of lists or a NumPy array. For instance, the following are equivalent:

- `array = [[1, 2], [3, 4]]`
- `array = np.array([[1, 2], [3, 4]])`

Or for only one line (one single result), the following are equivalent:

- `array = [1, 2]`
 - `array = [[1, 2]]`
 - `array = np.array([[1, 2]])`
-

property category: `str`

Return result category

check_array() → `None`

Check if array attribute is valid

Raises

AssertionError – invalid array

property headers: `list[str] | None`

Return result headers (one header per column of result array)

property shown_array: `ndarray`

Return array of shown results, i.e. including complementary array (if any)

Returns

Array of shown results

property label_contents: `tuple[tuple[int, str], ...]`

Return label contents, i.e. a tuple of couples of (index, text) where index is the column of `raw_data` and text is the associated label format string

create_label_item(*obj: BaseObj*) → `LabelItem` | `None`

Create label item

Returns

Label item

merge_with(*obj: BaseObj, other_metadata: dict[str, Any]*) → `None`

Merge object resultshape with another's metadata (`obj` ← other obj's metadata)

Parameters

- **obj** – object (signal/image)
- **other_metadata** – other object metadata

transform_coordinates(*func: Callable[[ndarray], None]*) → `None`

Transform shape coordinates.

Parameters

func – function to transform coordinates

iterate_plot_items(*fmt: str, lbl: bool, option: Literal['s', 'i']*) → `Iterable`

Iterate over metadata shape plot items.

Parameters

- **fmt** – numeric format (e.g. “%.3f”)
- **lbl** – if True, show shape labels
- **option** – shape style option (“s” for signal, “i” for image)

Yields

Plot item

create_shape_item(*coords: np.ndarray, fmt: str, lbl: bool, option: Literal['s', 'i']*) → `AnnotatedPoint` | `Marker` | `AnnotatedRectangle` | `AnnotatedCircle` | `AnnotatedSegment` | `AnnotatedEllipse` | `PolygonShape` | `None`

Make geometrical shape plot item adapted to the shape type.

Parameters

- **coords** – shape data
- **fmt** – numeric format (e.g. “%.3f”)
- **lbl** – if True, show shape labels
- **option** – shape style option (“s” for signal, “i” for image)

Returns

Plot item

```

class cdl.obj.ShapeTypes(value, names=None, *, module=None, qualname=None, type=None, start=1,
                        boundary=None)
    Shape types for image metadata
    RECTANGLE = '_rec_'
        Rectangle shape
    CIRCLE = '_cir_'
        Circle shape
    ELLIPSE = '_ell_'
        Ellipse shape
    SEGMENT = '_seg_'
        Segment shape
    MARKER = '_mar_'
        Marker shape
    POINT = '_poi_'
        Point shape
    POLYGON = '_pol_'
        Polygon shape

class cdl.obj.UniformRandomParam(title=None, comment=None, icon="")
    Uniform-law random signal/image parameters
    apply_integer_range(vmin, vmax)
        Do something in case of integer min-max range

class cdl.obj.NormalRandomParam(title=None, comment=None, icon="")
    Normal-law random signal/image parameters
    apply_integer_range(vmin, vmax)
        Do something in case of integer min-max range

class cdl.obj.BaseProcParam(title=None, comment=None, icon="")
    Base class for processing parameters
    apply_integer_range(vmin, vmax)
        Do something in case of integer min-max range
    apply_float_range(vmin, vmax)
        Do something in case of float min-max range
    set_from_datatype(dtype)
        Set min/max range from NumPy datatype

```

3.3.2 Signal model

class `cdl.obj.SignalObj`

Signal object

uuid

Default: None.

Type

`guidata.dataset.dataitems.StringItem`

xydata

Default: None.

Type

`guidata.dataset.dataitems.FloatArrayItem`

metadata

Default: {}.

Type

`guidata.dataset.dataitems.DictItem`

title

Signal title. Default: 'Untitled'.

Type

`guidata.dataset.dataitems.StringItem`

xlabel

Title. Default: ''.

Type

`guidata.dataset.dataitems.StringItem`

xunit

Default: ''.

Type

`guidata.dataset.dataitems.StringItem`

ylabel

Title. Default: ''.

Type

`guidata.dataset.dataitems.StringItem`

yunit

Default: ''.

Type

`guidata.dataset.dataitems.StringItem`

autoscale

Default: True.

Type

`guidata.dataset.dataitems.BoolItem`

xscalelog

Default: False.

Type

`guidata.dataset.dataitems.BoolItem`

xscalemin

Lower bound. Default: None.

Type

`guidata.dataset.dataitems.FloatItem`

xscalemax

Upper bound. Default: None.

Type

`guidata.dataset.dataitems.FloatItem`

yscalelog

Default: False.

Type

`guidata.dataset.dataitems.BoolItem`

yscalemin

Lower bound. Default: None.

Type

`guidata.dataset.dataitems.FloatItem`

yscalemax

Upper bound. Default: None.

Type

`guidata.dataset.dataitems.FloatItem`

classmethod **create**(*uuid: str, xydata: numpy.ndarray, metadata: dict, title: str, xlabel: str, xunit: str, ylabel: str, yunit: str, autoscale: bool, xscalelog: bool, xscalemin: float, xscalemax: float, yscalelog: bool, yscalemin: float, yscalemax: float*) → *cdl.core.model.signal.SignalObj*

Returns a new instance of *SignalObj* with the fields set to the given values.

Parameters

- **uuid** (*str*) – Default: None.
- **xydata** (*numpy.ndarray*) – Default: None.
- **metadata** (*dict*) – Default: {}.
- **title** (*str*) – Signal title. Default: ‘Untitled’.
- **xlabel** (*str*) – Title. Default: ‘’.
- **xunit** (*str*) – Default: ‘’.
- **ylabel** (*str*) – Title. Default: ‘’.
- **yunit** (*str*) – Default: ‘’.
- **autoscale** (*bool*) – Default: True.
- **xscalelog** (*bool*) – Default: False.

- **xscalemin** (*float*) – Lower bound. Default: None.
- **xscalemax** (*float*) – Upper bound. Default: None.
- **yscalelog** (*bool*) – Default: False.
- **yscalemin** (*float*) – Lower bound. Default: None.
- **yscalemax** (*float*) – Upper bound. Default: None.

Returns

New instance of *SignalObj*.

static get_roi_class() → *Type[SignalROI]*

Return ROI class

regenerate_uuid()

Regenerate UUID

This method is used to regenerate UUID after loading the object from a file. This is required to avoid UUID conflicts when loading objects from file without clearing the workspace first.

copy(*title: str | None = None, dtype: dtype | None = None*) → *SignalObj*

Copy object.

Parameters

- **title** – title
- **dtype** – data type

Returns

Copied object

set_data_type(*dtype: dtype*) → *None*

Change data type.

Parameters

type (*Data*) –

set_xydata(*x: ndarray | list, y: ndarray | list, dx: ndarray | list | None = None, dy: ndarray | list | None = None*) → *None*

Set xy data

Parameters

- **x** – x data
- **y** – y data
- **dx** – dx data (optional: error bars)
- **dy** – dy data (optional: error bars)

property x: *ndarray | None*

Get x data

property y: *ndarray | None*

Get y data

property data: *ndarray | None*

Get y data

property dx: `ndarray` | `None`

Get dx data

property dy: `ndarray` | `None`

Get dy data

get_data(*roi_index*: `int` | `None` = `None`) → `tuple`[`ndarray`, `ndarray`]

Return original data (if ROI is not defined or *roi_index* is `None`), or ROI data (if both ROI and *roi_index* are defined).

Parameters

roi_index – ROI index

Returns

Data

update_plot_item_parameters(*item*: `CurveItem`) → `None`

Update plot item parameters from object data/metadata

Takes into account a subset of plot item parameters. Those parameters may have been overridden by object metadata entries or other object data. The goal is to update the plot item accordingly.

This is *almost* the inverse operation of *update_metadata_from_plot_item*.

Parameters

item – plot item

update_metadata_from_plot_item(*item*: `CurveItem`) → `None`

Update metadata from plot item.

Takes into account a subset of plot item parameters. Those parameters may have been modified by the user through the plot item GUI. The goal is to update the metadata accordingly.

This is *almost* the inverse operation of *update_plot_item_parameters*.

Parameters

item – plot item

make_item(*update_from*: `CurveItem` | `None` = `None`) → `CurveItem`

Make plot item from data.

Parameters

update_from – plot item to update from

Returns

Plot item

update_item(*item*: `CurveItem`, *data_changed*: `bool` = `True`) → `None`

Update plot item from data.

Parameters

- **item** – plot item
- **data_changed** – if `True`, data has changed

physical_to_indices(*coords*: `list`[`float`] | `ndarray`) → `ndarray`

Convert coordinates from physical (real world) to (array) indices (pixel)

Parameters

coords – coordinates

Returns

Indices

indices_to_physical(*indices*: *list[int] | ndarray*) → *ndarray*

Convert coordinates from (array) indices to physical (real world)

Parameters**indices** – indices**Returns**

Coordinates

add_label_with_title(*title*: *str | None = None*) → *None*

Add label with title annotation

Parameters**title** – title (if None, use signal title)**accept**(*vis*: *object*) → *None*

Helper function that passes the visitor to the accept methods of all the items in this dataset

Parameters**vis** (*object*) – visitor object**add_annotations_from_file**(*filename*: *str*) → *None*

Add object annotations from file (JSON).

Parameters**filename** – filename**add_annotations_from_items**(*items*: *list*) → *None*

Add object annotations (annotation plot items).

Parameters**items** – annotation plot items**property annotations:** *str*

Get object annotations (JSON string describing annotation plot items)

check() → *list[str]*

Check the dataset item values

Returns

list of errors

Return type*list[str]***check_data**()

Check if data is valid, raise an exception if that's not the case

Raises**TypeError** – if data type is not supported**delete_results**() → *None*

Delete all object results (shapes and properties)

deserialize(*reader*: *HDF5Reader | JSONReader | INIReader*) → *None*

Deserialize the dataset

Parameters**reader** (*HDF5Reader | JSONReader | INIReader*) – reader object

edit(parent: *QWidget* | *None* = *None*, apply: *Callable* | *None* = *None*, wordwrap: *bool* = *True*, size: *QSize* | *tuple*[*int*, *int*] | *None* = *None*) → *DataSetEditDialog*

Open a dialog box to edit data set

Parameters

- **parent** – parent widget (default is *None*, meaning no parent)
- **apply** – apply callback (default is *None*)
- **wordwrap** – if *True*, comment text is wordwrapped
- **size** – dialog size (*QSize* object or integer tuple (width, height))

get_comment() → *str* | *None*

Return data set comment

Returns

comment

Return type

str | *None*

get_icon() → *str* | *None*

Return data set icon

Returns

icon

Return type

str | *None*

get_items(copy=*False*) → *list*[*DataItem*]

Returns all the *DataItem* objects from the *DataSet* instance. Ignore private items that have a name starting with an underscore (e.g. ‘_private_item = ...’)

Parameters

- **copy** – If *True*, deepcopy the *DataItem* list, else return the original.
- **False.** (*Defaults to*) –

Returns

description

get_masked_view() → *MaskedArray*

Return masked view for data

Returns

Masked view

get_metadata_option(name: *str*) → *Any*

Return metadata option value

A metadata option is a metadata entry starting with an underscore. It is a way to store application-specific options in object metadata.

Parameters

name – option name

Returns

Option value

Valid option names:

‘format’: format string ‘showlabel’: show label

get_title() → *str*

Return data set title

Returns

title

Return type

str

classmethod get_valid_dtypenames() → *list[str]*

Get valid data type names

Returns

Valid data type names supported by this class

invalidate_maskdata_cache() → *None*

Invalidate mask data cache: force to rebuild it

iterate_resultproperties() → *Iterable[ResultProperties]*

Iterate over object result properties.

Yields

Result properties

iterate_resultshapes() → *Iterable[ResultShape]*

Iterate over object result shapes.

Yields

Result shape

iterate_roi_indices() → *Generator[int | None, None, None]*

Iterate over object ROI indices (if there is no ROI, yield None)

iterate_shape_items(*editable: bool = False*)

Iterate over shape items encoded in metadata (if any).

Parameters

editable – if True, annotations are editable

Yields

Plot item

property maskdata: *ndarray*

Return masked data (areas outside defined regions of interest)

Returns

Masked data

property number: *int*

Return object number (used for short ID)

read_config(*conf: UserConfig, section: str, option: str*) → *None*

Read configuration from a UserConfig instance

Parameters

- **conf** (*UserConfig*) – UserConfig instance
- **section** (*str*) – section name

- **option** (*str*) – option name

remove_all_shapes() → *None*

Remove metadata shapes and ROIs

reset_metadata_to_defaults() → *None*

Reset metadata to default values

restore_attr_from_metadata(*attrname: str, default: Any*) → *None*

Restore attribute from metadata

Parameters

- **attrname** – attribute name
- **default** – default value

property roi: *TypeROI* | *None*

Return object regions of interest object.

Returns

Regions of interest object

roi_has_changed() → *bool*

Return True if ROI has changed since last call to this method.

The first call to this method will return True if ROI has not yet been set, or if ROI has been set and has changed since the last call to this method. The next call to this method will always return False if ROI has not changed in the meantime.

Returns

True if ROI has changed

save_attr_to_metadata(*attrname: str, new_value: Any*) → *None*

Save attribute to metadata

Parameters

- **attrname** – attribute name
- **new_value** – new value

serialize(*writer: HDF5Writer | JSONWriter | INIWriter*) → *None*

Serialize the dataset

Parameters

writer (*HDF5Writer | JSONWriter | INIWriter*) – writer object

set_defaults() → *None*

Set default values

classmethod set_global_prop(*realm: str, **kwargs*) → *None*

Set global properties for all data items in the dataset

Parameters

- **realm** (*str*) – realm name
- **kwargs** (*dict*) – properties to set

set_metadata_option(*name: str, value: Any*) → *None*

Set metadata option value

A metadata option is a metadata entry starting with an underscore. It is a way to store application-specific options in object metadata.

Parameters

- **name** – option name
- **value** – option value

Valid option names:

‘format’: format string ‘showlabel’: show label

property short_id: *str*

Short object ID

text_edit() → *None*

Edit data set with text input only

to_string(*debug: bool | None = False, indent: str | None = None, align: bool | None = False, show_hidden: bool | None = True*) → *str*

Return readable string representation of the data set If debug is True, add more details on data items

Parameters

- **debug** (*bool*) – if True, add more details on data items
- **indent** (*str*) – indentation string (default is None, meaning no indentation)
- **align** (*bool*) – if True, align data items (default is False)
- **show_hidden** (*bool*) – if True, show hidden data items (default is True)

Returns

string representation of the data set

Return type

str

transform_shapes(*orig, func, param=None*)

Apply transform function to result shape / annotations coordinates.

Parameters

- **orig** – original object
- **func** – transform function
- **param** – transform function parameter

update_metadata_from(*other_metadata: dict[str, Any]*) → *None*

Update metadata from another object’s metadata (merge result shapes and annotations, and update the rest of the metadata).

Parameters

other_metadata – other object metadata

update_metadata_view_settings() → *None*

Update metadata view settings from Conf.view

update_resultshapes_from(*other: TypeObj*) → *None*

Update geometric shape from another object (merge metadata).

Parameters

other – other object, from which to update this object

view(*parent: QWidget | None = None, wordwrap: bool = True, size: QSize | tuple[int, int] | None = None*) → *None*

Open a dialog box to view data set

Parameters

- **parent** – parent widget (default is None, meaning no parent)
- **wordwrap** – if True, comment text is wordwrapped
- **size** – dialog size (QSize object or integer tuple (width, height))

write_config(*conf: UserConfig, section: str, option: str*) → *None*

Write configuration to a UserConfig instance

Parameters

- **conf** (*UserConfig*) – UserConfig instance
- **section** (*str*) – section name
- **option** (*str*) – option name

cdl.obj.read_signal(*filename: str*) → *SignalObj*

Read a signal from a file.

Parameters

filename – File name.

Returns

Signal.

cdl.obj.read_signals(*filename: str*) → *list[SignalObj]*

Read a list of signals from a file.

Parameters

filename – File name.

Returns

List of signals.

cdl.obj.create_signal_roi(*coords: ndarray | list[float, float] | list[list[float, float]], indices: bool = False, singleobj: bool | None = None, inverse: bool = False, title: str = ""*) → *SignalROI*

Create Signal Regions of Interest (ROI) object. More ROIs can be added to the object after creation, using the *add_roi* method.

Parameters

- **coords** – single ROI coordinates [*xmin*, *xmax*], or multiple ROIs coordinates [[*xmin1*, *xmax1*], [*xmin2*, *xmax2*], ...] (lists or NumPy arrays)
- **indices** – if True, coordinates are indices, if False, they are physical values (default to False for signals)
- **singleobj** – if True, when extracting data defined by ROIs, only one object is created (default to True). If False, one object is created per single ROI. If None, the value is get from the user configuration

- **inverse** – if True, ROI is outside the region
- **title** – title

Returns

Regions of Interest (ROI) object

Raises

ValueError – if the number of coordinates is not even

```
cdl.obj.create_signal(title: str, x: ndarray | None = None, y: ndarray | None = None, dx: ndarray | None = None, dy: ndarray | None = None, metadata: dict | None = None, units: tuple[str, str] | None = None, labels: tuple[str, str] | None = None) → SignalObj
```

Create a new Signal object.

Parameters

- **title** – signal title
- **x** – X data
- **y** – Y data
- **dx** – dX data (optional: error bars)
- **dy** – dY data (optional: error bars)
- **metadata** – signal metadata
- **units** – X, Y units (tuple of strings)
- **labels** – X, Y labels (tuple of strings)

Returns

Signal object

```
cdl.obj.create_signal_from_param(newparam: NewSignalParam, addparam: DataSet | None = None, edit: bool = False, parent: QWidget | None = None) → SignalObj | None
```

Create a new Signal object from a dialog box.

Parameters

- **newparam** – new signal parameters
- **addparam** – additional parameters
- **edit** – Open a dialog box to edit parameters (default: False)
- **parent** – parent widget

Returns

Signal object or None if canceled

```
cdl.obj.new_signal_param(title: str | None = None, stype: str | None = None, xmin: float | None = None, xmax: float | None = None, size: int | None = None) → NewSignalParam
```

Create a new Signal dataset instance.

Parameters

- **title** – dataset title (default: None, uses default title)
- **stype** – signal type (default: None, uses default type)
- **xmin** – X min (default: None, uses default value)
- **xmax** – X max (default: None, uses default value)

- **size** – signal size (default: None, uses default value)

Returns

new signal dataset instance

Return type

NewSignalParam

```
class cdl.obj.SignalTypes(value, names=None, *, module=None, qualname=None, type=None, start=1,
                           boundary=None)
```

Signal types

ZEROS = 'zeros'

Signal filled with zeros

GAUSS = 'gaussian'

Gaussian function

LORENTZ = 'lorentzian'

Lorentzian function

VOIGT = 'Voigt'

Voigt function

UNIFORMRANDOM = 'random (uniform law)'

Random signal (uniform law)

NORMALRANDOM = 'random (normal law)'

Random signal (normal law)

SINUS = 'sinus'

Sinusoid

COSINUS = 'cosinus'

Cosinusoid

SAWTOOTH = 'sawtooth'

Sawtooth function

TRIANGLE = 'triangle'

Triangle function

SQUARE = 'square'

Square function

SINC = 'cardinal sine'

Cardinal sine

STEP = 'step'

Step function

EXPONENTIAL = 'exponential'

Exponential function

PULSE = 'pulse'

Pulse function

POLYNOMIAL = 'polynomial'

Polynomial function

EXPERIMENTAL = 'experimental'

Experimental function

class `cdl.obj.NewSignalParam`

New signal dataset

title

Default: None.

Type

`guidata.dataset.dataitems.StringItem`

xmin

Default: -10.0.

Type

`guidata.dataset.dataitems.FloatItem`

xmax

Default: 10.0.

Type

`guidata.dataset.dataitems.FloatItem`

size

Signal size (total number of points). Integer higher than 1. Default: 500.

Type

`guidata.dataset.dataitems.IntItem`

stype

Single choice from: `SignalTypes.ZEROS`, `SignalTypes.GAUSS`, `SignalTypes.LORENTZ`, `SignalTypes.VOIGT`, `SignalTypes.UNIFORMRANDOM`, `SignalTypes.NORMALRANDOM`, `SignalTypes.SINUS`, `SignalTypes.COSINUS`, `SignalTypes.SAWTOOTH`, `SignalTypes.TRIANGLE`, `SignalTypes.SQUARE`, `SignalTypes.SINC`, `SignalTypes.STEP`, `SignalTypes.EXPONENTIAL`, `SignalTypes.PULSE`, `SignalTypes.POLYNOMIAL`, `SignalTypes.EXPERIMENTAL`. Default: `SignalTypes.ZEROS`.

Type

`guidata.dataset.dataitems.ChoiceItem`

classmethod `create(title: str, xmin: float, xmax: float, size: int, stype: cdl.core.model.signal.SignalTypes)`
→ `cdl.core.model.signal.NewSignalParam`

Returns a new instance of `NewSignalParam` with the fields set to the given values.

Parameters

- **title** (*str*) – Default: None.
- **xmin** (*float*) – Default: -10.0.
- **xmax** (*float*) – Default: 10.0.
- **size** (*int*) – Signal size (total number of points). Integer higher than 1. Default: 500.
- **stype** (`cdl.core.model.signal.SignalTypes`) – Single choice from: `SignalTypes.ZEROS`, `SignalTypes.GAUSS`, `SignalTypes.LORENTZ`, `SignalTypes.VOIGT`, `SignalTypes.UNIFORMRANDOM`, `SignalTypes.NORMALRANDOM`, `SignalTypes.SINUS`, `SignalTypes.COSINUS`, `SignalTypes.SAWTOOTH`, `SignalTypes.TRIANGLE`, `SignalTypes.SQUARE`, `SignalTypes.SINC`, `SignalTypes.STEP`,

SignalTypes.EXPONENTIAL, SignalTypes.PULSE, SignalTypes.POLYNOMIAL,
SignalTypes.EXPERIMENTAL. Default: SignalTypes.ZEROS.

Returns

New instance of *NewSignalParam*.

class cdl.obj.GaussLorentzVoigtParam

Parameters for Gaussian and Lorentzian functions

a

Default: 1.0.

Type

guidata.dataset.dataitems.FloatItem

ymin

Default: 0.0.

Type

guidata.dataset.dataitems.FloatItem

sigma

. Default: 1.0.

Type

guidata.dataset.dataitems.FloatItem

mu

. Default: 0.0.

Type

guidata.dataset.dataitems.FloatItem

classmethod create(*a: float, ymin: float, sigma: float, mu: float*) →
cdl.core.model.signal.GaussLorentzVoigtParam

Returns a new instance of *GaussLorentzVoigtParam* with the fields set to the given values.

Parameters

- **a** (*float*) – Default: 1.0.
- **ymin** (*float*) – Default: 0.0.
- **sigma** (*float*) – . Default: 1.0.
- **mu** (*float*) – . Default: 0.0.

Returns

New instance of *GaussLorentzVoigtParam*.

class cdl.obj.StepParam

Parameters for step function

a1

Default: 0.0.

Type

guidata.dataset.dataitems.FloatItem

a2

Default: 1.0.

Type`guidata.dataset.dataitems.FloatItem`**x0**

Default: 0.0.

Type`guidata.dataset.dataitems.FloatItem`**classmethod create**(*a1: float, a2: float, x0: float*) → *cdl.core.model.signal.StepParam*Returns a new instance of *StepParam* with the fields set to the given values.**Parameters**

- **a1** (*float*) – Default: 0.0.
- **a2** (*float*) – Default: 1.0.
- **x0** (*float*) – Default: 0.0.

ReturnsNew instance of *StepParam*.**class** `cdl.obj.PeriodicParam`

Parameters for periodic functions

a

Default: 1.0.

Type`guidata.dataset.dataitems.FloatItem`**ymin**

Default: 0.0.

Type`guidata.dataset.dataitems.FloatItem`**freq**

Frequency. Default: 1.0.

Type`guidata.dataset.dataitems.FloatItem`**freq_unit**Single choice from: `FreqUnits.HZ`, `FreqUnits.KHZ`, `FreqUnits.MHZ`, `FreqUnits.GHZ`. Default: `FreqUnits.HZ`.**Type**`guidata.dataset.dataitems.ChoiceItem`**phase**

Float, unit: °. Default: 0.0.

Type`guidata.dataset.dataitems.FloatItem`**classmethod create**(*a: float, ymin: float, freq: float, freq_unit: cdl.core.model.signal.FreqUnits, phase: float*) → *cdl.core.model.signal.PeriodicParam*Returns a new instance of *PeriodicParam* with the fields set to the given values.**Parameters**

- **a** (*float*) – Default: 1.0.
- **ymin** (*float*) – Default: 0.0.
- **freq** (*float*) – Frequency. Default: 1.0.
- **freq_unit** (*cdl.core.model.signal.FreqUnits*) – Single choice from: *FreqUnits.HZ*, *FreqUnits.KHZ*, *FreqUnits.MHZ*, *FreqUnits.GHZ*. Default: *FreqUnits.HZ*.
- **phase** (*float*) – Float, unit: °. Default: 0.0.

Returns

New instance of *PeriodicParam*.

get_frequency_in_hz()

Return frequency in Hz

class *cdl.obj.ROI1DParam*

Signal ROI parameters

xmin

First point coordinate. Default: None.

Type

guidata.dataset.dataitems.FloatItem

xmax

Last point coordinate. Default: None.

Type

guidata.dataset.dataitems.FloatItem

classmethod **create**(*xmin: float, xmax: float*) → *cdl.core.model.signal.ROI1DParam*

Returns a new instance of *ROI1DParam* with the fields set to the given values.

Parameters

- **xmin** (*float*) – First point coordinate. Default: None.
- **xmax** (*float*) – Last point coordinate. Default: None.

Returns

New instance of *ROI1DParam*.

to_single_roi(*obj: SignalObj, title: str = ""*) → *SegmentROI*

Convert parameters to single ROI

Parameters

- **obj** – signal object
- **title** – ROI title

Returns

Single ROI

get_data(*obj: SignalObj*) → *ndarray*

Get signal data in ROI

Parameters

obj – signal object

Returns

Data in ROI

```
class cdl.obj.SignalROI(singleobj: bool | None = None, inverse: bool = False)
```

Signal Regions of Interest

Parameters

- **singleobj** – if True, when extracting data defined by ROIs, only one object is created (default to True). If False, one object is created per single ROI. If None, the value is get from the user configuration
- **inverse** – if True, ROI is outside the region

```
static get_compatible_single_roi_classes() → list[Type[SegmentROI]]
```

Return compatible single ROI classes

```
to_mask(obj: SignalObj) → ndarray[bool]
```

Create mask from ROI

Parameters

obj – signal object

Returns

Mask (boolean array where True values are inside the ROI)

3.3.3 Image model

```
class cdl.obj.ImageObj
```

Image object

uuid

Default: None.

Type

`guidata.dataset.dataitems.StringItem`

data

Default: None.

Type

`guidata.dataset.dataitems.FloatArrayItem`

metadata

Default: {}.

Type

`guidata.dataset.dataitems.DictItem`

x0

X₀. Default: 0.0.

Type

`guidata.dataset.dataitems.FloatItem`

y0

Y₀. Default: 0.0.

Type

`guidata.dataset.dataitems.FloatItem`

dx

x. Float, non zero. Default: 1.0.

Type

`guidata.dataset.dataitems.FloatItem`

dy

y. Float, non zero. Default: 1.0.

Type

`guidata.dataset.dataitems.FloatItem`

title

Image title. Default: 'Untitled'.

Type

`guidata.dataset.dataitems.StringItem`

xlabel

Title. Default: ''.

Type

`guidata.dataset.dataitems.StringItem`

xunit

Default: ''.

Type

`guidata.dataset.dataitems.StringItem`

ylabel

Title. Default: ''.

Type

`guidata.dataset.dataitems.StringItem`

yunit

Default: ''.

Type

`guidata.dataset.dataitems.StringItem`

zlabel

Title. Default: ''.

Type

`guidata.dataset.dataitems.StringItem`

zunit

Default: ''.

Type

`guidata.dataset.dataitems.StringItem`

autoscale

Default: True.

Type

`guidata.dataset.dataitems.BoolItem`

xscalelog

Default: False.

Type

`guidata.dataset.dataitems.BoolItem`

xscalemin

Lower bound. Default: None.

Type

`guidata.dataset.dataitems.FloatItem`

xscalemax

Upper bound. Default: None.

Type

`guidata.dataset.dataitems.FloatItem`

yscalelog

Default: False.

Type

`guidata.dataset.dataitems.BoolItem`

yscalemin

Lower bound. Default: None.

Type

`guidata.dataset.dataitems.FloatItem`

yscalemax

Upper bound. Default: None.

Type

`guidata.dataset.dataitems.FloatItem`

zscalemmin

Lower bound. Default: None.

Type

`guidata.dataset.dataitems.FloatItem`

zscalemmax

Upper bound. Default: None.

Type

`guidata.dataset.dataitems.FloatItem`

classmethod **create**(*uuid*: *str*, *data*: *numpy.ndarray*, *metadata*: *dict*, *x0*: *float*, *y0*: *float*, *dx*: *float*, *dy*: *float*, *title*: *str*, *xlabel*: *str*, *xunit*: *str*, *ylabel*: *str*, *yunit*: *str*, *zlabel*: *str*, *zunit*: *str*, *autoscale*: *bool*, *xscalelog*: *bool*, *xscalemin*: *float*, *xscalemax*: *float*, *yscalelog*: *bool*, *yscalemin*: *float*, *yscalemax*: *float*, *zscalemmin*: *float*, *zscalemmax*: *float*) → *cdl.core.model.image.ImageObj*

Returns a new instance of *ImageObj* with the fields set to the given values.

Parameters

- **uuid** (*str*) – Default: None.
- **data** (*numpy.ndarray*) – Default: None.
- **metadata** (*dict*) – Default: {}.

- **x0** (*float*) – X_0 . Default: 0.0.
- **y0** (*float*) – Y_0 . Default: 0.0.
- **dx** (*float*) – x . Float, non zero. Default: 1.0.
- **dy** (*float*) – y . Float, non zero. Default: 1.0.
- **title** (*str*) – Image title. Default: 'Untitled'.
- **xlabel** (*str*) – Title. Default: ''.
- **xunit** (*str*) – Default: ''.
- **ylabel** (*str*) – Title. Default: ''.
- **yunit** (*str*) – Default: ''.
- **zlabel** (*str*) – Title. Default: ''.
- **zunit** (*str*) – Default: ''.
- **autoscale** (*bool*) – Default: True.
- **xscalelog** (*bool*) – Default: False.
- **xscalemin** (*float*) – Lower bound. Default: None.
- **xscalemax** (*float*) – Upper bound. Default: None.
- **yscalelog** (*bool*) – Default: False.
- **yscalemin** (*float*) – Lower bound. Default: None.
- **yscalemax** (*float*) – Upper bound. Default: None.
- **zscalemin** (*float*) – Lower bound. Default: None.
- **zscalemax** (*float*) – Upper bound. Default: None.

Returns

New instance of *ImageObj*.

static get_roi_class() → *Type[ImageROI]*

Return ROI class

regenerate_uuid()

Regenerate UUID

This method is used to regenerate UUID after loading the object from a file. This is required to avoid UUID conflicts when loading objects from file without clearing the workspace first.

set_metadata_from(*obj: Mapping | dict*) → *None*

Set metadata from object: dict-like (only string keys are considered) or any other object (iterating over supported attributes)

Parameters

obj – object

property dicom_template

Get DICOM template

property width: *float*

Return image width, i.e. number of columns multiplied by pixel size

property height: `float`

Return image height, i.e. number of rows multiplied by pixel size

property xc: `float`

Return image center X-axis coordinate

property yc: `float`

Return image center Y-axis coordinate

get_data(*roi_index*: `int` | `None` = `None`) → `ndarray`

Return original data (if ROI is not defined or *roi_index* is `None`), or ROI data (if both ROI and *roi_index* are defined).

Parameters

roi_index – ROI index

Returns

Masked data

copy(*title*: `str` | `None` = `None`, *dtype*: `dtype` | `None` = `None`) → `ImageObj`

Copy object.

Parameters

- **title** – title
- **dtype** – data type

Returns

Copied object

set_data_type(*dtype*: `dtype`) → `None`

Change data type. If data type is integer, clip values to the new data type's range, thus avoiding overflow or underflow.

Parameters

type (`Data`) –

update_plot_item_parameters(*item*: `MaskedImageItem`) → `None`

Update plot item parameters from object data/metadata

Takes into account a subset of plot item parameters. Those parameters may have been overridden by object metadata entries or other object data. The goal is to update the plot item accordingly.

This is *almost* the inverse operation of *update_metadata_from_plot_item*.

Parameters

item – plot item

update_metadata_from_plot_item(*item*: `MaskedImageItem`) → `None`

Update metadata from plot item.

Takes into account a subset of plot item parameters. Those parameters may have been modified by the user through the plot item GUI. The goal is to update the metadata accordingly.

This is *almost* the inverse operation of *update_plot_item_parameters*.

Parameters

item – plot item

make_item(*update_from*: *MaskedImageItem* | *None* = *None*) → *MaskedImageItem*

Make plot item from data.

Parameters

update_from – update from plot item

Returns

Plot item

update_item(*item*: *MaskedImageItem*, *data_changed*: *bool* = *True*) → *None*

Update plot item from data.

Parameters

- **item** – plot item
- **data_changed** – if True, data has changed

physical_to_indices(*coords*: *list*[*float*], *clip*: *bool* = *False*) → *ndarray*

Convert coordinates from physical (real world) to (array) indices (pixel)

Parameters

- **coords** – coordinates
- **clip** – if True, clip values to image boundaries

Returns

Indices

indices_to_physical(*indices*: *list*[*float* | *int*] | *ndarray*) → *ndarray*

Convert coordinates from (array) indices to physical (real world)

Parameters

indices – indices

Returns

Coordinates

add_label_with_title(*title*: *str* | *None* = *None*) → *None*

Add label with title annotation

Parameters

title – title (if None, use image title)

accept(*vis*: *object*) → *None*

Helper function that passes the visitor to the accept methods of all the items in this dataset

Parameters

vis (*object*) – visitor object

add_annotations_from_file(*filename*: *str*) → *None*

Add object annotations from file (JSON).

Parameters

filename – filename

add_annotations_from_items(*items*: *list*) → *None*

Add object annotations (annotation plot items).

Parameters

items – annotation plot items

property annotations: `str`

Get object annotations (JSON string describing annotation plot items)

check() → `list[str]`

Check the dataset item values

Returns

list of errors

Return type

`list[str]`

check_data()

Check if data is valid, raise an exception if that's not the case

Raises

`TypeError` – if data type is not supported

delete_results() → `None`

Delete all object results (shapes and properties)

deserialize(*reader*: `HDF5Reader` | `JSONReader` | `INIReader`) → `None`

Deserialize the dataset

Parameters

reader (`HDF5Reader` | `JSONReader` | `INIReader`) – reader object

edit(*parent*: `QWidget` | `None` = `None`, *apply*: `Callable` | `None` = `None`, *wordwrap*: `bool` = `True`, *size*: `QSize` | `tuple[int, int]` | `None` = `None`) → `DataSetEditDialog`

Open a dialog box to edit data set

Parameters

- **parent** – parent widget (default is `None`, meaning no parent)
- **apply** – apply callback (default is `None`)
- **wordwrap** – if `True`, comment text is wordwrapped
- **size** – dialog size (`QSize` object or integer tuple (width, height))

get_comment() → `str` | `None`

Return data set comment

Returns

comment

Return type

`str` | `None`

get_icon() → `str` | `None`

Return data set icon

Returns

icon

Return type

`str` | `None`

get_items(*copy*=`False`) → `list[DataItem]`

Returns all the `DataItem` objects from the `DataSet` instance. Ignore private items that have a name starting with an underscore (e.g. `'_private_item = ...'`)

Parameters

- **copy** – If True, deepcopy the DataItem list, else return the original.
- **False.** (*Defaults to*) –

Returns

`_description_`

get_masked_view() → MaskedArray

Return masked view for data

Returns

Masked view

get_metadata_option(name: str) → Any

Return metadata option value

A metadata option is a metadata entry starting with an underscore. It is a way to store application-specific options in object metadata.

Parameters

name – option name

Returns

Option value

Valid option names:

‘format’: format string ‘showlabel’: show label

get_title() → str

Return data set title

Returns

title

Return type

str

classmethod get_valid_dtypenames() → list[str]

Get valid data type names

Returns

Valid data type names supported by this class

invalidate_maskdata_cache() → None

Invalidate mask data cache: force to rebuild it

iterate_resultproperties() → Iterable[ResultProperties]

Iterate over object result properties.

Yields

Result properties

iterate_resultshapes() → Iterable[ResultShape]

Iterate over object result shapes.

Yields

Result shape

iterate_roi_indices() → `Generator[int | None, None, None]`

Iterate over object ROI indices (if there is no ROI, yield None)

iterate_shape_items(*editable: bool = False*)

Iterate over shape items encoded in metadata (if any).

Parameters

editable – if True, annotations are editable

Yields

Plot item

property maskdata: `ndarray`

Return masked data (areas outside defined regions of interest)

Returns

Masked data

property number: `int`

Return object number (used for short ID)

read_config(*conf: UserConfig, section: str, option: str*) → `None`

Read configuration from a UserConfig instance

Parameters

- **conf** (*UserConfig*) – UserConfig instance
- **section** (*str*) – section name
- **option** (*str*) – option name

remove_all_shapes() → `None`

Remove metadata shapes and ROIs

reset_metadata_to_defaults() → `None`

Reset metadata to default values

restore_attr_from_metadata(*attrname: str, default: Any*) → `None`

Restore attribute from metadata

Parameters

- **attrname** – attribute name
- **default** – default value

property roi: `TypeROI | None`

Return object regions of interest object.

Returns

Regions of interest object

roi_has_changed() → `bool`

Return True if ROI has changed since last call to this method.

The first call to this method will return True if ROI has not yet been set, or if ROI has been set and has changed since the last call to this method. The next call to this method will always return False if ROI has not changed in the meantime.

Returns

True if ROI has changed

save_attr_to_metadata(*attrname: str, new_value: Any*) → *None*

Save attribute to metadata

Parameters

- **attrname** – attribute name
- **new_value** – new value

serialize(*writer: HDF5Writer | JSONWriter | INIWriter*) → *None*

Serialize the dataset

Parameters

writer (*HDF5Writer | JSONWriter | INIWriter*) – writer object

set_defaults() → *None*

Set default values

classmethod set_global_prop(*realm: str, **kwargs*) → *None*

Set global properties for all data items in the dataset

Parameters

- **realm** (*str*) – realm name
- **kwargs** (*dict*) – properties to set

set_metadata_option(*name: str, value: Any*) → *None*

Set metadata option value

A metadata option is a metadata entry starting with an underscore. It is a way to store application-specific options in object metadata.

Parameters

- **name** – option name
- **value** – option value

Valid option names:

‘format’: format string ‘showlabel’: show label

property short_id: *str*

Short object ID

text_edit() → *None*

Edit data set with text input only

to_string(*debug: bool | None = False, indent: str | None = None, align: bool | None = False, show_hidden: bool | None = True*) → *str*

Return readable string representation of the data set If debug is True, add more details on data items

Parameters

- **debug** (*bool*) – if True, add more details on data items
- **indent** (*str*) – indentation string (default is None, meaning no indentation)
- **align** (*bool*) – if True, align data items (default is False)
- **show_hidden** (*bool*) – if True, show hidden data items (default is True)

Returns

string representation of the data set

Return type`str`**transform_shapes**(*orig*, *func*, *param=None*)

Apply transform function to result shape / annotations coordinates.

Parameters

- **orig** – original object
- **func** – transform function
- **param** – transform function parameter

update_metadata_from(*other_metadata: dict[str, Any]*) → `None`

Update metadata from another object's metadata (merge result shapes and annotations, and update the rest of the metadata).

Parameters**other_metadata** – other object metadata**update_metadata_view_settings**() → `None`

Update metadata view settings from Conf.view

update_resultshapes_from(*other: TypeObj*) → `None`

Update geometric shape from another object (merge metadata).

Parameters**other** – other object, from which to update this object**view**(*parent: QWidget | None = None*, *wordwrap: bool = True*, *size: QSize | tuple[int, int] | None = None*) → `None`

Open a dialog box to view data set

Parameters

- **parent** – parent widget (default is None, meaning no parent)
- **wordwrap** – if True, comment text is wordwrapped
- **size** – dialog size (QSize object or integer tuple (width, height))

write_config(*conf: UserConfig*, *section: str*, *option: str*) → `None`

Write configuration to a UserConfig instance

Parameters

- **conf** (*UserConfig*) – UserConfig instance
- **section** (*str*) – section name
- **option** (*str*) – option name

`cdl.obj.read_image`(*filename: str*) → *ImageObj*

Read an image from a file.

Parameters**filename** – File name.**Returns**

Image.

`cdl.obj.read_images(filename: str) → list[ImageObj]`

Read a list of images from a file.

Parameters

filename – File name.

Returns

List of images.

`cdl.obj.create_image_roi(geometry: Literal['rectangle', 'circle', 'polygon'], coords: ndarray | list[float] | list[list[float]], indices: bool = True, singleobj: bool | None = None, inverse: bool = False, title: str = "") → ImageROI`

Create Image Regions of Interest (ROI) object. More ROIs can be added to the object after creation, using the `add_roi` method.

Parameters

- **geometry** – ROI type ('rectangle', 'circle', 'polygon')
- **coords** – ROI coords (physical coordinates), $[x0, y0, dx, dy]$ for a rectangle, $[xc, yc, r]$ for a circle, or $[x0, y0, x1, y1, \dots]$ for a polygon (lists or NumPy arrays are accepted). For multiple ROIs, nested lists or NumPy arrays are accepted but with a common geometry type (e.g. $[[xc1, yc1, r1], [xc2, yc2, r2], \dots]$ for circles).
- **indices** – if True, coordinates are indices, if False, they are physical values (default to True for images)
- **singleobj** – if True, when extracting data defined by ROIs, only one object is created (default to True). If False, one object is created per single ROI. If None, the value is get from the user configuration
- **inverse** – if True, ROI is outside the region
- **title** – title

Returns

Regions of Interest (ROI) object

Raises

ValueError – if ROI type is unknown or if the number of coordinates is invalid

`cdl.obj.create_image(title: str, data: ndarray | None = None, metadata: dict | None = None, units: tuple | None = None, labels: tuple | None = None) → ImageObj`

Create a new Image object

Parameters

- **title** – image title
- **data** – image data
- **metadata** – image metadata
- **units** – X, Y, Z units (tuple of strings)
- **labels** – X, Y, Z labels (tuple of strings)

Returns

Image object

`cdl.obj.create_image_from_param(newparam: NewImageParam, addparam: gds.DataSet | None = None, edit: bool = False, parent: QW.QWidget | None = None) → ImageObj | None`

Create a new Image object from dialog box.

Parameters

- **newparam** – new image parameters
- **addparam** – additional parameters
- **edit** – Open a dialog box to edit parameters (default: False)
- **parent** – parent widget

Returns

New image object or None if user cancelled

```
cdl.obj.new_image_param(title: str | None = None, itype: ImageTypes | None = None, height: int | None = None,
                        width: int | None = None, dtype: ImageDatatypes | None = None) →
                        NewImageParam
```

Create a new Image dataset instance.

Parameters

- **title** – dataset title (default: None, uses default title)
- **itype** – image type (default: None, uses default type)
- **height** – image height (default: None, uses default height)
- **width** – image width (default: None, uses default width)
- **dtype** – image data type (default: None, uses default data type)

Returns

New image dataset instance

```
class cdl.obj.ImageTypes(value, names=None, *, module=None, qualname=None, type=None, start=1,
                        boundary=None)
```

Image types

```
ZEROS = 'zeros'
```

Image filled with zeros

```
EMPTY = 'empty'
```

Empty image (filled with data from memory state)

```
GAUSS = 'gaussian'
```

2D Gaussian image

```
UNIFORMRANDOM = 'random (uniform law)'
```

Image filled with random data (uniform law)

```
NORMALRANDOM = 'random (normal law)'
```

Image filled with random data (normal law)

```
class cdl.obj.NewImageParam
```

New image dataset

title

Default: None.

Type

`guidata.dataset.dataitems.StringItem`

height

Image height: number of rows. Integer higher than 1. Default: None.

Type

`guidata.dataset.dataitems.IntItem`

width

Image width: number of columns. Integer higher than 1. Default: None.

Type

`guidata.dataset.dataitems.IntItem`

dtype

Data type. Single choice from: `ImageDatatypes.UINT8`, `ImageDatatypes.UINT16`, `ImageDatatypes.INT16`, `ImageDatatypes.FLOAT32`, `ImageDatatypes.FLOAT64`. Default: `ImageDatatypes.UINT8`.

Type

`guidata.dataset.dataitems.ChoiceItem`

itype

Single choice from: `ImageTypes.ZEROS`, `ImageTypes.EMPTY`, `ImageTypes.GAUSS`, `ImageTypes.UNIFORMRANDOM`, `ImageTypes.NORMALRANDOM`. Default: `ImageTypes.ZEROS`.

Type

`guidata.dataset.dataitems.ChoiceItem`

classmethod `create(title: str, height: int, width: int, dtype: cdl.core.model.image.ImageDatatypes, itype: cdl.core.model.image.ImageTypes) → cdl.core.model.image.NewImageParam`

Returns a new instance of `NewImageParam` with the fields set to the given values.

Parameters

- **title** (`str`) – Default: None.
- **height** (`int`) – Image height: number of rows. Integer higher than 1. Default: None.
- **width** (`int`) – Image width: number of columns. Integer higher than 1. Default: None.
- **dtype** (`cdl.core.model.image.ImageDatatypes`) – Data type. Single choice from: `ImageDatatypes.UINT8`, `ImageDatatypes.UINT16`, `ImageDatatypes.INT16`, `ImageDatatypes.FLOAT32`, `ImageDatatypes.FLOAT64`. Default: `ImageDatatypes.UINT8`.
- **itype** (`cdl.core.model.image.ImageTypes`) – Single choice from: `ImageTypes.ZEROS`, `ImageTypes.EMPTY`, `ImageTypes.GAUSS`, `ImageTypes.UNIFORMRANDOM`, `ImageTypes.NORMALRANDOM`. Default: `ImageTypes.ZEROS`.

Returns

New instance of `NewImageParam`.

class `cdl.obj.Gauss2DParam`

2D Gaussian parameters

a

Norm. Default: None.

Type

`guidata.dataset.dataitems.FloatItem`

xmin

Default: -10.

Type`guidata.dataset.dataitems.FloatItem`**sigma**

. Default: 1.0.

Type`guidata.dataset.dataitems.FloatItem`**xmax**

Default: 10.

Type`guidata.dataset.dataitems.FloatItem`**mu**

. Default: 0.0.

Type`guidata.dataset.dataitems.FloatItem`**ymin**

Default: -10.

Type`guidata.dataset.dataitems.FloatItem`**x0**

Default: 0.

Type`guidata.dataset.dataitems.FloatItem`**ymax**

Default: 10.

Type`guidata.dataset.dataitems.FloatItem`**y0**

Default: 0.

Type`guidata.dataset.dataitems.FloatItem`

classmethod `create`(*a*: *float*, *xmin*: *float*, *sigma*: *float*, *xmax*: *float*, *mu*: *float*, *ymin*: *float*, *x0*: *float*, *ymax*: *float*, *y0*: *float*) → *cdl.core.model.image.Gauss2DParam*

Returns a new instance of *Gauss2DParam* with the fields set to the given values.

Parameters

- **a** (*float*) – Norm. Default: None.
- **xmin** (*float*) – Default: -10.
- **sigma** (*float*) – . Default: 1.0.
- **xmax** (*float*) – Default: 10.
- **mu** (*float*) – . Default: 0.0.

- **ymin** (*float*) – Default: -10.
- **x0** (*float*) – Default: 0.
- **ymax** (*float*) – Default: 10.
- **y0** (*float*) – Default: 0.

Returns

New instance of *Gauss2DParam*.

class `cdl.obj.ROI2DParam`

Image ROI parameters

geometry

Single choice from: 'rectangle', 'circle', 'polygon'. Default: 'rectangle'.

Type

`guidata.dataset.dataitems.ChoiceItem`

x0

X₀. Integer, unit: pixels. Default: None.

Type

`guidata.dataset.dataitems.IntItem`

y0

Y₀. Integer, unit: pixels. Default: None.

Type

`guidata.dataset.dataitems.IntItem`

dx

X. Integer, unit: pixels. Default: None.

Type

`guidata.dataset.dataitems.IntItem`

dy

Y. Integer, unit: pixels. Default: None.

Type

`guidata.dataset.dataitems.IntItem`

xc

X_C. Integer, unit: pixels. Default: None.

Type

`guidata.dataset.dataitems.IntItem`

yc

Y_C. Integer, unit: pixels. Default: None.

Type

`guidata.dataset.dataitems.IntItem`

r

Radius. Integer, unit: pixels. Default: None.

Type

`guidata.dataset.dataitems.IntItem`

points

Coordinates (pixels). Default: None.

Type

`guidata.dataset.dataitems.FloatArrayItem`

classmethod **create**(*geometry*: *str*, *x0*: *int*, *y0*: *int*, *dx*: *int*, *dy*: *int*, *xc*: *int*, *yc*: *int*, *r*: *int*, *points*: *numpy.ndarray*) → *cdl.core.model.image.ROI2DParam*

Returns a new instance of *ROI2DParam* with the fields set to the given values.

Parameters

- **geometry** (*str*) – Single choice from: ‘rectangle’, ‘circle’, ‘polygon’. Default: ‘rectangle’.
- **x0** (*int*) – X_0 . Integer, unit: pixels. Default: None.
- **y0** (*int*) – Y_0 . Integer, unit: pixels. Default: None.
- **dx** (*int*) – X . Integer, unit: pixels. Default: None.
- **dy** (*int*) – Y . Integer, unit: pixels. Default: None.
- **xc** (*int*) – X_C . Integer, unit: pixels. Default: None.
- **yc** (*int*) – Y_C . Integer, unit: pixels. Default: None.
- **r** (*int*) – Radius. Integer, unit: pixels. Default: None.
- **points** (*numpy.ndarray*) – Coordinates (pixels). Default: None.

Returns

New instance of *ROI2DParam*.

to_single_roi(*obj*: *ImageObj*, *title*: *str* = "") → *PolygonalROI* | *RectangularROI* | *CircularROI*

Convert parameters to single ROI

Parameters

- **obj** – image object (used for conversion of pixel to physical coordinates)
- **title** – ROI title

Returns

Single ROI

get_suffix() → *str*

Get suffix text representation for ROI extraction

get_extracted_roi(*obj*: *ImageObj*) → *ImageROI* | *None*

Get extracted ROI, i.e. the remaining ROI after extracting ROI from image.

Parameters

obj – image object (used for conversion of pixel to physical coordinates)

When extracting ROIs from an image to multiple images (i.e. one image per ROI), this method returns the ROI that has to be kept in the destination image. This is not necessary for a rectangular ROI: the destination image is simply a crop of the source image according to the ROI coordinates. But for a circular ROI or a polygonal ROI, the destination image is a crop of the source image according to the bounding box of the ROI. Thus, to avoid any loss of information, a ROI has to be defined for the destination image: this is the ROI returned by this method. It’s simply the same as the source ROI, but with coordinates adjusted to the destination image. One may call this ROI the “extracted ROI”.

get_bounding_box_indices() → tuple[int, int, int, int]

Get bounding box (pixel coordinates)

get_data(obj: ImageObj) → ndarray

Get data in ROI

Parameters

obj – image object

Returns

Data in ROI

class cdl.obj.**ImageROI**(singleobj: bool | None = None, inverse: bool = False)

Image Regions of Interest

Parameters

- **singleobj** – if True, when extracting data defined by ROIs, only one object is created (default to True). If False, one object is created per single ROI. If None, the value is get from the user configuration
- **inverse** – if True, ROI is outside the region

static get_compatible_single_roi_classes() → list[Type[BaseSingleImageROI]]

Return compatible single ROI classes

to_mask(obj: ImageObj) → ndarray[bool]

Create mask from ROI

Parameters

obj – image object

Returns

Mask (boolean array where True values are inside the ROI)

class cdl.obj.**ImageDatatypes**(value, names=None, *, module=None, qualname=None, type=None, start=1, boundary=None)

Image data types

classmethod from_dtype(dtype)

Return member from NumPy dtype

classmethod check()

Check if data types are valid

UINT8 = 'uint8'

Unsigned integer number stored with 8 bits

UINT16 = 'uint16'

Unsigned integer number stored with 16 bits

INT16 = 'int16'

Signed integer number stored with 16 bits

FLOAT32 = 'float32'

Float number stored with 32 bits

FLOAT64 = 'float64'

Float number stored with 64 bits

3.4 Computation (`cdl.computation`)

This package contains the computation functions used by the DataLab project. Those functions operate directly on DataLab objects (i.e. `cdl.obj.SignalObj` and `cdl.obj.ImageObj`) and are designed to be used in the DataLab pipeline, but can be used independently as well.

See also:

The `cdl.computation` package is the main entry point for the DataLab computation functions when manipulating DataLab objects. See the `cdl.algorithms` package for algorithms that operate directly on NumPy arrays.

Each computation module defines a set of computation objects, that is, functions that implement processing features and classes that implement the corresponding parameters (in the form of `guidata.dataset.datatypes.Dataset` subclasses). The computation functions takes a DataLab object (e.g. `cdl.obj.SignalObj`) and a parameter object (e.g. `cdl.param.MovingAverageParam`) as input and return a DataLab object as output (the result of the computation). The parameter object is used to configure the computation function (e.g. the size of the moving average window).

In DataLab overall architecture, the purpose of this package is to provide the computation functions that are used by the `cdl.core.gui.processor` module, based on the algorithms defined in the `cdl.algorithms` module and on the data model defined in the `cdl.obj` (or `cdl.core.model`) module.

The computation modules are organized in subpackages according to their purpose. The following subpackages are available:

- `cdl.computation.base`: Common processing features
- `cdl.computation.signal`: Signal processing features
- `cdl.computation.image`: Image processing features

3.4.1 Common processing features

class `cdl.computation.base.ArithmeticParam`

Arithmetic parameters

operator

Single choice from: '+', '-', 'x', '/'. Default: '+'.
Type
`guidata.dataset.dataitems.ChoiceItem`

factor

Default: 1.0.
Type
`guidata.dataset.dataitems.FloatItem`

constant

Default: 0.0.
Type
`guidata.dataset.dataitems.FloatItem`

operation

Default: “.”.
Type
`guidata.dataset.dataitems.StringItem`

restore_dtype

Result. Default: True.

Type

`guidata.dataset.dataitems.BoolItem`

classmethod **create**(operator: *str*, factor: *float*, constant: *float*, operation: *str*, restore_dtype: *bool*) → *cdl.computation.base.ArithmeticParam*

Returns a new instance of *ArithmeticParam* with the fields set to the given values.

Parameters

- **operator** (*str*) – Single choice from: '+', '-', '×', '/'. Default: '+'.
- **factor** (*float*) – Default: 1.0.
- **constant** (*float*) – Default: 0.0.
- **operation** (*str*) – Default: '·'.
- **restore_dtype** (*bool*) – Result. Default: True.

Returns

New instance of *ArithmeticParam*.

get_operation() → *str*

Return the operation string

update_operation(*_item*, *_value*)

Update the operation item

class `cdl.computation.base.GaussianParam`

Gaussian filter parameters

sigma

. Default: 1.0.

Type

`guidata.dataset.dataitems.FloatItem`

classmethod **create**(sigma: *float*) → *cdl.computation.base.GaussianParam*

Returns a new instance of *GaussianParam* with the fields set to the given values.

Parameters

- **sigma** (*float*) – . Default: 1.0.

Returns

New instance of *GaussianParam*.

class `cdl.computation.base.MovingAverageParam`

Moving average parameters

n

Size of the moving window. Integer higher than 1. Default: 3.

Type

`guidata.dataset.dataitems.IntItem`

mode

Mode of the filter: - 'reflect': reflect the data at the boundary - 'constant': pad with a constant value - 'nearest': pad with the nearest value - 'mirror': reflect the data at the boundary with the data itself - 'wrap': circular boundary. Single choice from: 'reflect', 'constant', 'nearest', 'mirror', 'wrap'. Default: 'reflect'.

Type`guidata.dataset.dataitems.ChoiceItem`**classmethod** `create(n: int, mode: str) → cdl.computation.base.MovingAverageParam`Returns a new instance of `MovingAverageParam` with the fields set to the given values.**Parameters**

- **n** (`int`) – Size of the moving window. Integer higher than 1. Default: 3.
- **mode** (`str`) – Mode of the filter: - 'reflect': reflect the data at the boundary - 'constant': pad with a constant value - 'nearest': pad with the nearest value - 'mirror': reflect the data at the boundary with the data itself - 'wrap': circular boundary. Single choice from: 'reflect', 'constant', 'nearest', 'mirror', 'wrap'. Default: 'reflect'.

ReturnsNew instance of `MovingAverageParam`.**class** `cdl.computation.base.MovingMedianParam`

Moving median parameters

n

Size of the moving window. Integer higher than 1, odd. Default: 3.

Type`guidata.dataset.dataitems.IntItem`**mode**

Mode of the filter: - 'reflect': reflect the data at the boundary - 'constant': pad with a constant value - 'nearest': pad with the nearest value - 'mirror': reflect the data at the boundary with the data itself - 'wrap': circular boundary. Single choice from: 'reflect', 'constant', 'nearest', 'mirror', 'wrap'. Default: 'nearest'.

Type`guidata.dataset.dataitems.ChoiceItem`**classmethod** `create(n: int, mode: str) → cdl.computation.base.MovingMedianParam`Returns a new instance of `MovingMedianParam` with the fields set to the given values.**Parameters**

- **n** (`int`) – Size of the moving window. Integer higher than 1, odd. Default: 3.
- **mode** (`str`) – Mode of the filter: - 'reflect': reflect the data at the boundary - 'constant': pad with a constant value - 'nearest': pad with the nearest value - 'mirror': reflect the data at the boundary with the data itself - 'wrap': circular boundary. Single choice from: 'reflect', 'constant', 'nearest', 'mirror', 'wrap'. Default: 'nearest'.

ReturnsNew instance of `MovingMedianParam`.**class** `cdl.computation.base.ClipParam`

Data clipping parameters

lower

Lower clipping value. Default: None.

Type`guidata.dataset.dataitems.FloatItem`

upper

Upper clipping value. Default: None.

Type

`guidata.dataset.dataitems.FloatItem`

classmethod `create(lower: float, upper: float) → cdl.computation.base.ClipParam`

Returns a new instance of `ClipParam` with the fields set to the given values.

Parameters

- **lower** (*float*) – Lower clipping value. Default: None.
- **upper** (*float*) – Upper clipping value. Default: None.

Returns

New instance of `ClipParam`.

class `cdl.computation.base.NormalizeParam`

Normalize parameters

method

Normalize with respect to. Single choice from: ‘maximum’, ‘amplitude’, ‘area’, ‘energy’, ‘rms’. Default: ‘maximum’.

Type

`guidata.dataset.dataitems.ChoiceItem`

classmethod `create(method: str) → cdl.computation.base.NormalizeParam`

Returns a new instance of `NormalizeParam` with the fields set to the given values.

Parameters

method (*str*) – Normalize with respect to. Single choice from: ‘maximum’, ‘amplitude’, ‘area’, ‘energy’, ‘rms’. Default: ‘maximum’.

Returns

New instance of `NormalizeParam`.

class `cdl.computation.base.HistogramParam`

Histogram parameters

bins

Number of bins. Integer higher than 1. Default: 256.

Type

`guidata.dataset.dataitems.IntItem`

lower

Lower limit. Default: None.

Type

`guidata.dataset.dataitems.FloatItem`

upper

Upper limit. Default: None.

Type

`guidata.dataset.dataitems.FloatItem`

classmethod **create**(*bins: int, lower: float, upper: float*) → *cdl.computation.base.HistogramParam*

Returns a new instance of *HistogramParam* with the fields set to the given values.

Parameters

- **bins** (*int*) – Number of bins. Integer higher than 1. Default: 256.
- **lower** (*float*) – Lower limit. Default: None.
- **upper** (*float*) – Upper limit. Default: None.

Returns

New instance of *HistogramParam*.

get_suffix(*data: ndarray*) → *str*

Return suffix for the histogram computation

Parameters

data – data array

class *cdl.computation.base.FFTParam*

FFT parameters

shift

Shift zero frequency to center. Default: None.

Type

guidata.dataset.dataitems.BoolItem

classmethod **create**(*shift: bool*) → *cdl.computation.base.FFTParam*

Returns a new instance of *FFTParam* with the fields set to the given values.

Parameters

shift (*bool*) – Shift zero frequency to center. Default: None.

Returns

New instance of *FFTParam*.

class *cdl.computation.base.SpectrumParam*

Spectrum parameters

log

Default: False.

Type

guidata.dataset.dataitems.BoolItem

classmethod **create**(*log: bool*) → *cdl.computation.base.SpectrumParam*

Returns a new instance of *SpectrumParam* with the fields set to the given values.

Parameters

log (*bool*) – Default: False.

Returns

New instance of *SpectrumParam*.

class *cdl.computation.base.ConstantParam*

Parameter used to set a constant value to used in operations

value

Constant value. Default: None.

Type

guidata.dataset.dataitems.FloatItem

classmethod **create**(value: float) → cdl.computation.base.ConstantParamReturns a new instance of *ConstantParam* with the fields set to the given values.**Parameters****value** (float) – Constant value. Default: None.**Returns**New instance of *ConstantParam*.

cdl.computation.base.dst_11(src: SignalObj | ImageObj, name: str, suffix: str | None = None) → SignalObj | ImageObj

Create a result object, as returned by the callback function of the *cdl.core.gui.processor.base.BaseProcessor.compute_11()* method**Parameters**

- **src** – source signal or image object
- **name** – name of the function. If provided, the title of the result object will be {name}({src.short_id}){suffix}, unless the name is a single character, in which case the title will be {src.short_id}{name}{suffix} where *name* is an operator and *suffix* is the other term of the operation.
- **suffix** – suffix to add to the title. Optional.

Returns

Result signal or image object

cdl.computation.base.dst_n1n(src1: SignalObj | ImageObj, src2: SignalObj | ImageObj, name: str, suffix: str | None = None) → SignalObj | ImageObj

Create a result object, as returned by the callback function of the *cdl.core.gui.processor.base.BaseProcessor.compute_n1n()* method**Parameters**

- **src1** – input signal or image object
- **src2** – input signal or image object
- **name** – name of the processing function

Returns

Output signal or image object

cdl.computation.base.new_signal_result(src: SignalObj | ImageObj, name: str, suffix: str | None = None, units: tuple[str, str] | None = None, labels: tuple[str, str] | None = None) → SignalObj

Create new signal object as a result of a compute_11 function

As opposed to the *dst_11* functions, this function creates a new signal object without copying the original object metadata, except for the “source” entry.**Parameters**

- **src** – input signal or image object
- **name** – name of the processing function
- **suffix** – suffix to add to the title
- **units** – units of the output signal

- **labels** – labels of the output signal

Returns

Output signal object

`cdl.computation.base.calc_resultproperties(title: str, obj: SignalObj | ImageObj, labeledfuncs: dict[str, Callable]) → ResultProperties`

Calculate result properties by executing a computation function on a signal/image object.

Parameters

- **title** – title of the result properties
- **obj** – signal or image object
- **labeledfuncs** – dictionary of labeled computation functions. The keys are the labels of the computation functions and the values are the functions themselves (each function must take a single argument - which is the data of the ROI or the whole signal/image - and return a float)

Returns

Result properties object

3.4.2 Signal processing features

`cdl.computation.signal.restore_data_outside_roi(dst: SignalObj, src: SignalObj) → None`

Restore data outside the Region Of Interest (ROI) of the input signal after a computation, only if the input signal has a ROI, and if the output signal has the same ROI as the input signal, and if the data types are the same, and if the shapes are the same. Otherwise, do nothing.

Parameters

- **dst** – destination signal object
- **src** – source signal object

class `cdl.computation.signal.Wrap11Func(func: Callable, *args: Any, **kwargs: Any)`

Wrap a 1 array → 1 array function (the simple case of $y_1 = f(y_0)$) to produce a 1 signal → 1 signal function, which can be used inside DataLab's infrastructure to perform computations with `cdl.core.gui.processor.signal.SignalProcessor`.

This wrapping mechanism using a class is necessary for the resulted function to be pickable by the multiprocessing module.

The instance of this wrapper is callable and returns a `cdl.obj.SignalObj` object.

Example

```
>>> import numpy as np
>>> from cdl.computation.signal import Wrap11Func
>>> import cdl.obj
>>> def square(y):
...     return y**2
>>> compute_square = Wrap11Func(square)
>>> x = np.linspace(0, 10, 100)
>>> y = np.sin(x)
```

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```
>>> sig0 = cdl.obj.create_signal("Example", x, y)
>>> sig1 = compute_square(sig0)
```

Parameters

- **func** – 1 array → 1 array function
- ***args** – Additional positional arguments to pass to the function
- ****kwargs** – Additional keyword arguments to pass to the function

`cdl.computation.signal.compute_addition(dst: SignalObj, src: SignalObj) → SignalObj`

Add **dst** and **src** signals and return **dst** signal modified in place

Parameters

- **dst** – destination signal
- **src** – source signal

Returns

Modified **dst** signal (modified in place)

`cdl.computation.signal.compute_product(dst: SignalObj, src: SignalObj) → SignalObj`

Multiply **dst** and **src** signals and return **dst** signal modified in place

Parameters

- **dst** – destination signal
- **src** – source signal

Returns

Modified **dst** signal (modified in place)

`cdl.computation.signal.compute_addition_constant(src: SignalObj, p: ConstantParam) → SignalObj`

Add **dst** and a constant value and return a the new result signal object

Parameters

- **src** – input signal object
- **p** – constant value

Returns

Result signal object **src + p.value** (new object)

`cdl.computation.signal.compute_difference_constant(src: SignalObj, p: ConstantParam) → SignalObj`

Subtract a constant value from a signal

Parameters

- **src** – input signal object
- **p** – constant value

Returns

Result signal object **src - p.value** (new object)

`cdl.computation.signal.compute_product_constant(src: SignalObj, p: ConstantParam) → SignalObj`

Multiply **dst** by a constant value and return the new result signal object

Parameters

- **src** – input signal object
- **p** – constant value

Returns

Result signal object **src** * **p.value** (new object)

`cdl.computation.signal.compute_division_constant(src: SignalObj, p: ConstantParam) → SignalObj`

Divide a signal by a constant value

Parameters

- **src** – input signal object
- **p** – constant value

Returns

Result signal object **src** / **p.value** (new object)

`cdl.computation.signal.compute_arithmetic(src1: SignalObj, src2: SignalObj, p: ArithmeticParam) → SignalObj`

Perform arithmetic operation on two signals

Parameters

- **src1** – source signal 1
- **src2** – source signal 2
- **p** – parameters

Returns

Result signal object

`cdl.computation.signal.compute_difference(src1: SignalObj, src2: SignalObj) → SignalObj`

Compute difference between two signals

Note: If uncertainty is available, it is propagated.

Parameters

- **src1** – source signal 1
- **src2** – source signal 2

Returns

Result signal object **src1** - **src2**

`cdl.computation.signal.compute_quadratic_difference(src1: SignalObj, src2: SignalObj) → SignalObj`

Compute quadratic difference between two signals

Note: If uncertainty is available, it is propagated.

Parameters

- **src1** – source signal 1
- **src2** – source signal 2

Returns

Result signal object $(\text{src1} - \text{src2}) / \sqrt{2.0}$

`cdl.computation.signal.compute_division(src1: SignalObj, src2: SignalObj) → SignalObj`

Compute division between two signals

Parameters

- **src1** – source signal 1
- **src2** – source signal 2

Returns

Result signal object **src1 / src2**

`cdl.computation.signal.extract_multiple_roi(src: SignalObj, group: DataSetGroup) → SignalObj`

Extract multiple regions of interest from data

Parameters

- **src** – source signal
- **group** – group of parameters

Returns

Signal with multiple regions of interest

`cdl.computation.signal.extract_single_roi(src: SignalObj, p: ROI1DParam) → SignalObj`

Extract single region of interest from data

Parameters

- **src** – source signal
- **p** – ROI parameters

Returns

Signal with single region of interest

`cdl.computation.signal.compute_swap_axes(src: SignalObj) → SignalObj`

Swap axes

Parameters

src – source signal

Returns

Result signal object

`cdl.computation.signal.compute_inverse(src: SignalObj) → SignalObj`

Compute inverse with `numpy.invert`

Parameters

src – source signal

Returns

Result signal object

`cdl.computation.signal.compute_abs(src: SignalObj) → SignalObj`

Compute absolute value with `numpy.absolute`

Parameters

src – source signal

Returns

Result signal object

`cdl.computation.signal.compute_re(src: SignalObj) → SignalObj`Compute real part with `numpy.real()`**Parameters****src** – source signal**Returns**

Result signal object

`cdl.computation.signal.compute_im(src: SignalObj) → SignalObj`Compute imaginary part with `numpy.imag()`**Parameters****src** – source signal**Returns**

Result signal object

class `cdl.computation.signal.DataTypeSParam`

Convert signal data type parameters

dtype_str

Destination data type. Output image data type. Single choice from: 'float32', 'float64', 'complex128'. Default: 'float32'.

Type`guidata.dataset.dataitems.ChoiceItem`**classmethod** `create(dtype_str: str) → cdl.computation.signal.DataTypeSParam`Returns a new instance of `DataTypeSParam` with the fields set to the given values.**Parameters****dtype_str** (*str*) – Destination data type. Output image data type. Single choice from: 'float32', 'float64', 'complex128'. Default: 'float32'.**Returns**New instance of `DataTypeSParam`.`cdl.computation.signal.compute_astype(src: SignalObj, p: DataTypeSParam) → SignalObj`Convert data type with `numpy.astype()`**Parameters**

- **src** – source signal
- **p** – parameters

Returns

Result signal object

`cdl.computation.signal.compute_log10(src: SignalObj) → SignalObj`Compute Log10 with `numpy.log10`**Parameters****src** – source signal**Returns**

Result signal object

`cdl.computation.signal.compute_exp(src: SignalObj) → SignalObj`

Compute exponential with `numpy.exp`

Parameters

src – source signal

Returns

Result signal object

`cdl.computation.signal.compute_sqrt(src: SignalObj) → SignalObj`

Compute square root with `numpy.sqrt`

Parameters

src – source signal

Returns

Result signal object

class `cdl.computation.signal.PowerParam`

Power parameters

power

Default: 2.0.

Type

`guidata.dataset.dataitems.FloatItem`

classmethod `create(power: float) → cdl.computation.signal.PowerParam`

Returns a new instance of `PowerParam` with the fields set to the given values.

Parameters

power (`float`) – Default: 2.0.

Returns

New instance of `PowerParam`.

`cdl.computation.signal.compute_power(src: SignalObj, p: PowerParam) → SignalObj`

Compute power with `numpy.power`

Parameters

- **src** – source signal
- **p** – parameters

Returns

Result signal object

class `cdl.computation.signal.PeakDetectionParam`

Peak detection parameters

threshold

Integer between 0 and 100, unit: %. Default: 30.

Type

`guidata.dataset.dataitems.IntItem`

min_dist

Minimum distance. Integer higher than 1, unit: points. Default: 1.

Type

`guidata.dataset.dataitems.IntItem`

classmethod `create(threshold: int, min_dist: int) → cdl.computation.signal.PeakDetectionParam`

Returns a new instance of `PeakDetectionParam` with the fields set to the given values.

Parameters

- **threshold** (*int*) – Integer between 0 and 100, unit: %. Default: 30.
- **min_dist** (*int*) – Minimum distance. Integer higher than 1, unit: points. Default: 1.

Returns

New instance of `PeakDetectionParam`.

`cdl.computation.signal.compute_peak_detection(src: SignalObj, p: PeakDetectionParam) → SignalObj`

Peak detection with `cdl.algorithms.signal.peak_indices()`

Parameters

- **src** – source signal
- **p** – parameters

Returns

Result signal object

`cdl.computation.signal.compute_normalize(src: SignalObj, p: NormalizeParam) → SignalObj`

Normalize data with `cdl.algorithms.signal.normalize()`

Parameters

- **src** – source signal
- **p** – parameters

Returns

Result signal object

`cdl.computation.signal.compute_derivative(src: SignalObj) → SignalObj`

Compute derivative with `numpy.gradient()`

Parameters

src – source signal

Returns

Result signal object

`cdl.computation.signal.compute_integral(src: SignalObj) → SignalObj`

Compute integral with `scipy.integrate.cumulative_trapezoid()`

Parameters

src – source signal

Returns

Result signal object

class `cdl.computation.signal.XYCalibrateParam`

Signal calibration parameters

axis

Calibrate. Single choice from: 'x', 'y'. Default: 'y'.

Type

`guidata.dataset.dataitems.ChoiceItem`

a

Default: 1.0.

Type`guidata.dataset.dataitems.FloatItem`**b**

Default: 0.0.

Type`guidata.dataset.dataitems.FloatItem`**classmethod** `create(axis: str, a: float, b: float) → cdl.computation.signal.XYCalibrateParam`Returns a new instance of `XYCalibrateParam` with the fields set to the given values.**Parameters**

- **axis** (`str`) – Calibrate. Single choice from: ‘x’, ‘y’. Default: ‘y’.
- **a** (`float`) – Default: 1.0.
- **b** (`float`) – Default: 0.0.

ReturnsNew instance of `XYCalibrateParam`.`cdl.computation.signal.compute_calibration(src: SignalObj, p: XYCalibrateParam) → SignalObj`

Compute linear calibration

Parameters

- **src** – source signal
- **p** – parameters

Returns

Result signal object

`cdl.computation.signal.compute_clip(src: SignalObj, p: ClipParam) → SignalObj`Compute maximum data clipping with `numpy.clip()`**Parameters**

- **src** – source signal
- **p** – parameters

Returns

Result signal object

`cdl.computation.signal.compute_offset_correction(src: SignalObj, p: ROI1DParam) → SignalObj`

Correct offset: subtract the mean value of the signal in the specified range (baseline correction)

Parameters

- **src** – source signal
- **p** – parameters

Returns

Result signal object

`cdl.computation.signal.compute_gaussian_filter(src: SignalObj, p: GaussianParam) → SignalObj`

Compute gaussian filter with `scipy.ndimage.gaussian_filter()`

Parameters

- **src** – source signal
- **p** – parameters

Returns

Result signal object

`cdl.computation.signal.compute_moving_average(src: SignalObj, p: MovingAverageParam) → SignalObj`

Compute moving average with `scipy.ndimage.uniform_filter()`

Parameters

- **src** – source signal
- **p** – parameters

Returns

Result signal object

`cdl.computation.signal.compute_moving_median(src: SignalObj, p: MovingMedianParam) → SignalObj`

Compute moving median with `scipy.ndimage.median_filter()`

Parameters

- **src** – source signal
- **p** – parameters

Returns

Result signal object

`cdl.computation.signal.compute_wiener(src: SignalObj) → SignalObj`

Compute Wiener filter with `scipy.signal.wiener()`

Parameters

src – source signal

Returns

Result signal object

`class cdl.computation.signal.FilterType(value, names=None, *, module=None, qualname=None, type=None, start=1, boundary=None)`

Filter types

`class cdl.computation.signal.BaseHighLowBandParam`

Base class for high-pass, low-pass, band-pass and band-stop filters

method

Filter method. Single choice from: 'bessel', 'butter', 'cheby1', 'cheby2', 'ellip'. Default: 'bessel'.

Type

`guidata.dataset.dataitems.ChoiceItem`

order

Filter order. Integer higher than 1. Default: 3.

Type

`guidata.dataset.dataitems.IntItem`

f_cut0

Low cutoff frequency. Float higher than 0, non zero, unit: hz. Default: None.

Type

`guidata.dataset.dataitems.FloatItem`

f_cut1

High cutoff frequency. Float higher than 0, non zero, unit: hz. Default: None.

Type

`guidata.dataset.dataitems.FloatItem`

rp

Passband ripple. Float higher than 0, non zero, unit: db. Default: 1.

Type

`guidata.dataset.dataitems.FloatItem`

rs

Stopband attenuation. Float higher than 0, non zero, unit: db. Default: 1.

Type

`guidata.dataset.dataitems.FloatItem`

classmethod `create(method: str, order: int, f_cut0: float, f_cut1: float, rp: float, rs: float) → cdl.computation.signal.BaseHighLowBandParam`

Returns a new instance of `BaseHighLowBandParam` with the fields set to the given values.

Parameters

- **method** (*str*) – Filter method. Single choice from: ‘bessel’, ‘butter’, ‘cheby1’, ‘cheby2’, ‘ellip’. Default: ‘bessel’.
- **order** (*int*) – Filter order. Integer higher than 1. Default: 3.
- **f_cut0** (*float*) – Low cutoff frequency. Float higher than 0, non zero, unit: hz. Default: None.
- **f_cut1** (*float*) – High cutoff frequency. Float higher than 0, non zero, unit: hz. Default: None.
- **rp** (*float*) – Passband ripple. Float higher than 0, non zero, unit: db. Default: 1.
- **rs** (*float*) – Stopband attenuation. Float higher than 0, non zero, unit: db. Default: 1.

Returns

New instance of `BaseHighLowBandParam`.

static `get_nyquist_frequency(obj: SignalObj) → float`

Return the Nyquist frequency of a signal object

Parameters

obj – signal object

`update_from_signal(obj: SignalObj) → None`

Update the filter parameters from a signal object

Parameters

obj – signal object

get_filter_params(*obj*: SignalObj) → tuple[float | str, float | str]

Return the filter parameters (a and b) as a tuple. These parameters are used in the scipy.signal filter functions (eg. *scipy.signal.filtfilt*).

Parameters

obj – signal object

Returns

filter parameters

Return type

tuple

class cdl.computation.signal.LowPassFilterParam

Low-pass filter parameters

method

Filter method. Single choice from: ‘bessel’, ‘butter’, ‘cheby1’, ‘cheby2’, ‘ellip’. Default: ‘bessel’.

Type

guidata.dataset.dataitems.ChoiceItem

order

Filter order. Integer higher than 1. Default: 3.

Type

guidata.dataset.dataitems.IntItem

f_cut0

Low cutoff frequency. Float higher than 0, non zero, unit: hz. Default: None.

Type

guidata.dataset.dataitems.FloatItem

f_cut1

High cutoff frequency. Float higher than 0, non zero, unit: hz. Default: None.

Type

guidata.dataset.dataitems.FloatItem

rp

Passband ripple. Float higher than 0, non zero, unit: db. Default: 1.

Type

guidata.dataset.dataitems.FloatItem

rs

Stopband attenuation. Float higher than 0, non zero, unit: db. Default: 1.

Type

guidata.dataset.dataitems.FloatItem

classmethod **create**(*method*: str, *order*: int, *f_cut0*: float, *f_cut1*: float, *rp*: float, *rs*: float) →
cdl.computation.signal.LowPassFilterParam

Returns a new instance of *LowPassFilterParam* with the fields set to the given values.

Parameters

- **method** (*str*) – Filter method. Single choice from: ‘bessel’, ‘butter’, ‘cheby1’, ‘cheby2’, ‘ellip’. Default: ‘bessel’.
- **order** (*int*) – Filter order. Integer higher than 1. Default: 3.

- **f_cut0** (*float*) – Low cutoff frequency. Float higher than 0, non zero, unit: hz. Default: None.
- **f_cut1** (*float*) – High cutoff frequency. Float higher than 0, non zero, unit: hz. Default: None.
- **rp** (*float*) – Passband ripple. Float higher than 0, non zero, unit: db. Default: 1.
- **rs** (*float*) – Stopband attenuation. Float higher than 0, non zero, unit: db. Default: 1.

Returns

New instance of *LowPassFilterParam*.

class `cdl.computation.signal.HighPassFilterParam`

High-pass filter parameters

method

Filter method. Single choice from: 'bessel', 'butter', 'cheby1', 'cheby2', 'ellip'. Default: 'bessel'.

Type

`guidata.dataset.dataitems.ChoiceItem`

order

Filter order. Integer higher than 1. Default: 3.

Type

`guidata.dataset.dataitems.IntItem`

f_cut0

Low cutoff frequency. Float higher than 0, non zero, unit: hz. Default: None.

Type

`guidata.dataset.dataitems.FloatItem`

f_cut1

High cutoff frequency. Float higher than 0, non zero, unit: hz. Default: None.

Type

`guidata.dataset.dataitems.FloatItem`

rp

Passband ripple. Float higher than 0, non zero, unit: db. Default: 1.

Type

`guidata.dataset.dataitems.FloatItem`

rs

Stopband attenuation. Float higher than 0, non zero, unit: db. Default: 1.

Type

`guidata.dataset.dataitems.FloatItem`

classmethod `create`(*method: str, order: int, f_cut0: float, f_cut1: float, rp: float, rs: float*) → *cdl.computation.signal.HighPassFilterParam*

Returns a new instance of *HighPassFilterParam* with the fields set to the given values.

Parameters

- **method** (*str*) – Filter method. Single choice from: 'bessel', 'butter', 'cheby1', 'cheby2', 'ellip'. Default: 'bessel'.
- **order** (*int*) – Filter order. Integer higher than 1. Default: 3.

- **f_cut0** (*float*) – Low cutoff frequency. Float higher than 0, non zero, unit: hz. Default: None.
- **f_cut1** (*float*) – High cutoff frequency. Float higher than 0, non zero, unit: hz. Default: None.
- **rp** (*float*) – Passband ripple. Float higher than 0, non zero, unit: db. Default: 1.
- **rs** (*float*) – Stopband attenuation. Float higher than 0, non zero, unit: db. Default: 1.

Returns

New instance of *HighPassFilterParam*.

class cdl.computation.signal.**BandPassFilterParam**

Band-pass filter parameters

method

Filter method. Single choice from: ‘bessel’, ‘butter’, ‘cheby1’, ‘cheby2’, ‘ellip’. Default: ‘bessel’.

Type

guidata.dataset.dataitems.ChoiceItem

order

Filter order. Integer higher than 1. Default: 3.

Type

guidata.dataset.dataitems.IntItem

f_cut0

Low cutoff frequency. Float higher than 0, non zero, unit: hz. Default: None.

Type

guidata.dataset.dataitems.FloatItem

f_cut1

High cutoff frequency. Float higher than 0, non zero, unit: hz. Default: None.

Type

guidata.dataset.dataitems.FloatItem

rp

Passband ripple. Float higher than 0, non zero, unit: db. Default: 1.

Type

guidata.dataset.dataitems.FloatItem

rs

Stopband attenuation. Float higher than 0, non zero, unit: db. Default: 1.

Type

guidata.dataset.dataitems.FloatItem

classmethod **create**(*method: str, order: int, f_cut0: float, f_cut1: float, rp: float, rs: float*) → *cdl.computation.signal.BandPassFilterParam*

Returns a new instance of *BandPassFilterParam* with the fields set to the given values.

Parameters

- **method** (*str*) – Filter method. Single choice from: ‘bessel’, ‘butter’, ‘cheby1’, ‘cheby2’, ‘ellip’. Default: ‘bessel’.
- **order** (*int*) – Filter order. Integer higher than 1. Default: 3.

- **f_cut0** (*float*) – Low cutoff frequency. Float higher than 0, non zero, unit: hz. Default: None.
- **f_cut1** (*float*) – High cutoff frequency. Float higher than 0, non zero, unit: hz. Default: None.
- **rp** (*float*) – Passband ripple. Float higher than 0, non zero, unit: db. Default: 1.
- **rs** (*float*) – Stopband attenuation. Float higher than 0, non zero, unit: db. Default: 1.

Returns

New instance of *BandPassFilterParam*.

class `cdl.computation.signal.BandStopFilterParam`

Band-stop filter parameters

method

Filter method. Single choice from: 'bessel', 'butter', 'cheby1', 'cheby2', 'ellip'. Default: 'bessel'.

Type

`guidata.dataset.dataitems.ChoiceItem`

order

Filter order. Integer higher than 1. Default: 3.

Type

`guidata.dataset.dataitems.IntItem`

f_cut0

Low cutoff frequency. Float higher than 0, non zero, unit: hz. Default: None.

Type

`guidata.dataset.dataitems.FloatItem`

f_cut1

High cutoff frequency. Float higher than 0, non zero, unit: hz. Default: None.

Type

`guidata.dataset.dataitems.FloatItem`

rp

Passband ripple. Float higher than 0, non zero, unit: db. Default: 1.

Type

`guidata.dataset.dataitems.FloatItem`

rs

Stopband attenuation. Float higher than 0, non zero, unit: db. Default: 1.

Type

`guidata.dataset.dataitems.FloatItem`

classmethod `create`(*method: str, order: int, f_cut0: float, f_cut1: float, rp: float, rs: float*) → *cdl.computation.signal.BandStopFilterParam*

Returns a new instance of *BandStopFilterParam* with the fields set to the given values.

Parameters

- **method** (*str*) – Filter method. Single choice from: 'bessel', 'butter', 'cheby1', 'cheby2', 'ellip'. Default: 'bessel'.
- **order** (*int*) – Filter order. Integer higher than 1. Default: 3.

- **f_cut0** (*float*) – Low cutoff frequency. Float higher than 0, non zero, unit: hz. Default: None.
- **f_cut1** (*float*) – High cutoff frequency. Float higher than 0, non zero, unit: hz. Default: None.
- **rp** (*float*) – Passband ripple. Float higher than 0, non zero, unit: db. Default: 1.
- **rs** (*float*) – Stopband attenuation. Float higher than 0, non zero, unit: db. Default: 1.

Returns

New instance of *BandStopFilterParam*.

`cdl.computation.signal.compute_filter(src: SignalObj, p: BaseHighLowBandParam) → SignalObj`
Compute frequency filter (low-pass, high-pass, band-pass, band-stop), with `scipy.signal.filtfilt()`

Parameters

- **src** – source signal
- **p** – parameters

Returns

Result signal object

`cdl.computation.signal.compute_fft(src: SignalObj, p: FFTParam | None = None) → SignalObj`
Compute FFT with `cdl.algorithms.signal.fft1d()`

Parameters

- **src** – source signal
- **p** – parameters

Returns

Result signal object

`cdl.computation.signal.compute_ifft(src: SignalObj, p: FFTParam | None = None) → SignalObj`
Compute iFFT with `cdl.algorithms.signal.ifft1d()`

Parameters

- **src** – source signal
- **p** – parameters

Returns

Result signal object

`cdl.computation.signal.compute_magnitude_spectrum(src: SignalObj, p: SpectrumParam | None = None) → SignalObj`

Compute magnitude spectrum with `cdl.algorithms.signal.magnitude_spectrum()`

Parameters

- **src** – source signal
- **p** – parameters

Returns

Result signal object

`cdl.computation.signal.compute_phase_spectrum(src: SignalObj) → SignalObj`

Compute phase spectrum with `cdl.algorithms.signal.phase_spectrum()`

Parameters

src – source signal

Returns

Result signal object

`cdl.computation.signal.compute_psd(src: SignalObj, p: SpectrumParam | None = None) → SignalObj`

Compute power spectral density with `cdl.algorithms.signal.psd()`

Parameters

- **src** – source signal
- **p** – parameters

Returns

Result signal object

class `cdl.computation.signal.PolynomialFitParam`

Polynomial fitting parameters

degree

Integer between 1 and 10. Default: 3.

Type

`guidata.dataset.dataitems.IntItem`

classmethod `create(degree: int) → cdl.computation.signal.PolynomialFitParam`

Returns a new instance of `PolynomialFitParam` with the fields set to the given values.

Parameters

degree (`int`) – Integer between 1 and 10. Default: 3.

Returns

New instance of `PolynomialFitParam`.

`cdl.computation.signal.compute_histogram(src: SignalObj, p: HistogramParam) → SignalObj`

Compute histogram with `numpy.histogram()`

Parameters

- **src** – source signal
- **p** – parameters

Returns

Result signal object

class `cdl.computation.signal.InterpolationParam`

Interpolation parameters

method

Interpolation method. Single choice from: 'linear', 'spline', 'quadratic', 'cubic', 'barycentric', 'pchip'. Default: 'linear'.

Type

`guidata.dataset.dataitems.ChoiceItem`

fill_value

Value to use for points outside the interpolation domain (used only with linear, cubic and pchip methods).
Default: None.

Type

`guidata.dataset.dataitems.FloatItem`

classmethod `create(method: str, fill_value: float) → cdl.computation.signal.InterpolationParam`

Returns a new instance of `InterpolationParam` with the fields set to the given values.

Parameters

- **method** (`str`) – Interpolation method. Single choice from: ‘linear’, ‘spline’, ‘quadratic’, ‘cubic’, ‘barycentric’, ‘pchip’. Default: ‘linear’.
- **fill_value** (`float`) – Value to use for points outside the interpolation domain (used only with linear, cubic and pchip methods). Default: None.

Returns

New instance of `InterpolationParam`.

`cdl.computation.signal.compute_interpolation(src1: SignalObj, src2: SignalObj, p: InterpolationParam) → SignalObj`

Interpolate data with `cdl.algorithms.signal.interpolate()`

Parameters

- **src1** – source signal 1
- **src2** – source signal 2
- **p** – parameters

Returns

Result signal object

class `cdl.computation.signal.ResamplingParam`

Resample parameters

method

Interpolation method. Single choice from: ‘linear’, ‘spline’, ‘quadratic’, ‘cubic’, ‘barycentric’, ‘pchip’.
Default: ‘linear’.

Type

`guidata.dataset.dataitems.ChoiceItem`

fill_value

Value to use for points outside the interpolation domain (used only with linear, cubic and pchip methods).
Default: None.

Type

`guidata.dataset.dataitems.FloatItem`

xmin

X_{\min} . Default: None.

Type

`guidata.dataset.dataitems.FloatItem`

xmax

X_{\max} . Default: None.

Type`guidata.dataset.dataitems.FloatItem`**mode**

Single choice from: 'dx', 'nbpts'. Default: 'nbpts'.

Type`guidata.dataset.dataitems.ChoiceItem`**dx**

X. Default: None.

Type`guidata.dataset.dataitems.FloatItem`**nbpts**

Number of points. Default: None.

Type`guidata.dataset.dataitems.IntItem`

classmethod **create**(*method: str, fill_value: float, xmin: float, xmax: float, mode: str, dx: float, nbpts: int*)
 → `cdl.computation.signal.ResamplingParam`

Returns a new instance of `ResamplingParam` with the fields set to the given values.**Parameters**

- **method** (*str*) – Interpolation method. Single choice from: 'linear', 'spline', 'quadratic', 'cubic', 'barycentric', 'pchip'. Default: 'linear'.
- **fill_value** (*float*) – Value to use for points outside the interpolation domain (used only with linear, cubic and pchip methods). Default: None.
- **xmin** (*float*) – X_{\min} . Default: None.
- **xmax** (*float*) – X_{\max} . Default: None.
- **mode** (*str*) – Single choice from: 'dx', 'nbpts'. Default: 'nbpts'.
- **dx** (*float*) – X. Default: None.
- **nbpts** (*int*) – Number of points. Default: None.

ReturnsNew instance of `ResamplingParam`.

`cdl.computation.signal.compute_resampling`(*src: SignalObj, p: ResamplingParam*) → *SignalObj*

Resample data with `cdl.algorithms.signal.interpolate()`**Parameters**

- **src** – source signal
- **p** – parameters

Returns

Result signal object

class `cdl.computation.signal.DetrendingParam`

Detrending parameters

method

Detrending method. Single choice from: 'linear', 'constant'. Default: 'linear'.

Type

`guidata.dataset.dataitems.ChoiceItem`

classmethod `create(method: str) → cdl.computation.signal.DetrendingParam`

Returns a new instance of `DetrendingParam` with the fields set to the given values.

Parameters

method (*str*) – Detrending method. Single choice from: 'linear', 'constant'. Default: 'linear'.

Returns

New instance of `DetrendingParam`.

`cdl.computation.signal.compute_detrending(src: SignalObj, p: DetrendingParam) → SignalObj`

Detrend data with `scipy.signal.detrend()`

Parameters

- **src** – source signal
- **p** – parameters

Returns

Result signal object

`cdl.computation.signal.compute_convolution(src1: SignalObj, src2: SignalObj) → SignalObj`

Compute convolution of two signals with `scipy.signal.convolve()`

Parameters

- **src1** – source signal 1
- **src2** – source signal 2

Returns

Result signal object

class `cdl.computation.signal.WindowingParam`

Windowing parameters

method

Single choice from: 'barthann', 'bartlett', 'blackman', 'blackman-harris', 'bohman', 'boxcar', 'cosine', 'exponential', 'flat-top', 'gaussian', 'hamming', 'hanning', 'kaiser', 'lanczos', 'nuttall', 'parzen', 'rectangular', 'taylor', 'tukey'. Default: 'hamming'.

Type

`guidata.dataset.dataitems.ChoiceItem`

alpha

Shape parameter of the tukey windowing function. Default: 0.5.

Type

`guidata.dataset.dataitems.FloatItem`

beta

Shape parameter of the kaiser windowing function. Default: 14.0.

Type

`guidata.dataset.dataitems.FloatItem`

sigma

Shape parameter of the gaussian windowing function. Default: 0.5.

Type

`guidata.dataset.dataitems.FloatItem`

classmethod `create`(*method*: *str*, *alpha*: *float*, *beta*: *float*, *sigma*: *float*) → *cdl.computation.signal.WindowingParam*

Returns a new instance of *WindowingParam* with the fields set to the given values.

Parameters

- **method** (*str*) – Single choice from: ‘barthann’, ‘bartlett’, ‘blackman’, ‘blackman-harris’, ‘bohman’, ‘boxcar’, ‘cosine’, ‘exponential’, ‘flat-top’, ‘gaussian’, ‘hamming’, ‘hanning’, ‘kaiser’, ‘lanczos’, ‘nuttall’, ‘parzen’, ‘rectangular’, ‘taylor’, ‘tukey’. Default: ‘hamming’.
- **alpha** (*float*) – Shape parameter of the tukey windowing function. Default: 0.5.
- **beta** (*float*) – Shape parameter of the kaiser windowing function. Default: 14.0.
- **sigma** (*float*) – Shape parameter of the gaussian windowing function. Default: 0.5.

Returns

New instance of *WindowingParam*.

`cdl.computation.signal.compute_windowing`(*src*: *SignalObj*, *p*: *WindowingParam*) → *SignalObj*

Compute windowing (available methods: hamming, hanning, bartlett, blackman, tukey, rectangular) with *cdl.algorithms.signal.windowing()*

Parameters

- **dst** – destination signal
- **src** – source signal

Returns

Result signal object

`cdl.computation.signal.compute_reverse_x`(*src*: *SignalObj*) → *SignalObj*

Reverse x-axis

Parameters

src – source signal

Returns

Result signal object

class `cdl.computation.signal.AngleUnitParam`

Choice of angle unit.

unit

Angle unit. Single choice from: ‘rad’, ‘deg’. Default: ‘rad’.

Type

`guidata.dataset.dataitems.ChoiceItem`

classmethod `create`(*unit*: *str*) → *cdl.computation.signal.AngleUnitParam*

Returns a new instance of *AngleUnitParam* with the fields set to the given values.

Parameters

unit (*str*) – Angle unit. Single choice from: ‘rad’, ‘deg’. Default: ‘rad’.

Returns

New instance of *AngleUnitParam*.

`cdl.computation.signal.compute_cartesian2polar(src: SignalObj, p: AngleUnitParam) → SignalObj`

Convert cartesian coordinates to polar coordinates with *cdl.algorithms.coordinates.cartesian2polar()*.

Parameters

- **src** – Source signal.
- **p** – Parameters.

Returns

Result signal object.

`cdl.computation.signal.compute_polar2cartesian(src: SignalObj, p: AngleUnitParam) → SignalObj`

Convert polar coordinates to cartesian coordinates with *cdl.algorithms.coordinates.polar2cartesian()*.

Parameters

- **src** – Source signal.
- **p** – Parameters.

Returns

Result signal object.

Note: This function assumes that the x-axis represents the radius and the y-axis represents the angle. Negative values are not allowed for the radius, and will be clipped to 0 (a warning will be raised).

class `cdl.computation.signal.AllanVarianceParam`

Allan variance parameters

max_tau

Max . Integer higher than 1, unit: pts. Default: 100.

Type

guidata.dataset.dataitems.IntItem

classmethod `create(max_tau: int) → cdl.computation.signal.AllanVarianceParam`

Returns a new instance of *AllanVarianceParam* with the fields set to the given values.

Parameters

max_tau (*int*) – Max . Integer higher than 1, unit: pts. Default: 100.

Returns

New instance of *AllanVarianceParam*.

`cdl.computation.signal.compute_allan_variance(src: SignalObj, p: AllanVarianceParam) → SignalObj`

Compute Allan variance with *cdl.algorithms.signal.allan_variance()*

Parameters

- **src** – source signal
- **p** – parameters

Returns

Result signal object

`cdl.computation.signal.compute_allan_deviation(src: SignalObj, p: AllanVarianceParam) → SignalObj`
 Compute Allan deviation with `cdl.algorithms.signal.allan_deviation()`

Parameters

- **src** – source signal
- **p** – parameters

Returns

Result signal object

`cdl.computation.signal.compute_overlapping_allan_variance(src: SignalObj, p: AllanVarianceParam) → SignalObj`

Compute Overlapping Allan variance.

Parameters

- **src** – source signal
- **p** – parameters

Returns

Result signal object

`cdl.computation.signal.compute_modified_allan_variance(src: SignalObj, p: AllanVarianceParam) → SignalObj`

Compute Modified Allan variance.

Parameters

- **src** – source signal
- **p** – parameters

Returns

Result signal object

`cdl.computation.signal.compute_hadamard_variance(src: SignalObj, p: AllanVarianceParam) → SignalObj`

Compute Hadamard variance.

Parameters

- **src** – source signal
- **p** – parameters

Returns

Result signal object

`cdl.computation.signal.compute_total_variance(src: SignalObj, p: AllanVarianceParam) → SignalObj`

Compute Total variance.

Parameters

- **src** – source signal
- **p** – parameters

Returns

Result signal object

`cdl.computation.signal.compute_time_deviation(src: SignalObj, p: AllanVarianceParam) → SignalObj`
Compute Time Deviation (TDEV).

Parameters

- **src** – source signal
- **p** – parameters

Returns

Result signal object

`cdl.computation.signal.calc_result_shape(title: str, shape: Literal['rectangle', 'circle', 'ellipse', 'segment', 'marker', 'point', 'polygon'], obj: SignalObj, func: Callable, *args: Any, add_label: bool = False) → ResultShape | None`

Calculate result shape by executing a computation function on a signal object, taking into account the signal ROIs.

Parameters

- **title** – result title
- **shape** – result shape kind
- **obj** – input image object
- **func** – computation function
- ***args** – computation function arguments
- **add_label** – if True, add a label item (and the geometrical shape) to plot (default to False)

Returns

Result shape object or None if no result is found

Warning: The computation function must take either a single argument (the data) or multiple arguments (the data followed by the computation parameters).

Moreover, the computation function must return a 1D NumPy array (or a list, or a tuple) containing the result of the computation.

class `cdl.computation.signal.FWHMParam`

FWHM parameters

method

Single choice from: ‘zero-crossing’, ‘gauss’, ‘lorentz’, ‘voigt’. Default: ‘zero-crossing’.

Type

`guidata.dataset.dataitems.ChoiceItem`

xmin

X_{MIN}. Lower x boundary (empty for no limit, i.e. Start of the signal). Default: None.

Type

`guidata.dataset.dataitems.FloatItem`

xmax

X_{MAX}. Upper x boundary (empty for no limit, i.e. End of the signal). Default: None.

Type

`guidata.dataset.dataitems.FloatItem`

classmethod `create`(*method*: *str*, *xmin*: *float*, *xmax*: *float*) → *cdl.computation.signal.FWHMParam*

Returns a new instance of *FWHMParam* with the fields set to the given values.

Parameters

- **method** (*str*) – Single choice from: ‘zero-crossing’, ‘gauss’, ‘lorentz’, ‘voigt’. Default: ‘zero-crossing’.
- **xmin** (*float*) – X_{MIN} . Lower x boundary (empty for no limit, i.e. Start of the signal). Default: None.
- **xmax** (*float*) – X_{MAX} . Upper x boundary (empty for no limit, i.e. End of the signal). Default: None.

Returns

New instance of *FWHMParam*.

cdl.computation.signal.compute_fwhm(*obj*: *SignalObj*, *param*: *FWHMParam*) → *ResultShape* | None

Compute FWHM with *cdl.algorithms.signal.fwhm()*

Parameters

- **obj** – source signal
- **param** – parameters

Returns

Segment coordinates

cdl.computation.signal.compute_fw1e2(*obj*: *SignalObj*) → *ResultShape* | None

Compute FW at $1/e^2$ with *cdl.algorithms.signal.fw1e2()*

Parameters

obj – source signal

Returns

Segment coordinates

class *cdl.computation.signal.FindAbscissaParam*

Parameter dataset for abscissa finding

y

Ordinate. Default: 0.

Type

guidata.dataset.dataitems.FloatItem

classmethod `create`(*y*: *float*) → *cdl.computation.signal.FindAbscissaParam*

Returns a new instance of *FindAbscissaParam* with the fields set to the given values.

Parameters

y (*float*) – Ordinate. Default: 0.

Returns

New instance of *FindAbscissaParam*.

cdl.computation.signal.compute_x_at_y(*obj*: *SignalObj*, *p*: *FindAbscissaParam*) → *ResultProperties*

Compute the smallest x-value at a given y-value for a signal object.

Parameters

- **obj** – The signal object containing x and y data.
- **p** – The parameter dataset for finding the abscissa.

Returns

An object containing the x-value.

`cdl.computation.signal.compute_stats(obj: SignalObj) → ResultProperties`

Compute statistics on a signal

Parameters

obj – source signal

Returns

Result properties object

`cdl.computation.signal.compute_bandwidth_3db(obj: SignalObj) → ResultProperties`

Compute bandwidth at -3 dB with `cdl.algorithms.signal.bandwidth()`

Parameters

obj – source signal

Returns

Result properties with bandwidth

class `cdl.computation.signal.DynamicParam`

Parameters for dynamic range computation (ENOB, SNR, SINAD, THD, SFDR)

full_scale

Float higher than 0.0, unit: v. Default: 0.16.

Type

`guidata.dataset.dataitems.FloatItem`

unit

Unit for sinad. Single choice from: 'dBc', 'dBFS'. Default: 'dBc'.

Type

`guidata.dataset.dataitems.ChoiceItem`

nb_harm

Number of harmonics. Number of harmonics to consider for thd. Integer higher than 1. Default: 5.

Type

`guidata.dataset.dataitems.IntItem`

classmethod `create(full_scale: float, unit: str, nb_harm: int) → cdl.computation.signal.DynamicParam`

Returns a new instance of `DynamicParam` with the fields set to the given values.

Parameters

- **full_scale** (*float*) – Float higher than 0.0, unit: v. Default: 0.16.
- **unit** (*str*) – Unit for sinad. Single choice from: 'dBc', 'dBFS'. Default: 'dBc'.
- **nb_harm** (*int*) – Number of harmonics. Number of harmonics to consider for thd. Integer higher than 1. Default: 5.

Returns

New instance of `DynamicParam`.

`cdl.computation.signal.compute_dynamic_parameters(src: SignalObj, p: DynamicParam) → ResultProperties`

Compute Dynamic parameters using the following functions:

- Freq: `cdl.algorithms.signal.sinus_frequency()`

- ENOB: `cdl.algorithms.signal.enob()`
- SNR: `cdl.algorithms.signal.snr()`
- SINAD: `cdl.algorithms.signal.sinad()`
- THD: `cdl.algorithms.signal.thd()`
- SFDR: `cdl.algorithms.signal.sfdr()`

Parameters

- **src** – source signal
- **p** – parameters

Returns

Result properties with ENOB, SNR, SINAD, THD, SFDR

`cdl.computation.signal.compute_sampling_rate_period(obj: SignalObj) → ResultProperties`

Compute sampling rate and period using the following functions:

- fs: `cdl.algorithms.signal.sampling_rate()`
- T: `cdl.algorithms.signal.sampling_period()`

Parameters

obj – source signal

Returns

Result properties with sampling rate and period

`cdl.computation.signal.compute_contrast(obj: SignalObj) → ResultProperties`

Compute contrast with `cdl.algorithms.signal.contrast()`

`cdl.computation.signal.compute_x_at_minmax(obj: SignalObj) → ResultProperties`

Compute the smallest argument at the minima and the smallest argument at the maxima.

Parameters

obj – The signal object.

Returns

An object containing the x-values at the minima and the maxima.

3.4.3 Image processing features

Base image processing features

`cdl.computation.image.restore_data_outside_roi(dst: ImageObj, src: ImageObj) → None`

Restore data outside the Region Of Interest (ROI) of the input image after a computation, only if the input image has a ROI, and if the output image has the same ROI as the input image, and if the data types are compatible, and if the shapes are the same. Otherwise, do nothing.

Parameters

- **dst** – output image object
- **src** – input image object

class `cdl.computation.image.Wrap11Func`(*func: Callable, *args: Any, **kwargs: Any*)

Wrap a 1 array \rightarrow 1 array function to produce a 1 image \rightarrow 1 image function, which can be used inside DataLab's infrastructure to perform computations with `cdl.core.gui.processor.image.ImageProcessor`.

This wrapping mechanism using a class is necessary for the resulted function to be pickable by the multiprocessing module.

The instance of this wrapper is callable and returns a `cdl.obj.ImageObj` object.

Example

```
>>> import numpy as np
>>> from cdl.computation.image import Wrap11Func
>>> import cdl.obj
>>> def add_noise(data):
...     return data + np.random.random(data.shape)
>>> compute_add_noise = Wrap11Func(add_noise)
>>> data= np.ones((100, 100))
>>> ima0 = cdl.obj.create_image("Example", data)
>>> ima1 = compute_add_noise(ima0)
```

Parameters

- **func** – 1 array \rightarrow 1 array function
- ***args** – Additional positional arguments to pass to the function
- ****kwargs** – Additional keyword arguments to pass to the function

`cdl.computation.image.dst_11_signal`(*src: ImageObj, name: str, suffix: str | None = None*) \rightarrow *SignalObj*

Create a result signal object, as returned by the callback function of the `cdl.core.gui.processor.base.BaseProcessor.compute_11()` method

Parameters

- **src** – input image object
- **name** – name of the processing function

Returns

Output signal object

`cdl.computation.image.compute_addition`(*dst: ImageObj, src: ImageObj*) \rightarrow *ImageObj*

Add **dst** and **src** images and return **dst** image modified in place

Parameters

- **dst** – output image object
- **src** – input image object

Returns

Output image object (modified in place)

`cdl.computation.image.compute_product`(*dst: ImageObj, src: ImageObj*) \rightarrow *ImageObj*

Multiply **dst** and **src** images and return **dst** image modified in place

Parameters

- **dst** – output image object

- **src** – input image object

Returns

Output image object (modified in place)

`cdl.computation.image.compute_addition_constant(src: ImageObj, p: ConstantParam) → ImageObj`

Add **dst** and a constant value and return the new result image object

Parameters

- **src** – input image object
- **p** – constant value

Returns

Result image object **src + p.value** (new object)

`cdl.computation.image.compute_difference_constant(src: ImageObj, p: ConstantParam) → ImageObj`

Subtract a constant value from an image and return the new result image object

Parameters

- **src** – input image object
- **p** – constant value

Returns

Result image object **src - p.value** (new object)

`cdl.computation.image.compute_product_constant(src: ImageObj, p: ConstantParam) → ImageObj`

Multiply **dst** by a constant value and return the new result image object

Parameters

- **src** – input image object
- **p** – constant value

Returns

Result image object **src * p.value** (new object)

`cdl.computation.image.compute_division_constant(src: ImageObj, p: ConstantParam) → ImageObj`

Divide an image by a constant value and return the new result image object

Parameters

- **src** – input image object
- **p** – constant value

Returns

Result image object **src / p.value** (new object)

`cdl.computation.image.compute_arithmetic(src1: ImageObj, src2: ImageObj, p: ArithmeticParam) → ImageObj`

Compute arithmetic operation on two images

Parameters

- **src1** – input image object
- **src2** – input image object
- **p** – arithmetic parameters

Returns

Result image object

`cdl.computation.image.compute_difference(src1: ImageObj, src2: ImageObj) → ImageObj`

Compute difference between two images

Parameters

- **src1** – input image object
- **src2** – input image object

Returns

Result image object **src1 - src2** (new object)

`cdl.computation.image.compute_quadratic_difference(src1: ImageObj, src2: ImageObj) → ImageObj`

Compute quadratic difference between two images

Parameters

- **src1** – input image object
- **src2** – input image object

Returns

Result image object **(src1 - src2) / sqrt(2.0)** (new object)

`cdl.computation.image.compute_division(src1: ImageObj, src2: ImageObj) → ImageObj`

Compute division between two images

Parameters

- **src1** – input image object
- **src2** – input image object

Returns

Result image object **src1 / src2** (new object)

class `cdl.computation.image.FlatFieldParam`

Flat-field parameters

threshold

Default: 0.0.

Type

`guidata.dataset.dataitems.FloatItem`

classmethod `create(threshold: float) → cdl.computation.image.FlatFieldParam`

Returns a new instance of `FlatFieldParam` with the fields set to the given values.

Parameters

threshold (`float`) – Default: 0.0.

Returns

New instance of `FlatFieldParam`.

`cdl.computation.image.compute_flatfield(src1: ImageObj, src2: ImageObj, p: FlatFieldParam) → ImageObj`

Compute flat field correction with `cdl.algorithms.image.flatfield()`

Parameters

- **src1** – raw data image object

- **src2** – flat field image object
- **p** – flat field parameters

Returns

Output image object

`cdl.computation.image.compute_normalize(src: ImageObj, p: NormalizeParam) → ImageObj`

Normalize image data depending on its maximum, with `cdl.algorithms.image.normalize()`

Parameters

src – input image object

Returns

Output image object

class `cdl.computation.image.LogP1Param`

Log10 parameters

n

Default: None.

Type

`guidata.dataset.dataitems.FloatItem`

classmethod `create(n: float) → cdl.computation.image.LogP1Param`

Returns a new instance of `LogP1Param` with the fields set to the given values.

Parameters

n (*float*) – Default: None.

Returns

New instance of `LogP1Param`.

`cdl.computation.image.compute_logp1(src: ImageObj, p: LogP1Param) → ImageObj`

Compute $\log_{10}(z+n)$ with `numpy.log10`

Parameters

- **src** – input image object
- **p** – parameters

Returns

Output image object

class `cdl.computation.image.RotateParam`

Rotate parameters

angle

Angle (°). Default: None.

Type

`guidata.dataset.dataitems.FloatItem`

mode

Single choice from: 'constant', 'nearest', 'reflect', 'wrap'. Default: 'constant'.

Type

`guidata.dataset.dataitems.ChoiceItem`

cval

Value used for points outside the boundaries of the input if mode is 'constant'. Default: 0.0.

Type

`guidata.dataset.dataitems.FloatItem`

reshape

Reshape the output array so that the input array is contained completely in the output. Default: False.

Type

`guidata.dataset.dataitems.BoolItem`

prefilter

Default: True.

Type

`guidata.dataset.dataitems.BoolItem`

order

Spline interpolation order. Integer between 0 and 5. Default: 3.

Type

`guidata.dataset.dataitems.IntItem`

classmethod **create**(*angle: float, mode: str, cval: float, reshape: bool, prefilter: bool, order: int*) → *cdl.computation.image.RotateParam*

Returns a new instance of *[RotateParam](#)* with the fields set to the given values.

Parameters

- **angle** (*float*) – Angle (°). Default: None.
- **mode** (*str*) – Single choice from: 'constant', 'nearest', 'reflect', 'wrap'. Default: 'constant'.
- **cval** (*float*) – Value used for points outside the boundaries of the input if mode is 'constant'. Default: 0.0.
- **reshape** (*bool*) – Reshape the output array so that the input array is contained completely in the output. Default: False.
- **prefilter** (*bool*) – Default: True.
- **order** (*int*) – Spline interpolation order. Integer between 0 and 5. Default: 3.

Returns

New instance of *[RotateParam](#)*.

`cdl.computation.image.rotate_obj_coords`(*angle: float, obj: ImageObj, orig: ImageObj, coords: ndarray*) → *None*

Apply rotation to coords associated to image obj

Parameters

- **angle** – rotation angle (in degrees)
- **obj** – image object
- **orig** – original image object
- **coords** – coordinates to rotate

Returns

Output data

`cdl.computation.image.rotate_obj_alpha(obj: ImageObj, orig: ImageObj, coords: ndarray, p: RotateParam) → None`

Apply rotation to coords associated to image obj

`cdl.computation.image.compute_rotate(src: ImageObj, p: RotateParam) → ImageObj`

Rotate data with `scipy.ndimage.rotate()`

Parameters

- **src** – input image object
- **p** – parameters

Returns

Output image object

`cdl.computation.image.rotate_obj_90(dst: ImageObj, src: ImageObj, coords: ndarray) → None`

Apply rotation to coords associated to image obj

`cdl.computation.image.compute_rotate90(src: ImageObj) → ImageObj`

Rotate data 90° with `numpy.rot90()`

Parameters

src – input image object

Returns

Output image object

`cdl.computation.image.rotate_obj_270(dst: ImageObj, src: ImageObj, coords: ndarray) → None`

Apply rotation to coords associated to image obj

`cdl.computation.image.compute_rotate270(src: ImageObj) → ImageObj`

Rotate data 270° with `numpy.rot90()`

Parameters

src – input image object

Returns

Output image object

`cdl.computation.image.hflip_coords(dst: ImageObj, src: ImageObj, coords: ndarray) → None`

Apply HFlip to coords

`cdl.computation.image.compute_fliph(src: ImageObj) → ImageObj`

Flip data horizontally with `numpy.fliplr()`

Parameters

src – input image object

Returns

Output image object

`cdl.computation.image.vflip_coords(dst: ImageObj, src: ImageObj, coords: ndarray) → None`

Apply VFlip to coords

`cdl.computation.image.compute_flipv(src: ImageObj) → ImageObj`

Flip data vertically with `numpy.flipud()`

Parameters

src – input image object

Returns

Output image object

class `cdl.computation.image.GridParam`

Grid parameters

direction

Distribute over. Single choice from: 'col', 'row'. Default: 'col'.

Type

`guidata.dataset.dataitems.ChoiceItem`

cols

Columns. Integer, non zero. Default: 1.

Type

`guidata.dataset.dataitems.IntItem`

rows

Integer, non zero. Default: 1.

Type

`guidata.dataset.dataitems.IntItem`

colspac

Column spacing. Float higher than 0.0. Default: 0.0.

Type

`guidata.dataset.dataitems.FloatItem`

rowspac

Row spacing. Float higher than 0.0. Default: 0.0.

Type

`guidata.dataset.dataitems.FloatItem`

classmethod `create(direction: str, cols: int, rows: int, colspac: float, rowspac: float) → cdl.computation.image.GridParam`

Returns a new instance of `GridParam` with the fields set to the given values.

Parameters

- **direction** (*str*) – Distribute over. Single choice from: 'col', 'row'. Default: 'col'.
- **cols** (*int*) – Columns. Integer, non zero. Default: 1.
- **rows** (*int*) – Integer, non zero. Default: 1.
- **colspac** (*float*) – Column spacing. Float higher than 0.0. Default: 0.0.
- **rowspac** (*float*) – Row spacing. Float higher than 0.0. Default: 0.0.

Returns

New instance of `GridParam`.

class `cdl.computation.image.ResizeParam`

Resize parameters

zoom

Default: None.

Type

`guidata.dataset.dataitems.FloatItem`

mode

Single choice from: ‘constant’, ‘nearest’, ‘reflect’, ‘wrap’. Default: ‘constant’.

Type

`guidata.dataset.dataitems.ChoiceItem`

cval

Value used for points outside the boundaries of the input if mode is ‘constant’. Default: 0.0.

Type

`guidata.dataset.dataitems.FloatItem`

prefilter

Default: True.

Type

`guidata.dataset.dataitems.BoolItem`

order

Spline interpolation order. Integer between 0 and 5. Default: 3.

Type

`guidata.dataset.dataitems.IntItem`

classmethod `create`(*zoom: float, mode: str, cval: float, prefilter: bool, order: int*) → `cdl.computation.image.ResizeParam`

Returns a new instance of `ResizeParam` with the fields set to the given values.

Parameters

- **zoom** (*float*) – Default: None.
- **mode** (*str*) – Single choice from: ‘constant’, ‘nearest’, ‘reflect’, ‘wrap’. Default: ‘constant’.
- **cval** (*float*) – Value used for points outside the boundaries of the input if mode is ‘constant’. Default: 0.0.
- **prefilter** (*bool*) – Default: True.
- **order** (*int*) – Spline interpolation order. Integer between 0 and 5. Default: 3.

Returns

New instance of `ResizeParam`.

`cdl.computation.image.compute_resize`(*src: ImageObj, p: ResizeParam*) → `ImageObj`

Zooming function with `scipy.ndimage.zoom()`

Parameters

- **src** – input image object
- **p** – parameters

Returns

Output image object

class `cdl.computation.image.BinningParam`

Binning parameters

sx

Cluster size (X). Number of adjacent pixels to be combined together along x-axis. Integer higher than 2. Default: 2.

Type`guidata.dataset.dataitems.IntItem`**sy**

Cluster size (Y). Number of adjacent pixels to be combined together along y-axis. Integer higher than 2. Default: 2.

Type`guidata.dataset.dataitems.IntItem`**operation**

Single choice from: 'sum', 'average', 'median', 'min', 'max'. Default: 'sum'.

Type`guidata.dataset.dataitems.ChoiceItem`**dtype_str**

Data type. Output image data type. Single choice from: 'dtype', 'float32', 'float64', 'complex128', 'int32', 'int16', 'uint16', 'uint8'. Default: 'dtype'.

Type`guidata.dataset.dataitems.ChoiceItem`**change_pixel_size**

Change pixel size so that overall image size remains the same. Default: False.

Type`guidata.dataset.dataitems.BoolItem`

classmethod `create(sx: int, sy: int, operation: str, dtype_str: str, change_pixel_size: bool) → cdl.computation.image.BinningParam`

Returns a new instance of *BinningParam* with the fields set to the given values.

Parameters

- **sx** (*int*) – Cluster size (X). Number of adjacent pixels to be combined together along x-axis. Integer higher than 2. Default: 2.
- **sy** (*int*) – Cluster size (Y). Number of adjacent pixels to be combined together along y-axis. Integer higher than 2. Default: 2.
- **operation** (*str*) – Single choice from: 'sum', 'average', 'median', 'min', 'max'. Default: 'sum'.
- **dtype_str** (*str*) – Data type. Output image data type. Single choice from: 'dtype', 'float32', 'float64', 'complex128', 'int32', 'int16', 'uint16', 'uint8'. Default: 'dtype'.
- **change_pixel_size** (*bool*) – Change pixel size so that overall image size remains the same. Default: False.

Returns

New instance of *BinningParam*.

`cdl.computation.image.compute_binning(src: ImageObj, param: BinningParam) → ImageObj`

Binning function on data with *cdl.algorithms.image.binning()*

Parameters

- **src** – input image object
- **param** – parameters

Returns

Output image object

```
cdl.computation.image.extract_multiple_roi(src: ImageObj, group: DataSetGroup) → ImageObj
```

Extract multiple regions of interest from data

Parameters

- **src** – input image object
- **group** – parameters defining the regions of interest

Returns

Output image object

```
cdl.computation.image.extract_single_roi(src: ImageObj, p: ROI2DParam) → ImageObj
```

Extract single ROI

Parameters

- **src** – input image object
- **p** – ROI parameters

Returns

Output image object

```
class cdl.computation.image.LineProfileParam
```

Horizontal or vertical profile parameters

direction

Single choice from: 'horizontal', 'vertical'. Default: 'horizontal'.

Type`guidata.dataset.dataitems.ChoiceItem`**row**

Integer higher than 0. Default: 0.

Type`guidata.dataset.dataitems.IntItem`**col**

Column. Integer higher than 0. Default: 0.

Type`guidata.dataset.dataitems.IntItem`

```
classmethod create(direction: str, row: int, col: int) → cdl.computation.image.LineProfileParam
```

Returns a new instance of `LineProfileParam` with the fields set to the given values.**Parameters**

- **direction** (`str`) – Single choice from: 'horizontal', 'vertical'. Default: 'horizontal'.
- **row** (`int`) – Integer higher than 0. Default: 0.
- **col** (`int`) – Column. Integer higher than 0. Default: 0.

ReturnsNew instance of `LineProfileParam`.

`cdl.computation.image.compute_line_profile(src: ImageObj, p: LineProfileParam) → SignalObj`

Compute horizontal or vertical profile

Parameters

- **src** – input image object
- **p** – parameters

Returns

Signal object with the profile

class `cdl.computation.image.SegmentProfileParam`

Segment profile parameters

row1

Start row. Integer higher than 0. Default: 0.

Type

`guidata.dataset.dataitems.IntItem`

col1

Start column. Integer higher than 0. Default: 0.

Type

`guidata.dataset.dataitems.IntItem`

row2

End row. Integer higher than 0. Default: 0.

Type

`guidata.dataset.dataitems.IntItem`

col2

End column. Integer higher than 0. Default: 0.

Type

`guidata.dataset.dataitems.IntItem`

classmethod `create(row1: int, col1: int, row2: int, col2: int) → cdl.computation.image.SegmentProfileParam`

Returns a new instance of `SegmentProfileParam` with the fields set to the given values.

Parameters

- **row1** (*int*) – Start row. Integer higher than 0. Default: 0.
- **col1** (*int*) – Start column. Integer higher than 0. Default: 0.
- **row2** (*int*) – End row. Integer higher than 0. Default: 0.
- **col2** (*int*) – End column. Integer higher than 0. Default: 0.

Returns

New instance of `SegmentProfileParam`.

`cdl.computation.image.compute_segment_profile(src: ImageObj, p: SegmentProfileParam) → SignalObj`

Compute segment profile

Parameters

- **src** – input image object
- **p** – parameters

Returns

Signal object with the segment profile

class `cdl.computation.image.AverageProfileParam`

Average horizontal or vertical profile parameters

direction

Single choice from: 'horizontal', 'vertical'. Default: 'horizontal'.

Type

`guidata.dataset.dataitems.ChoiceItem`

row1

Integer higher than 0. Default: 0.

Type

`guidata.dataset.dataitems.IntItem`

row2

Integer higher than -1. Default: -1.

Type

`guidata.dataset.dataitems.IntItem`

col1

Column 1. Integer higher than 0. Default: 0.

Type

`guidata.dataset.dataitems.IntItem`

col2

Column 2. Integer higher than -1. Default: -1.

Type

`guidata.dataset.dataitems.IntItem`

classmethod `create(direction: str, row1: int, row2: int, col1: int, col2: int) → cdl.computation.image.AverageProfileParam`

Returns a new instance of *AverageProfileParam* with the fields set to the given values.

Parameters

- **direction** (*str*) – Single choice from: 'horizontal', 'vertical'. Default: 'horizontal'.
- **row1** (*int*) – Integer higher than 0. Default: 0.
- **row2** (*int*) – Integer higher than -1. Default: -1.
- **col1** (*int*) – Column 1. Integer higher than 0. Default: 0.
- **col2** (*int*) – Column 2. Integer higher than -1. Default: -1.

Returns

New instance of *AverageProfileParam*.

`cdl.computation.image.compute_average_profile(src: ImageObj, p: AverageProfileParam) → SignalObj`

Compute horizontal or vertical average profile

Parameters

- **src** – input image object
- **p** – parameters

Returns

Signal object with the average profile

class `cdl.computation.image.RadialProfileParam`

Radial profile parameters

center

Center position. Single choice from: 'centroid', 'center', 'user'. Default: 'centroid'.

Type

`guidata.dataset.dataitems.ChoiceItem`

x0

X_{Center} . Float, unit: pixel. Default: None.

Type

`guidata.dataset.dataitems.FloatItem`

y0

X_{Center} . Float, unit: pixel. Default: None.

Type

`guidata.dataset.dataitems.FloatItem`

classmethod `create(center: str, x0: float, y0: float) → cdl.computation.image.RadialProfileParam`

Returns a new instance of `RadialProfileParam` with the fields set to the given values.

Parameters

- **center** (*str*) – Center position. Single choice from: 'centroid', 'center', 'user'. Default: 'centroid'.
- **x0** (*float*) – X_{Center} . Float, unit: pixel. Default: None.
- **y0** (*float*) – X_{Center} . Float, unit: pixel. Default: None.

Returns

New instance of `RadialProfileParam`.

update_from_image(*obj*: ImageObj) → None

Update parameters from image

choice_callback(*item*, *value*)

Callback for choice item

`cdl.computation.image.compute_radial_profile(src: ImageObj, p: RadialProfileParam) → SignalObj`

Compute radial profile around the centroid with `cdl.algorithms.image.get_radial_profile()`

Parameters

- **src** – input image object
- **p** – parameters

Returns

Signal object with the radial profile

`cdl.computation.image.compute_histogram(src: ImageObj, p: HistogramParam) → SignalObj`

Compute histogram of the image data, with `numpy.histogram()`

Parameters

- **src** – input image object

- **p** – parameters

Returns

Signal object with the histogram

`cdl.computation.image.compute_swap_axes(src: ImageObj) → ImageObj`

Swap image axes with `numpy.transpose()`

Parameters

src – input image object

Returns

Output image object

`cdl.computation.image.compute_inverse(src: ImageObj) → ImageObj`

Compute the inverse of an image and return the new result image object

Parameters

src – input image object

Returns

Result image object $1 / \text{src}$ (new object)

`cdl.computation.image.compute_abs(src: ImageObj) → ImageObj`

Compute absolute value with `numpy.absolute`

Parameters

src – input image object

Returns

Output image object

`cdl.computation.image.compute_re(src: ImageObj) → ImageObj`

Compute real part with `numpy.real()`

Parameters

src – input image object

Returns

Output image object

`cdl.computation.image.compute_im(src: ImageObj) → ImageObj`

Compute imaginary part with `numpy.imag()`

Parameters

src – input image object

Returns

Output image object

class `cdl.computation.image.DataTypeIParam`

Convert image data type parameters

dtype_str

Destination data type. Output image data type. Single choice from: 'float32', 'float64', 'complex128', 'int32', 'int16', 'uint16', 'uint8'. Default: 'float32'.

Type

`guidata.dataset.dataitems.ChoiceItem`

classmethod `create(dtype_str: str) → cdl.computation.image.DataTypeIParam`

Returns a new instance of `DataTypeIParam` with the fields set to the given values.

Parameters

dtype_str (*str*) – Destination data type. Output image data type. Single choice from: ‘float32’, ‘float64’, ‘complex128’, ‘int32’, ‘int16’, ‘uint16’, ‘uint8’. Default: ‘float32’.

Returns

New instance of `DataTypeIParam`.

`cdl.computation.image.compute_astype(src: ImageObj, p: DataTypeIParam) → ImageObj`

Convert image data type with `cdl.algorithms.datatypes.clip_astype()`

Parameters

- **src** – input image object
- **p** – parameters

Returns

Output image object

`cdl.computation.image.compute_log10(src: ImageObj) → ImageObj`

Compute log10 with `numpy.log10`

Parameters

src – input image object

Returns

Output image object

`cdl.computation.image.compute_exp(src: ImageObj) → ImageObj`

Compute exponential with `numpy.exp`

Parameters

src – input image object

Returns

Output image object

class `cdl.computation.image.ZCalibrateParam`

Image linear calibration parameters

a

Default: 1.0.

Type

`guidata.dataset.dataitems.FloatItem`

b

Default: 0.0.

Type

`guidata.dataset.dataitems.FloatItem`

classmethod `create(a: float, b: float) → cdl.computation.image.ZCalibrateParam`

Returns a new instance of `ZCalibrateParam` with the fields set to the given values.

Parameters

- **a** (*float*) – Default: 1.0.
- **b** (*float*) – Default: 0.0.

Returns

New instance of *ZCalibrateParam*.

`cdl.computation.image.compute_calibration(src: ImageObj, p: ZCalibrateParam) → ImageObj`

Compute linear calibration

Parameters

- **src** – input image object
- **p** – calibration parameters

Returns

Output image object

`cdl.computation.image.compute_clip(src: ImageObj, p: ClipParam) → ImageObj`

Apply clipping with `numpy.clip()`

Parameters

- **src** – input image object
- **p** – parameters

Returns

Output image object

`cdl.computation.image.compute_offset_correction(src: ImageObj, p: ROI2DParam) → ImageObj`

Apply offset correction

Parameters

- **src** – input image object
- **p** – parameters

Returns

Output image object

`cdl.computation.image.compute_gaussian_filter(src: ImageObj, p: GaussianParam) → ImageObj`

Compute gaussian filter with `scipy.ndimage.gaussian_filter()`

Parameters

- **src** – input image object
- **p** – parameters

Returns

Output image object

`cdl.computation.image.compute_moving_average(src: ImageObj, p: MovingAverageParam) → ImageObj`

Compute moving average with `scipy.ndimage.uniform_filter()`

Parameters

- **src** – input image object
- **p** – parameters

Returns

Output image object

`cdl.computation.image.compute_moving_median(src: ImageObj, p: MovingMedianParam) → ImageObj`
Compute moving median with `scipy.ndimage.median_filter()`

Parameters

- **src** – input image object
- **p** – parameters

Returns

Output image object

`cdl.computation.image.compute_wiener(src: ImageObj) → ImageObj`
Compute Wiener filter with `scipy.signal.wiener()`

Parameters

src – input image object

Returns

Output image object

`cdl.computation.image.compute_fft(src: ImageObj, p: FFTParam | None = None) → ImageObj`
Compute FFT with `cdl.algorithms.image.fft2d()`

Parameters

- **src** – input image object
- **p** – parameters

Returns

Output image object

`cdl.computation.image.compute_ift(src: ImageObj, p: FFTParam | None = None) → ImageObj`
Compute inverse FFT with `cdl.algorithms.image.ift2d()`

Parameters

- **src** – input image object
- **p** – parameters

Returns

Output image object

`cdl.computation.image.compute_magnitude_spectrum(src: ImageObj, p: SpectrumParam | None = None) → ImageObj`

Compute magnitude spectrum with `cdl.algorithms.image.magnitude_spectrum()`

Parameters

- **src** – input image object
- **p** – parameters

Returns

Output image object

`cdl.computation.image.compute_phase_spectrum(src: ImageObj) → ImageObj`
Compute phase spectrum with `cdl.algorithms.image.phase_spectrum()`

Parameters

src – input image object

Returns

Output image object

```
cdl.computation.image.compute_psd(src: ImageObj, p: SpectrumParam | None = None) → ImageObj
```

Compute power spectral density with `cdl.algorithms.image.psd()`**Parameters**

- **src** – input image object
- **p** – parameters

Returns

Output image object

```
class cdl.computation.image.ButterworthParam
```

Butterworth filter parameters

cut_off

Cut-off frequency ratio. Cut-off frequency ratio. Float between 0.0 and 0.5. Default: 0.005.

Type`guidata.dataset.dataitems.FloatItem`**high_pass**

If true, apply high-pass filter instead of low-pass. Default: False.

Type`guidata.dataset.dataitems.BoolItem`**order**

Order of the butterworth filter. Integer higher than 1. Default: 2.

Type`guidata.dataset.dataitems.IntItem`

```
classmethod create(cut_off: float, high_pass: bool, order: int) →
```

`cdl.computation.image.ButterworthParam`Returns a new instance of `ButterworthParam` with the fields set to the given values.**Parameters**

- **cut_off** (*float*) – Cut-off frequency ratio. Cut-off frequency ratio. Float between 0.0 and 0.5. Default: 0.005.
- **high_pass** (*bool*) – If true, apply high-pass filter instead of low-pass. Default: False.
- **order** (*int*) – Order of the butterworth filter. Integer higher than 1. Default: 2.

ReturnsNew instance of `ButterworthParam`.

```
cdl.computation.image.compute_butterworth(src: ImageObj, p: ButterworthParam) → ImageObj
```

Compute Butterworth filter with `skimage.filters.butterworth()`**Parameters**

- **src** – input image object
- **p** – parameters

Returns

Output image object

`cdl.computation.image.calc_resultshape`(*title: str, shape: Literal['rectangle', 'circle', 'ellipse', 'segment', 'marker', 'point', 'polygon'], obj: ImageObj, func: Callable, *args: Any, add_label: bool = False*) → *ResultShape* | *None*

Calculate result shape by executing a computation function on an image object, taking into account the image origin (x0, y0), scale (dx, dy) and ROIs.

Parameters

- **title** – result title
- **shape** – result shape kind
- **obj** – input image object
- **func** – computation function
- ***args** – computation function arguments
- **add_label** – if True, add a label item (and the geometrical shape) to plot (default to False)

Returns

Result shape object or None if no result is found

Warning: The computation function must take either a single argument (the data) or multiple arguments (the data followed by the computation parameters).

Moreover, the computation function must return a single value or a NumPy array containing the result of the computation. This array contains the coordinates of points, polygons, circles or ellipses in the form `[[x, y], ...]`, or `[[x0, y0, x1, y1, ...], ...]`, or `[[x0, y0, r], ...]`, or `[[x0, y0, a, b, theta], ...]`.

`cdl.computation.image.get_centroid_coords`(*data: ndarray*) → *ndarray*

Return centroid coordinates with `cdl.algorithms.image.get_centroid_fourier()`

Parameters

data – input data

Returns

Centroid coordinates

`cdl.computation.image.compute_centroid`(*image: ImageObj*) → *ResultShape* | *None*

Compute centroid with `cdl.algorithms.image.get_centroid_fourier()`

Parameters

image – input image

Returns

Centroid coordinates

`cdl.computation.image.get_enclosing_circle_coords`(*data: ndarray*) → *ndarray*

Return diameter coords for the circle contour enclosing image values above threshold (FWHM)

Parameters

data – input data

Returns

Diameter coords

`cdl.computation.image.compute_enclosing_circle`(*image: ImageObj*) → *ResultShape* | *None*

Compute minimum enclosing circle with `cdl.algorithms.image.get_enclosing_circle()`

Parameters**image** – input image**Returns**

Diameter coords

class `cdl.computation.image.HoughCircleParam`

Circle Hough transform parameters

min_radiusRadius_{min}. Integer higher than 0, non zero, unit: pixels. Default: None.**Type**`guidata.dataset.dataitems.IntItem`**max_radius**Radius_{max}. Integer higher than 0, non zero, unit: pixels. Default: None.**Type**`guidata.dataset.dataitems.IntItem`**min_distance**

Minimal distance. Integer higher than 0. Default: None.

Type`guidata.dataset.dataitems.IntItem`**classmethod** `create(min_radius: int, max_radius: int, min_distance: int) → cdl.computation.image.HoughCircleParam`Returns a new instance of `HoughCircleParam` with the fields set to the given values.**Parameters**

- **min_radius** (`int`) – Radius_{min}. Integer higher than 0, non zero, unit: pixels. Default: None.
- **max_radius** (`int`) – Radius_{max}. Integer higher than 0, non zero, unit: pixels. Default: None.
- **min_distance** (`int`) – Minimal distance. Integer higher than 0. Default: None.

ReturnsNew instance of `HoughCircleParam`.`cdl.computation.image.compute_hough_circle_peaks(image: ImageObj, p: HoughCircleParam) → ResultShape | None`Compute Hough circles with `cdl.algorithms.image.get_hough_circle_peaks()`**Parameters**

- **image** – input image
- **p** – parameters

Returns

Circle coordinates

`cdl.computation.image.compute_stats(obj: ImageObj) → ResultProperties`

Compute statistics on an image

Parameters**obj** – input image object

Returns

Result properties

Threshold features**Threshold computation module**

class `cdl.computation.image.threshold.ThresholdParam`

Histogram threshold parameters

method

Threshold method. Single choice from: 'manual', 'isodata', 'li', 'mean', 'minimum', 'otsu', 'triangle', 'yen'. Default: 'manual'.

Type

`guidata.dataset.dataitems.ChoiceItem`

bins

Number of bins. Integer higher than 1. Default: 256.

Type

`guidata.dataset.dataitems.IntItem`

value

Threshold value. Default: 0.0.

Type

`guidata.dataset.dataitems.FloatItem`

operation

Single choice from: '>', '<'. Default: '>'.

Type

`guidata.dataset.dataitems.ChoiceItem`

classmethod `create`(*method*: *str*, *bins*: *int*, *value*: *float*, *operation*: *str*) → `cdl.computation.image.threshold.ThresholdParam`

Returns a new instance of `ThresholdParam` with the fields set to the given values.

Parameters

- **method** (*str*) – Threshold method. Single choice from: 'manual', 'isodata', 'li', 'mean', 'minimum', 'otsu', 'triangle', 'yen'. Default: 'manual'.
- **bins** (*int*) – Number of bins. Integer higher than 1. Default: 256.
- **value** (*float*) – Threshold value. Default: 0.0.
- **operation** (*str*) – Single choice from: '>', '<'. Default: '>'.

Returns

New instance of `ThresholdParam`.

`cdl.computation.image.threshold.compute_threshold`(*src*: `ImageObj`, *p*: `ThresholdParam`) → `ImageObj`

Compute the threshold, using one of the available algorithms:

- Manual: a fixed threshold value
- ISODATA: `skimage.filters.threshold_isodata()`
- Li: `skimage.filters.threshold_li()`

- Mean: `skimage.filters.threshold_mean()`
- Minimum: `skimage.filters.threshold_minimum()`
- Otsu: `skimage.filters.threshold_otsu()`
- Triangle: `skimage.filters.threshold_triangle()`
- Yen: `skimage.filters.threshold_yen()`

Parameters

- **src** – input image object
- **p** – parameters

Returns

Output image object

`cdl.computation.image.threshold.compute_threshold_isodata(src: ImageObj) → ImageObj`

Compute the threshold using the Isodata algorithm with default parameters, see `skimage.filters.threshold_isodata()`

Parameters

src – input image object

Returns

Output image object

`cdl.computation.image.threshold.compute_threshold_li(src: ImageObj) → ImageObj`

Compute the threshold using the Li algorithm with default parameters, see `skimage.filters.threshold_li()`

Parameters

src – input image object

Returns

Output image object

`cdl.computation.image.threshold.compute_threshold_mean(src: ImageObj) → ImageObj`

Compute the threshold using the Mean algorithm, see `skimage.filters.threshold_mean()`

Parameters

src – input image object

Returns

Output image object

`cdl.computation.image.threshold.compute_threshold_minimum(src: ImageObj) → ImageObj`

Compute the threshold using the Minimum algorithm with default parameters, see `skimage.filters.threshold_minimum()`

Parameters

src – input image object

Returns

Output image object

`cdl.computation.image.threshold.compute_threshold_otsu(src: ImageObj) → ImageObj`

Compute the threshold using the Otsu algorithm with default parameters, see `skimage.filters.threshold_otsu()`

Parameters

src – input image object

Returns

Output image object

`cdl.computation.image.threshold.compute_threshold_triangle(src: ImageObj) → ImageObj`

Compute the threshold using the Triangle algorithm with default parameters, see `skimage.filters.threshold_triangle()`

Parameters

src – input image object

Returns

Output image object

`cdl.computation.image.threshold.compute_threshold_yen(src: ImageObj) → ImageObj`

Compute the threshold using the Yen algorithm with default parameters, see `skimage.filters.threshold_yen()`

Parameters

src – input image object

Returns

Output image object

Exposure correction features

Exposure computation module

class `cdl.computation.image.exposure.AdjustGammaParam`

Gamma adjustment parameters

gamma

Gamma correction factor (higher values give more contrast). Float higher than 0.0. Default: 1.0.

Type

`guidata.dataset.dataitems.FloatItem`

gain

Gain factor (higher values give more contrast). Float higher than 0.0. Default: 1.0.

Type

`guidata.dataset.dataitems.FloatItem`

classmethod `create(gamma: float, gain: float) → cdl.computation.image.exposure.AdjustGammaParam`

Returns a new instance of `AdjustGammaParam` with the fields set to the given values.

Parameters

- **gamma** (*float*) – Gamma correction factor (higher values give more contrast). Float higher than 0.0. Default: 1.0.
- **gain** (*float*) – Gain factor (higher values give more contrast). Float higher than 0.0. Default: 1.0.

Returns

New instance of `AdjustGammaParam`.

`cdl.computation.image.exposure.compute_adjust_gamma(src: ImageObj, p: AdjustGammaParam) → ImageObj`

Gamma correction with `skimage.exposure.adjust_gamma()`

Parameters

- **src** – input image object
- **p** – parameters

Returns

Output image object

class `cdl.computation.image.exposure.AdjustLogParam`

Logarithmic adjustment parameters

gain

Gain factor (higher values give more contrast). Float higher than 0.0. Default: 1.0.

Type

`guidata.dataset.dataitems.FloatItem`

inv

If true, apply inverse logarithmic transformation. Default: False.

Type

`guidata.dataset.dataitems.BoolItem`

classmethod `create(gain: float, inv: bool) → cdl.computation.image.exposure.AdjustLogParam`

Returns a new instance of `AdjustLogParam` with the fields set to the given values.

Parameters

- **gain** (*float*) – Gain factor (higher values give more contrast). Float higher than 0.0. Default: 1.0.
- **inv** (*bool*) – If true, apply inverse logarithmic transformation. Default: False.

Returns

New instance of `AdjustLogParam`.

`cdl.computation.image.exposure.compute_adjust_log(src: ImageObj, p: AdjustLogParam) → ImageObj`

Compute log correction with `skimage.exposure.adjust_log()`

Parameters

- **src** – input image object
- **p** – parameters

Returns

Output image object

class `cdl.computation.image.exposure.AdjustSigmoidParam`

Sigmoid adjustment parameters

cutoff

Cutoff value (higher values give more contrast). Float between 0.0 and 1.0. Default: 0.5.

Type

`guidata.dataset.dataitems.FloatItem`

gain

Gain factor (higher values give more contrast). Float higher than 0.0. Default: 10.0.

Type

`guidata.dataset.dataitems.FloatItem`

inv

If true, apply inverse sigmoid transformation. Default: False.

Type

`guidata.dataset.dataitems.BoolItem`

classmethod `create(cutoff: float, gain: float, inv: bool) →`

`cdl.computation.image.exposure.AdjustSigmoidParam`

Returns a new instance of `AdjustSigmoidParam` with the fields set to the given values.

Parameters

- **cutoff** (*float*) – Cutoff value (higher values give more contrast). Float between 0.0 and 1.0. Default: 0.5.
- **gain** (*float*) – Gain factor (higher values give more contrast). Float higher than 0.0. Default: 10.0.
- **inv** (*bool*) – If true, apply inverse sigmoid transformation. Default: False.

Returns

New instance of `AdjustSigmoidParam`.

`cdl.computation.image.exposure.compute_adjust_sigmoid(src: ImageObj, p: AdjustSigmoidParam) →`

`ImageObj`

Compute sigmoid correction with `skimage.exposure.adjust_sigmoid()`

Parameters

- **src** – input image object
- **p** – parameters

Returns

Output image object

class `cdl.computation.image.exposure.RescaleIntensityParam`

Intensity rescaling parameters

in_range

Input range. Min and max intensity values of input image ('image' refers to input image min/max levels, 'dtype' refers to input image data type range). Single choice from: 'image', 'dtype', 'float32', 'float64', 'complex128', 'int32', 'int16', 'uint16', 'uint8'. Default: 'image'.

Type

`guidata.dataset.dataitems.ChoiceItem`

out_range

Output range. Min and max intensity values of output image ('image' refers to input image min/max levels, 'dtype' refers to input image data type range).. Single choice from: 'image', 'dtype', 'float32', 'float64', 'complex128', 'int32', 'int16', 'uint16', 'uint8'. Default: 'dtype'.

Type

`guidata.dataset.dataitems.ChoiceItem`

classmethod `create(in_range: str, out_range: str) →`
cdl.computation.image.exposure.RescaleIntensityParam

Returns a new instance of *RescaleIntensityParam* with the fields set to the given values.

Parameters

- **in_range** (*str*) – Input range. Min and max intensity values of input image ('image' refers to input image min/max levels, 'dtype' refers to input image data type range). Single choice from: 'image', 'dtype', 'float32', 'float64', 'complex128', 'int32', 'int16', 'uint16', 'uint8'. Default: 'image'.
- **out_range** (*str*) – Output range. Min and max intensity values of output image ('image' refers to input image min/max levels, 'dtype' refers to input image data type range).. Single choice from: 'image', 'dtype', 'float32', 'float64', 'complex128', 'int32', 'int16', 'uint16', 'uint8'. Default: 'dtype'.

Returns

New instance of *RescaleIntensityParam*.

`cdl.computation.image.exposure.compute_rescale_intensity(src: ImageObj, p: RescaleIntensityParam) → ImageObj`

Rescale image intensity levels with `skimage.exposure.rescale_intensity()`

Parameters

- **src** – input image object
- **p** – parameters

Returns

Output image object

class `cdl.computation.image.exposure.EqualizeHistParam`

Histogram equalization parameters

nbins

Number of bins. Number of bins for image histogram. Integer higher than 1. Default: 256.

Type

guidata.dataset.dataitems.IntItem

classmethod `create(nbins: int) → cdl.computation.image.exposure.EqualizeHistParam`

Returns a new instance of *EqualizeHistParam* with the fields set to the given values.

Parameters

- **nbins** (*int*) – Number of bins. Number of bins for image histogram. Integer higher than 1. Default: 256.

Returns

New instance of *EqualizeHistParam*.

`cdl.computation.image.exposure.compute_equalize_hist(src: ImageObj, p: EqualizeHistParam) → ImageObj`

Histogram equalization with `skimage.exposure.equalize_hist()`

Parameters

- **src** – input image object
- **p** – parameters

Returns

Output image object

class `cdl.computation.image.exposure.EqualizeAdaptHistParam`

Adaptive histogram equalization parameters

nbins

Number of bins. Number of bins for image histogram. Integer higher than 1. Default: 256.

Type

`guidata.dataset.dataitems.IntItem`

clip_limit

Clipping limit. Clipping limit (higher values give more contrast). Float between 0.0 and 1.0. Default: 0.01.

Type

`guidata.dataset.dataitems.FloatItem`

classmethod `create`(*nbins: int, clip_limit: float*) →

`cdl.computation.image.exposure.EqualizeAdaptHistParam`

Returns a new instance of `EqualizeAdaptHistParam` with the fields set to the given values.

Parameters

- **nbins** (*int*) – Number of bins. Number of bins for image histogram. Integer higher than 1. Default: 256.
- **clip_limit** (*float*) – Clipping limit. Clipping limit (higher values give more contrast). Float between 0.0 and 1.0. Default: 0.01.

Returns

New instance of `EqualizeAdaptHistParam`.

`cdl.computation.image.exposure.compute_equalize_adapthist`(*src: ImageObj, p:*

`EqualizeAdaptHistParam`) → *ImageObj*

Adaptive histogram equalization with `skimage.exposure.equalize_adapthist()`

Parameters

- **src** – input image object
- **p** – parameters

Returns

Output image object

Restoration features

Restoration computation module

class `cdl.computation.image.restoration.DenoiseTVParam`

Total Variation denoising parameters

weight

Denoising weight. The greater weight, the more denoising (at the expense of fidelity to input). Float higher than 0, non zero. Default: 0.1.

Type

`guidata.dataset.dataitems.FloatItem`

eps

Epsilon. Relative difference of the value of the cost function that determines the stop criterion. The algorithm stops when: $(e_{(n-1)} - e_n) < \text{eps} * e_0$. Float higher than 0, non zero. Default: 0.0002.

Type

`guidata.dataset.dataitems.FloatItem`

max_num_iter

Max. iterations. Maximal number of iterations used for the optimization. Integer higher than 0, non zero. Default: 200.

Type

`guidata.dataset.dataitems.IntItem`

classmethod `create(weight: float, eps: float, max_num_iter: int) →`
`cdl.computation.image.restoration.DenoiseTVParam`

Returns a new instance of `DenoiseTVParam` with the fields set to the given values.

Parameters

- **weight** (*float*) – Denoising weight. The greater weight, the more denoising (at the expense of fidelity to input). Float higher than 0, non zero. Default: 0.1.
- **eps** (*float*) – Epsilon. Relative difference of the value of the cost function that determines the stop criterion. The algorithm stops when: $(e_{(n-1)} - e_n) < \text{eps} * e_0$. Float higher than 0, non zero. Default: 0.0002.
- **max_num_iter** (*int*) – Max. iterations. Maximal number of iterations used for the optimization. Integer higher than 0, non zero. Default: 200.

Returns

New instance of `DenoiseTVParam`.

`cdl.computation.image.restoration.compute_denoise_tv(src: ImageObj, p: DenoiseTVParam) →`
`ImageObj`

Compute Total Variation denoising with `skimage.restoration.denoise_tv_chambolle()`

Parameters

- **src** – input image object
- **p** – parameters

Returns

Output image object

class `cdl.computation.image.restoration.DenoiseBilateralParam`

Bilateral filter denoising parameters

sigma_spatial

^{spatial}. Standard deviation for range distance. A larger value results in averaging of pixels with larger spatial differences. Float higher than 0, non zero, unit: pixels. Default: 1.0.

Type

`guidata.dataset.dataitems.FloatItem`

mode

Single choice from: 'constant', 'edge', 'symmetric', 'reflect', 'wrap'. Default: 'constant'.

Type

`guidata.dataset.dataitems.ChoiceItem`

cval

Used in conjunction with mode ‘constant’, the value outside the image boundaries. Default: 0.

Type

`guidata.dataset.dataitems.FloatItem`

classmethod `create(sigma_spatial: float, mode: str, cval: float) →`
`cdl.computation.image.restoration.DenoiseBilateralParam`

Returns a new instance of `DenoiseBilateralParam` with the fields set to the given values.

Parameters

- **sigma_spatial** (*float*) – *spatial*. Standard deviation for range distance. A larger value results in averaging of pixels with larger spatial differences. Float higher than 0, non zero, unit: pixels. Default: 1.0.
- **mode** (*str*) – Single choice from: ‘constant’, ‘edge’, ‘symmetric’, ‘reflect’, ‘wrap’. Default: ‘constant’.
- **cval** (*float*) – Used in conjunction with mode ‘constant’, the value outside the image boundaries. Default: 0.

Returns

New instance of `DenoiseBilateralParam`.

`cdl.computation.image.restoration.compute_denoise_bilateral(src: ImageObj, p:`
`DenoiseBilateralParam) → ImageObj`

Compute bilateral filter denoising with `skimage.restoration.denoise_bilateral()`

Parameters

- **src** – input image object
- **p** – parameters

Returns

Output image object

class `cdl.computation.image.restoration.DenoiseWaveletParam`

Wavelet denoising parameters

wavelet

Single choice from: ‘bior1.1’, ‘bior1.3’, ‘bior1.5’, ‘bior2.2’, ‘bior2.4’, ‘bior2.6’, ‘bior2.8’, ‘bior3.1’, ‘bior3.3’, ‘bior3.5’, ‘bior3.7’, ‘bior3.9’, ‘bior4.4’, ‘bior5.5’, ‘bior6.8’, ‘cgau1’, ‘cgau2’, ‘cgau3’, ‘cgau4’, ‘cgau5’, ‘cgau6’, ‘cgau7’, ‘cgau8’, ‘cmor’, ‘coif1’, ‘coif2’, ‘coif3’, ‘coif4’, ‘coif5’, ‘coif6’, ‘coif7’, ‘coif8’, ‘coif9’, ‘coif10’, ‘coif11’, ‘coif12’, ‘coif13’, ‘coif14’, ‘coif15’, ‘coif16’, ‘coif17’, ‘db1’, ‘db2’, ‘db3’, ‘db4’, ‘db5’, ‘db6’, ‘db7’, ‘db8’, ‘db9’, ‘db10’, ‘db11’, ‘db12’, ‘db13’, ‘db14’, ‘db15’, ‘db16’, ‘db17’, ‘db18’, ‘db19’, ‘db20’, ‘db21’, ‘db22’, ‘db23’, ‘db24’, ‘db25’, ‘db26’, ‘db27’, ‘db28’, ‘db29’, ‘db30’, ‘db31’, ‘db32’, ‘db33’, ‘db34’, ‘db35’, ‘db36’, ‘db37’, ‘db38’, ‘dmey’, ‘fbsp’, ‘gaus1’, ‘gaus2’, ‘gaus3’, ‘gaus4’, ‘gaus5’, ‘gaus6’, ‘gaus7’, ‘gaus8’, ‘haar’, ‘mexh’, ‘morl’, ‘rbio1.1’, ‘rbio1.3’, ‘rbio1.5’, ‘rbio2.2’, ‘rbio2.4’, ‘rbio2.6’, ‘rbio2.8’, ‘rbio3.1’, ‘rbio3.3’, ‘rbio3.5’, ‘rbio3.7’, ‘rbio3.9’, ‘rbio4.4’, ‘rbio5.5’, ‘rbio6.8’, ‘shan’, ‘sym2’, ‘sym3’, ‘sym4’, ‘sym5’, ‘sym6’, ‘sym7’, ‘sym8’, ‘sym9’, ‘sym10’, ‘sym11’, ‘sym12’, ‘sym13’, ‘sym14’, ‘sym15’, ‘sym16’, ‘sym17’, ‘sym18’, ‘sym19’, ‘sym20’. Default: ‘sym9’.

Type

`guidata.dataset.dataitems.ChoiceItem`

mode

Single choice from: ‘soft’, ‘hard’. Default: ‘soft’.

Type`guidata.dataset.dataitems.ChoiceItem`**method**

Single choice from: 'BayesShrink', 'VisuShrink'. Default: 'VisuShrink'.

Type`guidata.dataset.dataitems.ChoiceItem`**classmethod** **create**(*wavelet*: *str*, *mode*: *str*, *method*: *str*) →`cdl.computation.image.restoration.DenoiseWaveletParam`Returns a new instance of `DenoiseWaveletParam` with the fields set to the given values.**Parameters**

- **wavelet** (*str*) – Single choice from: 'bior1.1', 'bior1.3', 'bior1.5', 'bior2.2', 'bior2.4', 'bior2.6', 'bior2.8', 'bior3.1', 'bior3.3', 'bior3.5', 'bior3.7', 'bior3.9', 'bior4.4', 'bior5.5', 'bior6.8', 'cgau1', 'cgau2', 'cgau3', 'cgau4', 'cgau5', 'cgau6', 'cgau7', 'cgau8', 'cmor', 'coif1', 'coif2', 'coif3', 'coif4', 'coif5', 'coif6', 'coif7', 'coif8', 'coif9', 'coif10', 'coif11', 'coif12', 'coif13', 'coif14', 'coif15', 'coif16', 'coif17', 'db1', 'db2', 'db3', 'db4', 'db5', 'db6', 'db7', 'db8', 'db9', 'db10', 'db11', 'db12', 'db13', 'db14', 'db15', 'db16', 'db17', 'db18', 'db19', 'db20', 'db21', 'db22', 'db23', 'db24', 'db25', 'db26', 'db27', 'db28', 'db29', 'db30', 'db31', 'db32', 'db33', 'db34', 'db35', 'db36', 'db37', 'db38', 'dmey', 'fbsp', 'gaus1', 'gaus2', 'gaus3', 'gaus4', 'gaus5', 'gaus6', 'gaus7', 'gaus8', 'haar', 'mexh', 'morl', 'rbio1.1', 'rbio1.3', 'rbio1.5', 'rbio2.2', 'rbio2.4', 'rbio2.6', 'rbio2.8', 'rbio3.1', 'rbio3.3', 'rbio3.5', 'rbio3.7', 'rbio3.9', 'rbio4.4', 'rbio5.5', 'rbio6.8', 'shan', 'sym2', 'sym3', 'sym4', 'sym5', 'sym6', 'sym7', 'sym8', 'sym9', 'sym10', 'sym11', 'sym12', 'sym13', 'sym14', 'sym15', 'sym16', 'sym17', 'sym18', 'sym19', 'sym20'. Default: 'sym9'.
- **mode** (*str*) – Single choice from: 'soft', 'hard'. Default: 'soft'.
- **method** (*str*) – Single choice from: 'BayesShrink', 'VisuShrink'. Default: 'VisuShrink'.

ReturnsNew instance of `DenoiseWaveletParam`.

`cdl.computation.image.restoration.compute_denoise_wavelet`(*src*: `ImageObj`, *p*: `DenoiseWaveletParam`) → `ImageObj`

Compute Wavelet denoising with `skimage.restoration.denoise_wavelet()`**Parameters**

- **src** – input image object
- **p** – parameters

Returns

Output image object

`cdl.computation.image.restoration.compute_denoise_tophat`(*src*: `ImageObj`, *p*: `MorphologyParam`) → `ImageObj`

Denoise using White Top-Hat with `skimage.morphology.white_tophat()`**Parameters**

- **src** – input image object
- **p** – parameters

Returns

Output image object

Morphological features

Morphology computation module

class `cdl.computation.image.morphology.MorphologyParam`

White Top-Hat parameters

radius

Footprint (disk) radius. Integer higher than 1. Default: 1.

Type

`guidata.dataset.dataitems.IntItem`

classmethod `create(radius: int) → cdl.computation.image.morphology.MorphologyParam`

Returns a new instance of *MorphologyParam* with the fields set to the given values.

Parameters

radius (*int*) – Footprint (disk) radius. Integer higher than 1. Default: 1.

Returns

New instance of *MorphologyParam*.

`cdl.computation.image.morphology.compute_white_tophat(src: ImageObj, p: MorphologyParam) → ImageObj`

Compute White Top-Hat with `skimage.morphology.white_tophat()`

Parameters

- **src** – input image object
- **p** – parameters

Returns

Output image object

`cdl.computation.image.morphology.compute_black_tophat(src: ImageObj, p: MorphologyParam) → ImageObj`

Compute Black Top-Hat with `skimage.morphology.black_tophat()`

Parameters

- **src** – input image object
- **p** – parameters

Returns

Output image object

`cdl.computation.image.morphology.compute_erosion(src: ImageObj, p: MorphologyParam) → ImageObj`

Compute Erosion with `skimage.morphology.erosion()`

Parameters

- **src** – input image object
- **p** – parameters

Returns

Output image object

`cdl.computation.image.morphology.compute_dilation(src: ImageObj, p: MorphologyParam) → ImageObj`

Compute Dilation with `skimage.morphology.dilation()`

Parameters

- **src** – input image object
- **p** – parameters

Returns

Output image object

`cdl.computation.image.morphology.compute_opening(src: ImageObj, p: MorphologyParam) → ImageObj`

Compute morphological opening with `skimage.morphology.opening()`

Parameters

- **src** – input image object
- **p** – parameters

Returns

Output image object

`cdl.computation.image.morphology.compute_closing(src: ImageObj, p: MorphologyParam) → ImageObj`

Compute morphological closing with `skimage.morphology.closing()`

Parameters

- **src** – input image object
- **p** – parameters

Returns

Output image object

Edge detection features

Edges computation module

class `cdl.computation.image.edges.CannyParam`

Canny filter parameters

sigma

Standard deviation of the gaussian filter. Float higher than 0, non zero, unit: pixels. Default: 1.0.

Type

`guidata.dataset.dataitems.FloatItem`

low_threshold

Lower bound for hysteresis thresholding (linking edges). Float higher than 0. Default: 0.1.

Type

`guidata.dataset.dataitems.FloatItem`

high_threshold

Upper bound for hysteresis thresholding (linking edges). Float higher than 0. Default: 0.9.

Type

`guidata.dataset.dataitems.FloatItem`

use_quantiles

If true then treat `low_threshold` and `high_threshold` as quantiles of the edge magnitude image, rather than absolute edge magnitude values. If true then the thresholds must be in the range [0, 1]. Default: True.

Type

`guidata.dataset.dataitems.BoolItem`

mode

Single choice from: 'reflect', 'constant', 'nearest', 'mirror', 'wrap'. Default: 'constant'.

Type

`guidata.dataset.dataitems.ChoiceItem`

cval

Value to fill past edges of input if mode is constant. Default: 0.0.

Type

`guidata.dataset.dataitems.FloatItem`

classmethod **create**(*sigma: float, low_threshold: float, high_threshold: float, use_quantiles: bool, mode: str, cval: float*) → `cdl.computation.image.edges.CannyParam`

Returns a new instance of `CannyParam` with the fields set to the given values.

Parameters

- **sigma** (*float*) – Standard deviation of the gaussian filter. Float higher than 0, non zero, unit: pixels. Default: 1.0.
- **low_threshold** (*float*) – Lower bound for hysteresis thresholding (linking edges). Float higher than 0. Default: 0.1.
- **high_threshold** (*float*) – Upper bound for hysteresis thresholding (linking edges). Float higher than 0. Default: 0.9.
- **use_quantiles** (*bool*) – If true then treat `low_threshold` and `high_threshold` as quantiles of the edge magnitude image, rather than absolute edge magnitude values. If true then the thresholds must be in the range [0, 1]. Default: True.
- **mode** (*str*) – Single choice from: 'reflect', 'constant', 'nearest', 'mirror', 'wrap'. Default: 'constant'.
- **cval** (*float*) – Value to fill past edges of input if mode is constant. Default: 0.0.

Returns

New instance of `CannyParam`.

`cdl.computation.image.edges.compute_canny`(*src: ImageObj, p: CannyParam*) → `ImageObj`

Compute Canny filter with `skimage.feature.canny()`

Parameters

- **src** – input image object
- **p** – parameters

Returns

Output image object

`cdl.computation.image.edges.compute_roberts`(*src: ImageObj*) → `ImageObj`

Compute Roberts filter with `skimage.filters.roberts()`

Parameters

src – input image object

Returns

Output image object

```
cdl.computation.image.edges.compute_prewitt(src: ImageObj) → ImageObj
```

Compute Prewitt filter with `skimage.filters.prewitt()`**Parameters****src** – input image object**Returns**

Output image object

```
cdl.computation.image.edges.compute_prewitt_h(src: ImageObj) → ImageObj
```

Compute horizontal Prewitt filter with `skimage.filters.prewitt_h()`**Parameters****src** – input image object**Returns**

Output image object

```
cdl.computation.image.edges.compute_prewitt_v(src: ImageObj) → ImageObj
```

Compute vertical Prewitt filter with `skimage.filters.prewitt_v()`**Parameters****src** – input image object**Returns**

Output image object

```
cdl.computation.image.edges.compute_sobel(src: ImageObj) → ImageObj
```

Compute Sobel filter with `skimage.filters.sobel()`**Parameters****src** – input image object**Returns**

Output image object

```
cdl.computation.image.edges.compute_sobel_h(src: ImageObj) → ImageObj
```

Compute horizontal Sobel filter with `skimage.filters.sobel_h()`**Parameters****src** – input image object**Returns**

Output image object

```
cdl.computation.image.edges.compute_sobel_v(src: ImageObj) → ImageObj
```

Compute vertical Sobel filter with `skimage.filters.sobel_v()`**Parameters****src** – input image object**Returns**

Output image object

```
cdl.computation.image.edges.compute_scharr(src: ImageObj) → ImageObj
```

Compute Scharr filter with `skimage.filters.scharr()`**Parameters****src** – input image object

Returns

Output image object

`cdl.computation.image.edges.compute_scharr_h(src: ImageObj) → ImageObj`Compute horizontal Scharr filter with `skimage.filters.scharr_h()`**Parameters****src** – input image object**Returns**

Output image object

`cdl.computation.image.edges.compute_scharr_v(src: ImageObj) → ImageObj`Compute vertical Scharr filter with `skimage.filters.scharr_v()`**Parameters****src** – input image object**Returns**

Output image object

`cdl.computation.image.edges.compute_farid(src: ImageObj) → ImageObj`Compute Farid filter with `skimage.filters.farid()`**Parameters****src** – input image object**Returns**

Output image object

`cdl.computation.image.edges.compute_farid_h(src: ImageObj) → ImageObj`Compute horizontal Farid filter with `skimage.filters.farid_h()`**Parameters****src** – input image object**Returns**

Output image object

`cdl.computation.image.edges.compute_farid_v(src: ImageObj) → ImageObj`Compute vertical Farid filter with `skimage.filters.farid_v()`**Parameters****src** – input image object**Returns**

Output image object

`cdl.computation.image.edges.compute_laplace(src: ImageObj) → ImageObj`Compute Laplace filter with `skimage.filters.laplace()`**Parameters****src** – input image object**Returns**

Output image object

Detection features

Blob detection computation module

class `cdl.computation.image.detection.GenericDetectionParam`

Generic detection parameters

threshold

Relative threshold. Detection threshold, relative to difference between data maximum and minimum. Float between 0.1 and 0.9. Default: 0.5.

Type

`guidata.dataset.dataitems.FloatItem`

classmethod `create(threshold: float) → cdl.computation.image.detection.GenericDetectionParam`

Returns a new instance of `GenericDetectionParam` with the fields set to the given values.

Parameters

threshold (*float*) – Relative threshold. Detection threshold, relative to difference between data maximum and minimum. Float between 0.1 and 0.9. Default: 0.5.

Returns

New instance of `GenericDetectionParam`.

class `cdl.computation.image.detection.Peak2DDetectionParam`

Peak detection parameters

threshold

Relative threshold. Detection threshold, relative to difference between data maximum and minimum. Float between 0.1 and 0.9. Default: 0.5.

Type

`guidata.dataset.dataitems.FloatItem`

size

Neighborhoods size. Size of the sliding window used in maximum/minimum filtering algorithm. Integer higher than 1, unit: pixels. Default: 10.

Type

`guidata.dataset.dataitems.IntItem`

create_rois

Default: True.

Type

`guidata.dataset.dataitems.BoolItem`

classmethod `create(threshold: float, size: int, create_rois: bool) → cdl.computation.image.detection.Peak2DDetectionParam`

Returns a new instance of `Peak2DDetectionParam` with the fields set to the given values.

Parameters

- **threshold** (*float*) – Relative threshold. Detection threshold, relative to difference between data maximum and minimum. Float between 0.1 and 0.9. Default: 0.5.
- **size** (*int*) – Neighborhoods size. Size of the sliding window used in maximum/minimum filtering algorithm. Integer higher than 1, unit: pixels. Default: 10.
- **create_rois** (*bool*) – Default: True.

Returns

New instance of *Peak2DDetectionParam*.

```
cdl.computation.image.detection.compute_peak_detection(image: ImageObj, p:
                                                    Peak2DDetectionParam) → ResultShape |
                                                    None
```

Compute 2D peak detection with *cdl.algorithms.image.get_2d_peaks_coords()*

Parameters

- **imageOutput** – input image
- **p** – parameters

Returns

Peak coordinates

```
class cdl.computation.image.detection.ContourShapeParam
```

Contour shape parameters

threshold

Relative threshold. Detection threshold, relative to difference between data maximum and minimum. Float between 0.1 and 0.9. Default: 0.5.

Type

guidata.dataset.dataitems.FloatItem

shape

Single choice from: 'ellipse', 'circle', 'polygon'. Default: 'ellipse'.

Type

guidata.dataset.dataitems.ChoiceItem

```
classmethod create(threshold: float, shape: str) → cdl.computation.image.detection.ContourShapeParam
```

Returns a new instance of *ContourShapeParam* with the fields set to the given values.

Parameters

- **threshold** (*float*) – Relative threshold. Detection threshold, relative to difference between data maximum and minimum. Float between 0.1 and 0.9. Default: 0.5.
- **shape** (*str*) – Single choice from: 'ellipse', 'circle', 'polygon'. Default: 'ellipse'.

Returns

New instance of *ContourShapeParam*.

```
cdl.computation.image.detection.compute_contour_shape(image: ImageObj, p: ContourShapeParam)
                                                    → ResultShape | None
```

Compute contour shape fit with *cdl.algorithms.image.get_contour_shapes()*

```
class cdl.computation.image.detection.BaseBlobParam
```

Base class for blob detection parameters

min_sigma

min. The minimum standard deviation for gaussian kernel. Keep this low to detect smaller blobs. Float higher than 0, non zero, unit: pixels. Default: 1.0.

Type

guidata.dataset.dataitems.FloatItem

max_sigma

max. The maximum standard deviation for gaussian kernel. Keep this high to detect larger blobs. Float higher than 0, non zero, unit: pixels. Default: 30.0.

Type

`guidata.dataset.dataitems.FloatItem`

threshold_rel

Relative threshold. Minimum intensity of blobs. Float between 0.0 and 1.0. Default: 0.2.

Type

`guidata.dataset.dataitems.FloatItem`

overlap

If two blobs overlap by a fraction greater than this value, the smaller blob is eliminated. Float between 0.0 and 1.0. Default: 0.5.

Type

`guidata.dataset.dataitems.FloatItem`

classmethod create(*min_sigma: float, max_sigma: float, threshold_rel: float, overlap: float*) → *cdl.computation.image.detection.BaseBlobParam*

Returns a new instance of *BaseBlobParam* with the fields set to the given values.

Parameters

- **min_sigma** (*float*) – min. The minimum standard deviation for gaussian kernel. Keep this low to detect smaller blobs. Float higher than 0, non zero, unit: pixels. Default: 1.0.
- **max_sigma** (*float*) – max. The maximum standard deviation for gaussian kernel. Keep this high to detect larger blobs. Float higher than 0, non zero, unit: pixels. Default: 30.0.
- **threshold_rel** (*float*) – Relative threshold. Minimum intensity of blobs. Float between 0.0 and 1.0. Default: 0.2.
- **overlap** (*float*) – If two blobs overlap by a fraction greater than this value, the smaller blob is eliminated. Float between 0.0 and 1.0. Default: 0.5.

Returns

New instance of *BaseBlobParam*.

class `cdl.computation.image.detection.BlobDOGParam`

Blob detection using Difference of Gaussian method

min_sigma

min. The minimum standard deviation for gaussian kernel. Keep this low to detect smaller blobs. Float higher than 0, non zero, unit: pixels. Default: 1.0.

Type

`guidata.dataset.dataitems.FloatItem`

max_sigma

max. The maximum standard deviation for gaussian kernel. Keep this high to detect larger blobs. Float higher than 0, non zero, unit: pixels. Default: 30.0.

Type

`guidata.dataset.dataitems.FloatItem`

threshold_rel

Relative threshold. Minimum intensity of blobs. Float between 0.0 and 1.0. Default: 0.2.

Type`guidata.dataset.dataitems.FloatItem`**overlap**

If two blobs overlap by a fraction greater than this value, the smaller blob is eliminated. Float between 0.0 and 1.0. Default: 0.5.

Type`guidata.dataset.dataitems.FloatItem`**exclude_border**

If true, exclude blobs from the border of the image. Default: True.

Type`guidata.dataset.dataitems.BoolItem`

classmethod `create(min_sigma: float, max_sigma: float, threshold_rel: float, overlap: float, exclude_border: bool) → cdl.computation.image.detection.BlobDOGParam`

Returns a new instance of `BlobDOGParam` with the fields set to the given values.

Parameters

- **min_sigma** (*float*) – _{min}. The minimum standard deviation for gaussian kernel. Keep this low to detect smaller blobs. Float higher than 0, non zero, unit: pixels. Default: 1.0.
- **max_sigma** (*float*) – _{max}. The maximum standard deviation for gaussian kernel. Keep this high to detect larger blobs. Float higher than 0, non zero, unit: pixels. Default: 30.0.
- **threshold_rel** (*float*) – Relative threshold. Minimum intensity of blobs. Float between 0.0 and 1.0. Default: 0.2.
- **overlap** (*float*) – If two blobs overlap by a fraction greater than this value, the smaller blob is eliminated. Float between 0.0 and 1.0. Default: 0.5.
- **exclude_border** (*bool*) – If true, exclude blobs from the border of the image. Default: True.

Returns

New instance of `BlobDOGParam`.

`cdl.computation.image.detection.compute_blob_dog(image: ImageObj, p: BlobDOGParam) → ResultShape | None`

Compute blobs using Difference of Gaussian method with `cdl.algorithms.image.find_blobs_dog()`

Parameters

- **imageOutput** – input image
- **p** – parameters

Returns

Blobs coordinates

class `cdl.computation.image.detection.BlobDOHParam`

Blob detection using Determinant of Hessian method

min_sigma

_{min}. The minimum standard deviation for gaussian kernel. Keep this low to detect smaller blobs. Float higher than 0, non zero, unit: pixels. Default: 1.0.

Type`guidata.dataset.dataitems.FloatItem`

max_sigma

max. The maximum standard deviation for gaussian kernel. Keep this high to detect larger blobs. Float higher than 0, non zero, unit: pixels. Default: 30.0.

Type

`guidata.dataset.dataitems.FloatItem`

threshold_rel

Relative threshold. Minimum intensity of blobs. Float between 0.0 and 1.0. Default: 0.2.

Type

`guidata.dataset.dataitems.FloatItem`

overlap

If two blobs overlap by a fraction greater than this value, the smaller blob is eliminated. Float between 0.0 and 1.0. Default: 0.5.

Type

`guidata.dataset.dataitems.FloatItem`

log_scale

If set intermediate values of standard deviations are interpolated using a logarithmic scale to the base 10. If not, linear interpolation is used. Default: False.

Type

`guidata.dataset.dataitems.BoolItem`

classmethod `create(min_sigma: float, max_sigma: float, threshold_rel: float, overlap: float, log_scale: bool) → cdl.computation.image.detection.BlobDOHParam`

Returns a new instance of `BlobDOHParam` with the fields set to the given values.

Parameters

- **min_sigma** (*float*) – min. The minimum standard deviation for gaussian kernel. Keep this low to detect smaller blobs. Float higher than 0, non zero, unit: pixels. Default: 1.0.
- **max_sigma** (*float*) – max. The maximum standard deviation for gaussian kernel. Keep this high to detect larger blobs. Float higher than 0, non zero, unit: pixels. Default: 30.0.
- **threshold_rel** (*float*) – Relative threshold. Minimum intensity of blobs. Float between 0.0 and 1.0. Default: 0.2.
- **overlap** (*float*) – If two blobs overlap by a fraction greater than this value, the smaller blob is eliminated. Float between 0.0 and 1.0. Default: 0.5.
- **log_scale** (*bool*) – If set intermediate values of standard deviations are interpolated using a logarithmic scale to the base 10. If not, linear interpolation is used. Default: False.

Returns

New instance of `BlobDOHParam`.

`cdl.computation.image.detection.compute_blob_doh(image: ImageObj, p: BlobDOHParam) → ResultShape | None`

Compute blobs using Determinant of Hessian method with `cdl.algorithms.image.find_blobs_doh()`

Parameters

- **imageOutput** – input image
- **p** – parameters

Returns

Blobs coordinates

class `cdl.computation.image.detection.BlobLOGParam`

Blob detection using Laplacian of Gaussian method

min_sigma

min. The minimum standard deviation for gaussian kernel. Keep this low to detect smaller blobs. Float higher than 0, non zero, unit: pixels. Default: 1.0.

Type

`guidata.dataset.dataitems.FloatItem`

max_sigma

max. The maximum standard deviation for gaussian kernel. Keep this high to detect larger blobs. Float higher than 0, non zero, unit: pixels. Default: 30.0.

Type

`guidata.dataset.dataitems.FloatItem`

threshold_rel

Relative threshold. Minimum intensity of blobs. Float between 0.0 and 1.0. Default: 0.2.

Type

`guidata.dataset.dataitems.FloatItem`

overlap

If two blobs overlap by a fraction greater than this value, the smaller blob is eliminated. Float between 0.0 and 1.0. Default: 0.5.

Type

`guidata.dataset.dataitems.FloatItem`

log_scale

If set intermediate values of standard deviations are interpolated using a logarithmic scale to the base 10. If not, linear interpolation is used. Default: False.

Type

`guidata.dataset.dataitems.BoolItem`

exclude_border

If true, exclude blobs from the border of the image. Default: True.

Type

`guidata.dataset.dataitems.BoolItem`

classmethod `create(min_sigma: float, max_sigma: float, threshold_rel: float, overlap: float, log_scale: bool, exclude_border: bool) → cdl.computation.image.detection.BlobLOGParam`

Returns a new instance of `BlobLOGParam` with the fields set to the given values.

Parameters

- **min_sigma** (*float*) – min. The minimum standard deviation for gaussian kernel. Keep this low to detect smaller blobs. Float higher than 0, non zero, unit: pixels. Default: 1.0.
- **max_sigma** (*float*) – max. The maximum standard deviation for gaussian kernel. Keep this high to detect larger blobs. Float higher than 0, non zero, unit: pixels. Default: 30.0.
- **threshold_rel** (*float*) – Relative threshold. Minimum intensity of blobs. Float between 0.0 and 1.0. Default: 0.2.

- **overlap** (*float*) – If two blobs overlap by a fraction greater than this value, the smaller blob is eliminated. Float between 0.0 and 1.0. Default: 0.5.
- **log_scale** (*bool*) – If set intermediate values of standard deviations are interpolated using a logarithmic scale to the base 10. If not, linear interpolation is used. Default: False.
- **exclude_border** (*bool*) – If true, exclude blobs from the border of the image. Default: True.

Returns

New instance of *BlobLOGParam*.

`cdl.computation.image.detection.compute_blob_log(image: ImageObj, p: BlobLOGParam) → ResultShape | None`

Compute blobs using Laplacian of Gaussian method with `cdl.algorithms.image.find_blobs_log()`

Parameters

- **imageOutput** – input image
- **p** – parameters

Returns

Blobs coordinates

class `cdl.computation.image.detection.BlobOpenCVPParam`

Blob detection using OpenCV

min_threshold

Min. threshold. The minimum threshold between local maxima and minima. This parameter does not affect the quality of the blobs, only the quantity. Lower thresholds result in larger numbers of blobs. Float higher than 0.0. Default: 10.0.

Type

`guidata.dataset.dataitems.FloatItem`

max_threshold

Max. threshold. The maximum threshold between local maxima and minima. This parameter does not affect the quality of the blobs, only the quantity. Lower thresholds result in larger numbers of blobs. Float higher than 0.0. Default: 200.0.

Type

`guidata.dataset.dataitems.FloatItem`

min_repeatability

Min. repeatability. The minimum number of times a blob needs to be detected in a sequence of images to be considered valid. Integer higher than 1. Default: 2.

Type

`guidata.dataset.dataitems.IntItem`

min_dist_between_blobs

Min. distance between blobs. The minimum distance between two blobs. If blobs are found closer together than this distance, the smaller blob is removed. Float higher than 0.0, non zero. Default: 10.0.

Type

`guidata.dataset.dataitems.FloatItem`

filter_by_color

If true, the image is filtered by color instead of intensity. Default: True.

Type`guidata.dataset.dataitems.BoolItem`**blob_color**

The color of the blobs to detect (0 for dark blobs, 255 for light blobs). Default: 0.

Type`guidata.dataset.dataitems.IntItem`**filter_by_area**

If true, the image is filtered by blob area. Default: True.

Type`guidata.dataset.dataitems.BoolItem`**min_area**

Min. area. The minimum blob area. Float higher than 0.0. Default: 25.0.

Type`guidata.dataset.dataitems.FloatItem`**max_area**

Max. area. The maximum blob area. Float higher than 0.0. Default: 500.0.

Type`guidata.dataset.dataitems.FloatItem`**filter_by_circularity**

If true, the image is filtered by blob circularity. Default: False.

Type`guidata.dataset.dataitems.BoolItem`**min_circularity**

Min. circularity. The minimum circularity of the blobs. Float between 0.0 and 1.0. Default: 0.8.

Type`guidata.dataset.dataitems.FloatItem`**max_circularity**

Max. circularity. The maximum circularity of the blobs. Float between 0.0 and 1.0. Default: 1.0.

Type`guidata.dataset.dataitems.FloatItem`**filter_by_inertia**

If true, the image is filtered by blob inertia. Default: False.

Type`guidata.dataset.dataitems.BoolItem`**min_inertia_ratio**

Min. inertia ratio. The minimum inertia ratio of the blobs. Float between 0.0 and 1.0. Default: 0.6.

Type`guidata.dataset.dataitems.FloatItem`**max_inertia_ratio**

Max. inertia ratio. The maximum inertia ratio of the blobs. Float between 0.0 and 1.0. Default: 1.0.

Type`guidata.dataset.dataitems.FloatItem`

filter_by_convexity

If true, the image is filtered by blob convexity. Default: False.

Type

`guidata.dataset.dataitems.BoolItem`

min_convexity

Min. convexity. The minimum convexity of the blobs. Float between 0.0 and 1.0. Default: 0.8.

Type

`guidata.dataset.dataitems.FloatItem`

max_convexity

Max. convexity. The maximum convexity of the blobs. Float between 0.0 and 1.0. Default: 1.0.

Type

`guidata.dataset.dataitems.FloatItem`

classmethod create(*min_threshold: float, max_threshold: float, min_repeatability: int, min_dist_between_blobs: float, filter_by_color: bool, blob_color: int, filter_by_area: bool, min_area: float, max_area: float, filter_by_circularity: bool, min_circularity: float, max_circularity: float, filter_by_inertia: bool, min_inertia_ratio: float, max_inertia_ratio: float, filter_by_convexity: bool, min_convexity: float, max_convexity: float*) → `cdl.computation.image.detection.BlobOpenCVParam`

Returns a new instance of `BlobOpenCVParam` with the fields set to the given values.

Parameters

- **min_threshold** (*float*) – Min. threshold. The minimum threshold between local maxima and minima. This parameter does not affect the quality of the blobs, only the quantity. Lower thresholds result in larger numbers of blobs. Float higher than 0.0. Default: 10.0.
- **max_threshold** (*float*) – Max. threshold. The maximum threshold between local maxima and minima. This parameter does not affect the quality of the blobs, only the quantity. Lower thresholds result in larger numbers of blobs. Float higher than 0.0. Default: 200.0.
- **min_repeatability** (*int*) – Min. repeatability. The minimum number of times a blob needs to be detected in a sequence of images to be considered valid. Integer higher than 1. Default: 2.
- **min_dist_between_blobs** (*float*) – Min. distance between blobs. The minimum distance between two blobs. If blobs are found closer together than this distance, the smaller blob is removed. Float higher than 0.0, non zero. Default: 10.0.
- **filter_by_color** (*bool*) – If true, the image is filtered by color instead of intensity. Default: True.
- **blob_color** (*int*) – The color of the blobs to detect (0 for dark blobs, 255 for light blobs). Default: 0.
- **filter_by_area** (*bool*) – If true, the image is filtered by blob area. Default: True.
- **min_area** (*float*) – Min. area. The minimum blob area. Float higher than 0.0. Default: 25.0.
- **max_area** (*float*) – Max. area. The maximum blob area. Float higher than 0.0. Default: 500.0.
- **filter_by_circularity** (*bool*) – If true, the image is filtered by blob circularity. Default: False.

- **min_circularity** (*float*) – Min. circularity. The minimum circularity of the blobs. Float between 0.0 and 1.0. Default: 0.8.
- **max_circularity** (*float*) – Max. circularity. The maximum circularity of the blobs. Float between 0.0 and 1.0. Default: 1.0.
- **filter_by_inertia** (*bool*) – If true, the image is filtered by blob inertia. Default: False.
- **min_inertia_ratio** (*float*) – Min. inertia ratio. The minimum inertia ratio of the blobs. Float between 0.0 and 1.0. Default: 0.6.
- **max_inertia_ratio** (*float*) – Max. inertia ratio. The maximum inertia ratio of the blobs. Float between 0.0 and 1.0. Default: 1.0.
- **filter_by_convexity** (*bool*) – If true, the image is filtered by blob convexity. Default: False.
- **min_convexity** (*float*) – Min. convexity. The minimum convexity of the blobs. Float between 0.0 and 1.0. Default: 0.8.
- **max_convexity** (*float*) – Max. convexity. The maximum convexity of the blobs. Float between 0.0 and 1.0. Default: 1.0.

Returns

New instance of *BlobOpenCVParam*.

`cdl.computation.image.detection.compute_blob_opencv(image: ImageObj, p: BlobOpenCVParam) → ResultShape | None`

Compute blobs using OpenCV with `cdl.algorithms.image.find_blobs_opencv()`

Parameters

- **imageOutput** – input image
- **p** – parameters

Returns

Blobs coordinates

3.5 Proxy objects (cdl.proxy)

The `cdl.proxy` module provides a way to access DataLab features from a proxy class.

The list of compute methods accessible from the proxy objects is available in the *Calling processor methods using proxy objects* section.

3.5.1 Remote proxy

The remote proxy is used when DataLab is started from a different process than the proxy. In this case, the proxy connects to DataLab XML-RPC server.

class `cdl.proxy.RemoteProxy(autoconnect: bool = True)`

DataLab remote proxy class.

This class provides access to DataLab features from a proxy class. This is the remote version of proxy, which is used when DataLab is started from a different process than the proxy.

Parameters

autoconnect (*bool*) – Automatically connect to DataLab XML-RPC server.

Raises

- **ConnectionRefusedError** – Unable to connect to DataLab
- **ValueError** – Invalid timeout (must be ≥ 0.0)
- **ValueError** – Invalid number of retries (must be ≥ 1)

Note: The proxy object also allows to access DataLab computing methods exposed by the processor classes (see *Calling processor methods using proxy objects*).

Examples

Here is a simple example of how to use RemoteProxy in a Python script or in a Jupyter notebook:

```
>>> from cdl.proxy import RemoteProxy
>>> proxy = RemoteProxy()
Connecting to DataLab XML-RPC server...OK (port: 28867)
>>> proxy.get_version()
'1.0.0'
>>> proxy.add_signal("toto", np.array([1., 2., 3.]), np.array([4., 5., -1.]))
True
>>> proxy.get_object_titles()
['toto']
>>> proxy["toto"] # from title
<cdl.core.model.signal.SignalObj at 0x7f7f1c0b4a90>
>>> proxy[1] # from number
<cdl.core.model.signal.SignalObj at 0x7f7f1c0b4a90>
>>> proxy[1].data
array([1., 2., 3.])
>>> proxy.set_current_panel("image")
```

add_annotations_from_items(items: list, refresh_plot: bool = True, panel: str | None = None) → None

Add object annotations (annotation plot items).

Parameters

- **items** – annotation plot items
- **refresh_plot** – refresh plot. Defaults to True.
- **panel** – panel name (valid values: “signal”, “image”). If None, current panel is used.

add_group(title: str, panel: str | None = None, select: bool = False) → None

Add group to DataLab.

Parameters

- **title** – Group title
- **panel** – Panel name (valid values: “signal”, “image”). Defaults to None.
- **select** – Select the group after creation. Defaults to False.

add_image(title: str, data: ndarray, xunit: str | None = None, yunit: str | None = None, zunit: str | None = None, xlabel: str | None = None, ylabel: str | None = None, zlabel: str | None = None) → bool

Add image data to DataLab.

Parameters

- **title** – Image title
- **data** – Image data
- **xunit** – X unit. Defaults to None.
- **yunit** – Y unit. Defaults to None.
- **zunit** – Z unit. Defaults to None.
- **xlabel** – X label. Defaults to None.
- **ylabel** – Y label. Defaults to None.
- **zlabel** – Z label. Defaults to None.

Returns

True if image was added successfully, False otherwise

Raises

ValueError – Invalid data dtype

add_label_with_title(title: *str* | *None* = None, panel: *str* | *None* = None) → *None*

Add a label with object title on the associated plot

Parameters

- **title** – Label title. Defaults to None. If None, the title is the object title.
- **panel** – panel name (valid values: “signal”, “image”). If None, current panel is used.

add_object(obj: *SignalObj* | *ImageObj*) → *None*

Add object to DataLab.

Parameters

obj – Signal or image object

add_signal(title: *str*, xdata: *ndarray*, ydata: *ndarray*, xunit: *str* | *None* = None, yunit: *str* | *None* = None, xlabel: *str* | *None* = None, ylabel: *str* | *None* = None) → *bool*

Add signal data to DataLab.

Parameters

- **title** – Signal title
- **xdata** – X data
- **ydata** – Y data
- **xunit** – X unit. Defaults to None.
- **yunit** – Y unit. Defaults to None.
- **xlabel** – X label. Defaults to None.
- **ylabel** – Y label. Defaults to None.

Returns

True if signal was added successfully, False otherwise

Raises

- **ValueError** – Invalid xdata dtype
- **ValueError** – Invalid ydata dtype

calc(name: *str*, param: *DataSet* | *None* = *None*) → *None*

Call compute function name in current panel's processor.

Parameters

- **name** – Compute function name
- **param** – Compute function parameter. Defaults to *None*.

Raises

ValueError – unknown function

close_application() → *None*

Close DataLab application

connect(port: *str* | *None* = *None*, timeout: *float* | *None* = *None*, retries: *int* | *None* = *None*) → *None*

Try to connect to DataLab XML-RPC server.

Parameters

- **port** – XML-RPC port to connect to. If not specified, the port is automatically retrieved from DataLab configuration.
- **timeout** – Timeout in seconds. Defaults to 5.0.
- **retries** – Number of retries. Defaults to 10.

Raises

- **ConnectionRefusedError** – Unable to connect to DataLab
- **ValueError** – Invalid timeout (must be >= 0.0)
- **ValueError** – Invalid number of retries (must be >= 1)

context_no_refresh() → *Generator*[*None*, *None*, *None*]

Return a context manager to temporarily disable auto refresh.

Returns

Context manager

Example

```
>>> with proxy.context_no_refresh():
...     proxy.add_image("image1", data1)
...     proxy.compute_fft()
...     proxy.compute_wiener()
...     proxy.compute_ifft()
...     # Auto refresh is disabled during the above operations
```

delete_metadata(refresh_plot: *bool* = *True*, keep_roi: *bool* = *False*) → *None*

Delete metadata of selected objects

Parameters

- **refresh_plot** – Refresh plot. Defaults to *True*.
- **keep_roi** – Keep ROI. Defaults to *False*.

disconnect() → *None*

Disconnect from DataLab XML-RPC server.

get_current_panel() → *str*

Return current panel name.

Returns

“signal”, “image”, “macro”))

Return type

Panel name (valid values

get_group_titles_with_object_infos() → *tuple[list[str], list[list[str]], list[list[str]]]*

Return groups titles and lists of inner objects uuids and titles.

Returns

groups titles, lists of inner objects uuids and titles

Return type

Tuple

get_method_list() → *list[str]*

Return list of available methods.

get_object(*nb_id_title: int | str | None = None, panel: str | None = None*) → *SignalObj | ImageObj*

Get object (signal/image) from index.

Parameters

- **nb_id_title** – Object number, or object id, or object title. Defaults to None (current object).
- **panel** – Panel name. Defaults to None (current panel).

Returns

Object

Raises

KeyError – if object not found

get_object_shapes(*nb_id_title: int | str | None = None, panel: str | None = None*) → *list*

Get plot item shapes associated to object (signal/image).

Parameters

- **nb_id_title** – Object number, or object id, or object title. Defaults to None (current object).
- **panel** – Panel name. Defaults to None (current panel).

Returns

List of plot item shapes

get_object_titles(*panel: str | None = None*) → *list[str]*

Get object (signal/image) list for current panel. Objects are sorted by group number and object index in group.

Parameters

panel – panel name (valid values: “signal”, “image”, “macro”). If None, current data panel is used (i.e. signal or image panel).

Returns

List of object titles

Raises

ValueError – if panel not found

get_object_uuids(*panel: str | None = None, group: int | str | None = None*) → list[str]

Get object (signal/image) uuid list for current panel. Objects are sorted by group number and object index in group.

Parameters

- **panel** – panel name (valid values: “signal”, “image”). If None, current panel is used.
- **group** – Group number, or group id, or group title. Defaults to None (all groups).

Returns

List of object uuids

Raises

ValueError – if panel not found

classmethod get_public_methods() → list[str]

Return all public methods of the class, except itself.

Returns

List of public methods

get_sel_object_uuids(*include_groups: bool = False*) → list[str]

Return selected objects uuids.

Parameters

include_groups – If True, also return objects from selected groups.

Returns

List of selected objects uuids.

get_version() → str

Return DataLab public version.

Returns

DataLab version

import_h5_file(*filename: str, reset_all: bool | None = None*) → None

Open DataLab HDF5 browser to Import HDF5 file.

Parameters

- **filename** – HDF5 file name
- **reset_all** – Reset all application data. Defaults to None.

import_macro_from_file(*filename: str*) → None

Import macro from file

Parameters

filename – Filename.

is_connected() → bool

Return True if connected to DataLab XML-RPC server.

load_from_directory(*path: str*) → None

Open objects from directory in current panel (signals/images).

Parameters

path – directory path

load_from_files(*filenames: list[str]*) → *None*

Open objects from files in current panel (signals/images).

Parameters

filenames – list of file names

open_h5_files(*h5files: list[str] | None = None, import_all: bool | None = None, reset_all: bool | None = None*) → *None*

Open a DataLab HDF5 file or import from any other HDF5 file.

Parameters

- **h5files** – List of HDF5 files to open. Defaults to *None*.
- **import_all** – Import all objects from HDF5 files. Defaults to *None*.
- **reset_all** – Reset all application data. Defaults to *None*.

raise_window() → *None*

Raise DataLab window

reset_all() → *None*

Reset all application data

run_macro(*number_or_title: int | str | None = None*) → *None*

Run macro.

Parameters

number_or_title – Macro number, or macro title. Defaults to *None* (current macro).

Raises

ValueError – if macro not found

save_to_h5_file(*filename: str*) → *None*

Save to a DataLab HDF5 file.

Parameters

filename – HDF5 file name

select_groups(*selection: list[int | str] | None = None, panel: str | None = None*) → *None*

Select groups in current panel.

Parameters

- **selection** – List of group numbers (1 to N), or list of group uuids, or *None* to select all groups. Defaults to *None*.
- **panel** – panel name (valid values: “signal”, “image”). If *None*, current panel is used. Defaults to *None*.

select_objects(*selection: list[int | str], panel: str | None = None*) → *None*

Select objects in current panel.

Parameters

- **selection** – List of object numbers (1 to N) or uuids to select
- **panel** – panel name (valid values: “signal”, “image”). If *None*, current panel is used. Defaults to *None*.

set_current_panel(*panel: str*) → *None*

Switch to panel.

Parameters

panel – Panel name (valid values: “signal”, “image”, “macro”)

stop_macro(*number_or_title: int | str | None = None*) → *None*

Stop macro.

Parameters

number_or_title – Macro number, or macro title. Defaults to None (current macro).

Raises

ValueError – if macro not found

toggle_auto_refresh(*state: bool*) → *None*

Toggle auto refresh state.

Parameters

state – Auto refresh state

toggle_show_titles(*state: bool*) → *None*

Toggle show titles state.

Parameters

state – Show titles state

3.5.2 Local proxy

The local proxy is used when DataLab is started from the same process as the proxy. In this case, the proxy is directly connected to DataLab main window instance. The typical use case is high-level scripting.

class `cdl.proxy.LocalProxy`(*cdl: CDLMainWindow | ServerProxy | None = None*)

DataLab local proxy class.

This class provides access to DataLab features from a proxy class. This is the local version of proxy, which is used when DataLab is started from the same process as the proxy.

Parameters

cdl (*CDLMainWindow*) – CDLMainWindow instance.

Note: The proxy object also allows to access DataLab computing methods exposed by the processor classes (see *Calling processor methods using proxy objects*).

add_signal(*title: str, xdata: ndarray, ydata: ndarray, xunit: str | None = None, yunit: str | None = None, xlabel: str | None = None, ylabel: str | None = None*) → *bool*

Add signal data to DataLab.

Parameters

- **title** (*str*) – Signal title
- **xdata** (*numpy.ndarray*) – X data
- **ydata** (*numpy.ndarray*) – Y data
- **xunit** (*str | None*) – X unit. Defaults to None.
- **yunit** (*str | None*) – Y unit. Defaults to None.

- **xlabel** (*str* / *None*) – X label. Defaults to *None*.
- **ylabel** (*str* / *None*) – Y label. Defaults to *None*.

Returns

True if signal was added successfully, False otherwise

Return type

bool

Raises

- **ValueError** – Invalid xdata dtype
- **ValueError** – Invalid ydata dtype

add_image(*title: str*, *data: ndarray*, *xunit: str | None = None*, *yunit: str | None = None*, *zunit: str | None = None*, *xlabel: str | None = None*, *ylabel: str | None = None*, *zlabel: str | None = None*) → *bool*

Add image data to DataLab.

Parameters

- **title** (*str*) – Image title
- **data** (*numpy.ndarray*) – Image data
- **xunit** (*str* / *None*) – X unit. Defaults to *None*.
- **yunit** (*str* / *None*) – Y unit. Defaults to *None*.
- **zunit** (*str* / *None*) – Z unit. Defaults to *None*.
- **xlabel** (*str* / *None*) – X label. Defaults to *None*.
- **ylabel** (*str* / *None*) – Y label. Defaults to *None*.
- **zlabel** (*str* / *None*) – Z label. Defaults to *None*.

Returns

True if image was added successfully, False otherwise

Return type

bool

Raises

ValueError – Invalid data dtype

add_object(*obj: SignalObj | ImageObj*) → *None*

Add object to DataLab.

Parameters

obj (*SignalObj* / *ImageObj*) – Signal or image object

calc(*name: str*, *param: DataSet | None = None*) → *None*

Call compute function name in current panel's processor.

Parameters

- **name** – Compute function name
- **param** – Compute function parameter. Defaults to *None*.

Raises

ValueError – unknown function

get_object(*nb_id_title*: *int* | *str* | *None* = *None*, *panel*: *str* | *None* = *None*) → *SignalObj* | *ImageObj*

Get object (signal/image) from index.

Parameters

- **nb_id_title** – Object number, or object id, or object title. Defaults to *None* (current object).
- **panel** – Panel name. Defaults to *None* (current panel).

Returns

Object

Raises

KeyError – if object not found

get_object_shapes(*nb_id_title*: *int* | *str* | *None* = *None*, *panel*: *str* | *None* = *None*) → *list*

Get plot item shapes associated to object (signal/image).

Parameters

- **nb_id_title** – Object number, or object id, or object title. Defaults to *None* (current object).
- **panel** – Panel name. Defaults to *None* (current panel).

Returns

List of plot item shapes

add_annotations_from_items(*items*: *list*, *refresh_plot*: *bool* = *True*, *panel*: *str* | *None* = *None*) → *None*

Add object annotations (annotation plot items).

Parameters

- **items** (*list*) – annotation plot items
- **refresh_plot** (*bool* | *None*) – refresh plot. Defaults to *True*.
- **panel** (*str* | *None*) – panel name (valid values: “signal”, “image”). If *None*, current panel is used.

add_group(*title*: *str*, *panel*: *str* | *None* = *None*, *select*: *bool* = *False*) → *None*

Add group to DataLab.

Parameters

- **title** – Group title
- **panel** – Panel name (valid values: “signal”, “image”). Defaults to *None*.
- **select** – Select the group after creation. Defaults to *False*.

add_label_with_title(*title*: *str* | *None* = *None*, *panel*: *str* | *None* = *None*) → *None*

Add a label with object title on the associated plot

Parameters

- **title** – Label title. Defaults to *None*. If *None*, the title is the object title.
- **panel** – panel name (valid values: “signal”, “image”). If *None*, current panel is used.

close_application() → *None*

Close DataLab application

context_no_refresh() → `Generator[None, None, None]`

Return a context manager to temporarily disable auto refresh.

Returns

Context manager

Example

```
>>> with proxy.context_no_refresh():
...     proxy.add_image("image1", data1)
...     proxy.compute_fft()
...     proxy.compute_wiener()
...     proxy.compute_ifft()
...     # Auto refresh is disabled during the above operations
```

delete_metadata(*refresh_plot: bool = True, keep_roi: bool = False*) → `None`

Delete metadata of selected objects

Parameters

- **refresh_plot** – Refresh plot. Defaults to True.
- **keep_roi** – Keep ROI. Defaults to False.

get_current_panel() → `str`

Return current panel name.

Returns

“signal”, “image”, “macro”))

Return type

Panel name (valid values

get_group_titles_with_object_infos() → `tuple[list[str], list[list[str]], list[list[str]]]`

Return groups titles and lists of inner objects uuids and titles.

Returns

groups titles, lists of inner objects uuids and titles

Return type

Tuple

get_object_titles(*panel: str | None = None*) → `list[str]`

Get object (signal/image) list for current panel. Objects are sorted by group number and object index in group.

Parameters

panel – panel name (valid values: “signal”, “image”, “macro”). If None, current data panel is used (i.e. signal or image panel).

Returns

List of object titles

Raises

ValueError – if panel not found

get_object_uuids(*panel: str | None = None, group: int | str | None = None*) → `list[str]`

Get object (signal/image) uuid list for current panel. Objects are sorted by group number and object index in group.

Parameters

- **panel** – panel name (valid values: “signal”, “image”). If None, current panel is used.
- **group** – Group number, or group id, or group title. Defaults to None (all groups).

Returns

List of object uuids

Raises

ValueError – if panel not found

classmethod `get_public_methods()` → `list[str]`

Return all public methods of the class, except itself.

Returns

List of public methods

`get_sel_object_uuids(include_groups: bool = False)` → `list[str]`

Return selected objects uuids.

Parameters

include_groups – If True, also return objects from selected groups.

Returns

List of selected objects uuids.

`get_version()` → `str`

Return DataLab public version.

Returns

DataLab version

`import_h5_file(filename: str, reset_all: bool | None = None)` → `None`

Open DataLab HDF5 browser to Import HDF5 file.

Parameters

- **filename** – HDF5 file name
- **reset_all** – Reset all application data. Defaults to None.

`import_macro_from_file(filename: str)` → `None`

Import macro from file

Parameters

filename – Filename.

`load_from_directory(path: str)` → `None`

Open objects from directory in current panel (signals/images).

Parameters

path – directory path

`load_from_files(filenamees: list[str])` → `None`

Open objects from files in current panel (signals/images).

Parameters

filenamees – list of file names

`open_h5_files(h5files: list[str] | None = None, import_all: bool | None = None, reset_all: bool | None = None)` → `None`

Open a DataLab HDF5 file or import from any other HDF5 file.

Parameters

- **h5files** – List of HDF5 files to open. Defaults to None.
- **import_all** – Import all objects from HDF5 files. Defaults to None.
- **reset_all** – Reset all application data. Defaults to None.

raise_window() → None

Raise DataLab window

reset_all() → None

Reset all application data

run_macro(*number_or_title: int | str | None = None*) → None

Run macro.

Parameters

number_or_title – Macro number, or macro title. Defaults to None (current macro).

Raises

ValueError – if macro not found

save_to_h5_file(*filename: str*) → None

Save to a DataLab HDF5 file.

Parameters

filename – HDF5 file name

select_groups(*selection: list[int | str] | None = None, panel: str | None = None*) → None

Select groups in current panel.

Parameters

- **selection** – List of group numbers (1 to N), or list of group uuids, or None to select all groups. Defaults to None.
- **panel** – panel name (valid values: “signal”, “image”). If None, current panel is used. Defaults to None.

select_objects(*selection: list[int | str], panel: str | None = None*) → None

Select objects in current panel.

Parameters

- **selection** – List of object numbers (1 to N) or uuids to select
- **panel** – panel name (valid values: “signal”, “image”). If None, current panel is used. Defaults to None.

set_current_panel(*panel: str*) → None

Switch to panel.

Parameters

panel – Panel name (valid values: “signal”, “image”, “macro”))

stop_macro(*number_or_title: int | str | None = None*) → None

Stop macro.

Parameters

number_or_title – Macro number, or macro title. Defaults to None (current macro).

Raises

ValueError – if macro not found

toggle_auto_refresh(*state: bool*) → *None*

Toggle auto refresh state.

Parameters

state – Auto refresh state

toggle_show_titles(*state: bool*) → *None*

Toggle show titles state.

Parameters

state – Show titles state

3.5.3 Proxy context manager

The proxy context manager is a convenient way to handle proxy creation and destruction. It is used as follows:

```
with proxy_context("local") as proxy:
    proxy.add_signal(...)
```

The proxy type can be “local” or “remote”. For remote proxy, the port can be specified as “remote:port”.

Note: The proxy context manager allows to use the proxy in various contexts (Python script, Jupyter notebook, etc.). It also allows to switch seamlessly between local and remote proxy, keeping the same code inside the context.

cdl.proxy.proxy_context(*what: str*) → *Generator[LocalProxy | RemoteProxy, None, None]*

Context manager handling CDL proxy creation and destruction.

Parameters

what (*str*) – proxy type (“local” or “remote”) For remote proxy, the port can be specified as “remote:port”

Yields

Generator[LocalProxy | RemoteProxy, None, None] –

proxy

LocalProxy if what == “local” RemoteProxy if what == “remote” or “remote:port”

Example

```
with proxy_context("local") as proxy:
    proxy.add_signal(...)
```

3.5.4 Calling processor methods using proxy objects

All the proxy objects provide access to the DataLab computing methods exposed by the processor classes:

- *cdl.core.gui.processor.signal.SignalProcessor*
- *cdl.core.gui.processor.image.ImageProcessor*

See also:

The list of processor methods is available in tables below.

There are two ways to call a processor method:

1. Using the `calc()` method of the proxy object:

```
# Call a method without parameter
proxy.calc("compute_average")

# This is equivalent to:
proxy.calc("average")

# Call a method with parameters
p = cdl.param.MovingAverageParam.create(n=30)
proxy.calc("compute_moving_average", p)
```

2. Directly calling the processor method from the proxy object:

```
# Call a method without parameter
proxy.compute_average()

# Call a method with parameters
p = cdl.param.MovingAverageParam.create(n=30)
proxy.compute_moving_average(p)
```

Warning: The `compute_{name}` methods are not statically defined in the proxy classes (and not even dynamically). They are nevertheless available through the proxy objects thanks to the magic method `__getattr__()` which forwards the call to the `calc()` method. However, this means that the methods are not listed in the proxy classes documentation, and they are not available in the auto-completion feature of your IDE.

Number of compute methods

Table 1: Number of compute methods

Signal	Image	Total
71	101	172

Signal processing

The following table lists the signal processor methods - it is automatically generated from the source code:

Table 2: Signal processor methods

Compute method	Description
<code>compute_abs()</code>	Compute absolute value with <code>cdl.computation.signal.compute_abs()</code>
<code>compute_addition_constant()</code>	Compute sum with a constant
<code>compute_all_stability()</code>	Compute all stability analysis features
<code>compute_allan_deviation()</code>	Compute Allan deviation
<code>compute_allan_variance()</code>	Compute Allan variance
<code>compute_arithmetic()</code>	Compute arithmetic operation between two signals
<code>compute_astype()</code>	Convert data type with <code>cdl.computation.signal.compute_astype()</code>

continues on next page

Table 2 – continued from previous page

Compute method	Description
<code>compute_average()</code>	Compute average with <code>cdl.computation.signal.compute_addition()</code>
<code>compute_bandpass()</code>	Compute band-pass filter
<code>compute_bandstop()</code>	Compute band-stop filter
<code>compute_bandwidth_3db()</code>	Compute bandwidth at -3dB
<code>compute_calibration()</code>	Compute data linear calibration
<code>compute_cartesian2polar()</code>	Convert cartesian to polar coordinates
<code>compute_clip()</code>	Compute maximum data clipping
<code>compute_contrast()</code>	Compute contrast with <code>cdl.computation.signal.compute_contrast()</code>
<code>compute_convolution()</code>	Compute convolution
<code>compute_derivative()</code>	Compute derivative
<code>compute_detrending()</code>	Compute detrending
<code>compute_difference()</code>	Compute difference between two signals
<code>compute_difference_constant()</code>	Compute difference with a constant
<code>compute_division()</code>	Compute division between two signals
<code>compute_division_constant()</code>	Compute division by a constant
<code>compute_dynamic_parameters()</code>	Compute Dynamic Parameters (ENOB, SINAD, THD, SFDR, SNR)
<code>compute_exp()</code>	Compute Log10 with <code>cdl.computation.signal.compute_exp()</code>
<code>compute_fft()</code>	Compute FFT with <code>cdl.computation.signal.compute_fft()</code>
<code>compute_fit()</code>	Compute fitting curve using an interactive dialog
<code>compute_fw1e2()</code>	Compute FW at $1/e^2$ with <code>cdl.computation.signal.compute_fw1e2()</code>
<code>compute_fwhm()</code>	Compute FWHM with <code>cdl.computation.signal.compute_fwhm()</code>
<code>compute_gaussian_filter()</code>	Compute gaussian filter
<code>compute_hadamard_variance()</code>	Compute Hadamard variance
<code>compute_highpass()</code>	Compute high-pass filter
<code>compute_histogram()</code>	Compute histogram
<code>compute_iff()</code>	Compute iFFT with <code>cdl.computation.signal.compute_iff()</code>
<code>compute_im()</code>	Compute imaginary part with <code>cdl.computation.signal.compute_im()</code>
<code>compute_integral()</code>	Compute integral with <code>cdl.computation.signal.compute_integral()</code>
<code>compute_interpolation()</code>	Compute interpolation
<code>compute_inverse()</code>	Compute inverse
<code>compute_log10()</code>	Compute Log10 with <code>cdl.computation.signal.compute_log10()</code>
<code>compute_lowpass()</code>	Compute high-pass filter
<code>compute_magnitude_spectrum()</code>	Compute magnitude spectrum
<code>compute_modified_allan_variance()</code>	Compute modified Allan variance
<code>compute_moving_average()</code>	Compute moving average
<code>compute_moving_median()</code>	Compute moving median
<code>compute_multigaussianfit()</code>	Compute multi-Gaussian fitting curve using an interactive dialog
<code>compute_normalize()</code>	Normalize data with <code>cdl.computation.signal.compute_normalize()</code>
<code>compute_offset_correction()</code>	Compute offset correction
<code>compute_overlapping_allan_variance()</code>	Compute overlapping Allan variance

continues on next page

Table 2 – continued from previous page

Compute method	Description
<code>compute_peak_detection()</code>	Detect peaks from data
<code>compute_phase_spectrum()</code>	Compute phase spectrum
<code>compute_polar2cartesian()</code>	Convert polar to cartesian coordinates
<code>compute_polyfit()</code>	Compute polynomial fitting curve
<code>compute_power()</code>	Compute power with <code>cdl.computation.signal.compute_power()</code>
<code>compute_product()</code>	Compute product with <code>cdl.computation.signal.compute_product()</code>
<code>compute_product_constant()</code>	Compute product with a constant
<code>compute_psd()</code>	Compute power spectral density
<code>compute_quadratic_difference()</code>	Compute quadratic difference between two signals
<code>compute_re()</code>	Compute real part with <code>cdl.computation.signal.compute_re()</code>
<code>compute_resampling()</code>	Compute resampling
<code>compute_reverse_x()</code>	Reverse X axis with <code>cdl.computation.signal.compute_reverse_x()</code>
<code>compute_roi_extraction()</code>	Extract Region Of Interest (ROI) from data
<code>compute_sampling_rate_period()</code>	Compute sampling rate and period (mean and std)
<code>compute_sqrt()</code>	Compute square root with <code>cdl.computation.signal.compute_sqrt()</code>
<code>compute_stats()</code>	Compute data statistics
<code>compute_sum()</code>	Compute sum with <code>cdl.computation.signal.compute_addition()</code>
<code>compute_swap_axes()</code>	Swap data axes with <code>cdl.computation.signal.compute_swap_axes()</code>
<code>compute_time_deviation()</code>	Compute time deviation
<code>compute_total_variance()</code>	Compute total variance
<code>compute_wiener()</code>	Compute Wiener filter
<code>compute_windowing()</code>	Compute windowing
<code>compute_x_at_minmax()</code>	Compute x at min/max
<code>compute_x_at_y()</code>	Compute x at y with <code>cdl.computation.signal.compute_x_at_y()</code>

Image processing

The following table lists the image processor methods - it is automatically generated from the source code:

Table 3: Image processor methods

Compute method	Description
<code>compute_abs()</code>	Compute absolute value with <code>cdl.computation.image.compute_abs()</code>
<code>compute_addition_constant()</code>	Compute sum with a constant
<code>compute_adjust_gamma()</code>	Compute gamma correction
<code>compute_adjust_log()</code>	Compute log correction
<code>compute_adjust_sigmoid()</code>	Compute sigmoid correction
<code>compute_all_denoise()</code>	Compute all denoising filters
<code>compute_all_edges()</code>	Compute all edges filters
<code>compute_all_morphology()</code>	Compute all morphology filters

continues on next page

Table 3 – continued from previous page

Compute method	Description
<code>compute_all_threshold()</code>	Compute all threshold algorithms
<code>compute_arithmetic()</code>	Compute arithmetic operation between two images
<code>compute_astype()</code>	Convert data type with <code>cdl.computation.image.compute_astype()</code>
<code>compute_average()</code>	Compute average with <code>cdl.computation.image.compute_addition()</code>
<code>compute_average_profile()</code>	Compute average profile
<code>compute_binning()</code>	Binning image with <code>cdl.computation.image.compute_binning()</code>
<code>compute_black_tophat()</code>	Compute Black Top-Hat
<code>compute_blob_dog()</code>	Compute blob detection using Difference of Gaussian method
<code>compute_blob_doh()</code>	Compute blob detection using Determinant of Hessian method
<code>compute_blob_log()</code>	Compute blob detection using Laplacian of Gaussian method
<code>compute_blob_opencv()</code>	Compute blob detection using OpenCV
<code>compute_butterworth()</code>	Compute Butterworth filter
<code>compute_calibration()</code>	Compute data linear calibration
<code>compute_canny()</code>	Compute Canny filter
<code>compute_centroid()</code>	Compute image centroid
<code>compute_clip()</code>	Compute maximum data clipping
<code>compute_closing()</code>	Compute morphological closing
<code>compute_contour_shape()</code>	Compute contour shape fit
<code>compute_denoise_bilateral()</code>	Compute bilateral filter denoising
<code>compute_denoise_tophat()</code>	Denoise using White Top-Hat
<code>compute_denoise_tv()</code>	Compute Total Variation denoising
<code>compute_denoise_wavelet()</code>	Compute Wavelet denoising
<code>compute_difference()</code>	Compute difference between two images
<code>compute_difference_constant()</code>	Compute difference with a constant
<code>compute_dilation()</code>	Compute Dilation
<code>compute_division()</code>	Compute division between two images
<code>compute_division_constant()</code>	Compute division by a constant
<code>compute_enclosing_circle()</code>	Compute minimum enclosing circle
<code>compute_equalize_adapthist()</code>	Adaptive histogram equalization
<code>compute_equalize_hist()</code>	Histogram equalization
<code>compute_erosion()</code>	Compute Erosion
<code>compute_exp()</code>	Compute Log10 with <code>cdl.computation.image.compute_exp()</code>
<code>compute_farid()</code>	Compute Farid filter
<code>compute_farid_h()</code>	Compute Farid filter (horizontal)
<code>compute_farid_v()</code>	Compute Farid filter (vertical)
<code>compute_fft()</code>	Compute FFT with <code>cdl.computation.image.compute_fft()</code>
<code>compute_flatfield()</code>	Compute flat field correction
<code>compute_fliph()</code>	Flip data horizontally
<code>compute_flipv()</code>	Flip data vertically with <code>cdl.computation.image.compute_flipv()</code>
<code>compute_gaussian_filter()</code>	Compute gaussian filter
<code>compute_histogram()</code>	Compute histogram with <code>cdl.computation.image.compute_histogram()</code>
<code>compute_hough_circle_peaks()</code>	Compute peak detection based on a circle Hough transform
<code>compute_iff()</code>	Compute iFFT with <code>cdl.computation.image.compute_iff()</code>
<code>compute_im()</code>	Compute imaginary part with <code>cdl.computation.image.compute_im()</code>

continues on next page

Table 3 – continued from previous page

Compute method	Description
<code>compute_inverse()</code>	Compute inverse
<code>compute_laplace()</code>	Compute Laplace filter
<code>compute_line_profile()</code>	Compute profile along a vertical or horizontal line
<code>compute_log10()</code>	Compute Log10 with <code>cdl.computation.image.compute_log10()</code>
<code>compute_logp1()</code>	Compute base 10 logarithm
<code>compute_magnitude_spectrum()</code>	Compute magnitude spectrum
<code>compute_moving_average()</code>	Compute moving average
<code>compute_moving_median()</code>	Compute moving median
<code>compute_normalize()</code>	Normalize data with <code>cdl.computation.image.compute_normalize()</code>
<code>compute_offset_correction()</code>	Compute offset correction
<code>compute_opening()</code>	Compute morphological opening
<code>compute_peak_detection()</code>	Compute 2D peak detection
<code>compute_phase_spectrum()</code>	Compute phase spectrum
<code>compute_prewitt()</code>	Compute Prewitt filter
<code>compute_prewitt_h()</code>	Compute Prewitt filter (horizontal)
<code>compute_prewitt_v()</code>	Compute Prewitt filter (vertical)
<code>compute_product()</code>	Compute product with <code>cdl.computation.image.compute_product()</code>
<code>compute_product_constant()</code>	Compute product with a constant
<code>compute_psd()</code>	Compute Power Spectral Density (PSD)
<code>compute_quadratic_difference()</code>	Compute quadratic difference between two images
<code>compute_radial_profile()</code>	Compute radial profile
<code>compute_re()</code>	Compute real part with <code>cdl.computation.image.compute_re()</code>
<code>compute_rescale_intensity()</code>	Rescale image intensity levels
<code>compute_resize()</code>	Resize image with <code>cdl.computation.image.compute_resize()</code>
<code>compute_roberts()</code>	Compute Roberts filter
<code>compute_roi_extraction()</code>	Extract Region Of Interest (ROI) from data
<code>compute_rotate()</code>	Rotate data arbitrarily
<code>compute_rotate270()</code>	Rotate data 270° with <code>cdl.computation.image.compute_rotate270()</code>
<code>compute_rotate90()</code>	Rotate data 90° with <code>cdl.computation.image.compute_rotate90()</code>
<code>compute_scharr()</code>	Compute Scharr filter
<code>compute_scharr_h()</code>	Compute Scharr filter (horizontal)
<code>compute_scharr_v()</code>	Compute Scharr filter (vertical)
<code>compute_segment_profile()</code>	Compute profile along a segment
<code>compute_sobel()</code>	Compute Sobel filter
<code>compute_sobel_h()</code>	Compute Sobel filter (horizontal)
<code>compute_sobel_v()</code>	Compute Sobel filter (vertical)
<code>compute_stats()</code>	Compute data statistics
<code>compute_sum()</code>	Compute sum with <code>cdl.computation.image.compute_addition()</code>
<code>compute_swap_axes()</code>	Swap data axes with <code>cdl.computation.image.compute_swap_axes()</code>
<code>compute_threshold()</code>	Compute parametric threshold
<code>compute_threshold_isodata()</code>	Compute threshold using Isodata algorithm

continues on next page

Table 3 – continued from previous page

Compute method	Description
<code>compute_threshold_li()</code>	Compute threshold using Li algorithm
<code>compute_threshold_mean()</code>	Compute threshold using Mean algorithm
<code>compute_threshold_minimum()</code>	Compute threshold using Minimum algorithm
<code>compute_threshold_otsu()</code>	Compute threshold using Otsu algorithm
<code>compute_threshold_triangle()</code>	Compute threshold using Triangle algorithm
<code>compute_threshold_yen()</code>	Compute threshold using Yen algorithm
<code>compute_white_tophat()</code>	Compute White Top-Hat
<code>compute_wiener()</code>	Compute Wiener filter

3.6 GUI

The `cdl.core.gui` package contains functionalities related to the graphical user interface (GUI) of the DataLab (CDL) project. Those features are mostly specific to DataLab and are not intended to be used independently.

The purpose of this section of the documentation is to provide an overview of the DataLab GUI architecture and to describe the main features of the modules contained in this package. It is not intended to provide a detailed description of the GUI features, but rather to provide a starting point for the reader who wants to understand the DataLab internal architecture.

DataLab's main window is composed of several parts, each of them being handled by a specific module of this package:

- **Signal and image panels:** those panels are used to display signals and images and to provide a set of tools to manipulate them. Each data panel relies on a set of modules to handle the GUI features (`cdl.core.gui.actionhandler` and `cdl.core.gui.objectview`), the data model (`cdl.core.gui.objectmodel`), the data visualization (`cdl.core.gui.plothandler`), and the data processing (`cdl.core.gui.processor`).
- **Macro panel:** this panel is used to display and run macros. It relies on the `cdl.core.gui.macroeditor` module to handle the macro edition and execution.
- **Specialized widgets:** those widgets are used to handle specific features such as ROI edition (`cdl.core.gui.roieditor`), Intensity profile edition (`cdl.core.gui.profiledialog`), etc.

Submodule	Purpose
<code>cdl.core.gui.main</code>	DataLab main window and application
<code>cdl.core.gui.panel</code>	Signal, image and macro panels
<code>cdl.core.gui.actionhandler</code>	Application actions (menus, toolbars, context menu)
<code>cdl.core.gui.objectview</code>	Widgets to display object (signal/image) trees
<code>cdl.core.gui.plothandler</code>	<i>PlotPy</i> plot items for representing signals and images
<code>cdl.core.gui.roieditor</code>	ROI editor
<code>cdl.core.gui.processor</code>	Processor
<code>cdl.core.gui.docks</code>	Dock widgets
<code>cdl.core.gui.h5io</code>	HDF5 input/output

3.7 Main window

The `cdl.core.gui.main` module provides the main window of the DataLab (CDL) project.

class `cdl.core.gui.main.CDLMainWindow`(*console=None, hide_on_close=False*)

DataLab main window

Parameters

- **console** – enable internal console
- **hide_on_close** – True to hide window on close

static `get_instance`(*console=None, hide_on_close=False*)

Return singleton instance

static `xmlrpc_server_started`(*port*)

XML-RPC server has started, writing comm port in configuration file

`get_group_titles_with_object_infos`() → `tuple[list[str], list[list[str]], list[list[str]]]`

Return groups titles and lists of inner objects uuids and titles.

Returns

Groups titles, lists of inner objects uuids and titles

`get_object_titles`(*panel: str | None = None*) → `list[str]`

Get object (signal/image) list for current panel. Objects are sorted by group number and object index in group.

Parameters

panel – panel name (valid values: “signal”, “image”, “macro”). If None, current data panel is used (i.e. signal or image panel).

Returns

List of object titles

Raises

ValueError – if panel is unknown

`get_object`(*nb_id_title: int | str | None = None, panel: str | None = None*) → `SignalObj | ImageObj`

Get object (signal/image) from index.

Parameters

- **nb_id_title** – Object number, or object id, or object title. Defaults to None (current object).
- **panel** – Panel name. Defaults to None (current panel).

Returns

Object

Raises

- **KeyError** – if object not found
- **TypeError** – if index_id_title type is invalid

`get_object_uuids`(*panel: str | None = None, group: int | str | None = None*) → `list[str]`

Get object (signal/image) uuid list for current panel. Objects are sorted by group number and object index in group.

Parameters

- **panel** – panel name (valid values: “signal”, “image”). If None, current panel is used.
- **group** – Group number, or group id, or group title. Defaults to None (all groups).

Returns

List of object uuids

Raises

ValueError – if panel is unknown

get_sel_object_uuids(*include_groups: bool = False*) → list[str]

Return selected objects uuids.

Parameters

include_groups – If True, also return objects from selected groups.

Returns

List of selected objects uuids.

add_group(*title: str, panel: str | None = None, select: bool = False*) → None

Add group to DataLab.

Parameters

- **title** – Group title
- **panel** – Panel name (valid values: “signal”, “image”). Defaults to None.
- **select** – Select the group after creation. Defaults to False.

select_objects(*selection: list[int | str], panel: str | None = None*) → None

Select objects in current panel.

Parameters

- **selection** – List of object numbers (1 to N) or uuids to select
- **panel** – panel name (valid values: “signal”, “image”). If None, current panel is used. Defaults to None.

select_groups(*selection: list[int | str] | None = None, panel: str | None = None*) → None

Select groups in current panel.

Parameters

- **selection** – List of group numbers (1 to N), or list of group uuids, or None to select all groups. Defaults to None.
- **panel** – panel name (valid values: “signal”, “image”). If None, current panel is used. Defaults to None.

delete_metadata(*refresh_plot: bool = True, keep_roi: bool = False*) → None

Delete metadata of selected objects

Parameters

- **refresh_plot** – Refresh plot. Defaults to True.
- **keep_roi** – Keep ROI. Defaults to False.

get_object_shapes(*nb_id_title: int | str | None = None, panel: str | None = None*) → list

Get plot item shapes associated to object (signal/image).

Parameters

- **nb_id_title** – Object number, or object id, or object title. Defaults to None (current object).
- **panel** – Panel name. Defaults to None (current panel).

Returns

List of plot item shapes

add_annotations_from_items(items: *list*, refresh_plot: *bool* = *True*, panel: *str* | *None* = *None*) → *None*

Add object annotations (annotation plot items).

Parameters

- **items** – annotation plot items
- **refresh_plot** – refresh plot. Defaults to True.
- **panel** – panel name (valid values: “signal”, “image”). If None, current panel is used.

add_label_with_title(title: *str* | *None* = *None*, panel: *str* | *None* = *None*) → *None*

Add a label with object title on the associated plot

Parameters

- **title** – Label title. Defaults to None. If None, the title is the object title.
- **panel** – panel name (valid values: “signal”, “image”). If None, current panel is used.

run_macro(number_or_title: *int* | *str* | *None* = *None*) → *None*

Run macro.

Parameters

number – Number of the macro (starting at 1). Defaults to None (run current macro, or does nothing if there is no macro).

stop_macro(number_or_title: *int* | *str* | *None* = *None*) → *None*

Stop macro.

Parameters

number – Number of the macro (starting at 1). Defaults to None (stop current macro, or does nothing if there is no macro).

import_macro_from_file(filename: *str*) → *None*

Import macro from file

Parameters

filename – Filename.

property panels: *tuple*[*AbstractPanel*, ...]

Return the tuple of implemented panels (signal, image)

Returns

Tuple of panels

confirm_memory_state() → *bool*

Check memory warning state and eventually show a warning dialog

Returns

True if memory state is ok

check_stable_release() → *None*

Check if this is a stable release

check_for_previous_crash() → *None*

Check for previous crash

execute_post_show_actions() → *None*

Execute post-show actions

take_screenshot(name: str) → *None*

Take main window screenshot

take_menu_screenshots() → *None*

Take menu screenshots

setup(console: bool = False) → *None*

Setup main window

Parameters

console – True to setup console

set_process_isolation_enabled(state: bool) → *None*

Enable/disable process isolation

Parameters

state – True to enable process isolation

get_current_panel() → *str*

Return current panel name

Returns

“signal”, “image”, “macro”

Return type

Panel name (valid values

set_current_panel(panel: str) → *None*

Switch to panel.

Parameters

panel – panel name (valid values: “signal”, “image”, “macro”)

Raises

ValueError – unknown panel

calc(name: str, param: DataSet | None = None) → *None*

Call compute function name in current panel’s processor.

Parameters

- **name** – Compute function name
- **param** – Compute function parameter. Defaults to None.

Raises

ValueError – unknown function

has_objects() → *bool*

Return True if sig/ima panels have any object

set_modified(state: bool = True) → *None*

Set mainwindow modified state

repopulate_panel_trees() → *None*

Repopulate all panel trees

toggle_show_titles(*state: bool*) → *None*

Toggle show annotations option

Parameters

state – state

toggle_auto_refresh(*state: bool*) → *None*

Toggle auto refresh option

Parameters

state – state

toggle_show_first_only(*state: bool*) → *None*

Toggle show first only option

Parameters

state – state

reset_all() → *None*

Reset all application data

save_to_h5_file(*filename=None*) → *None*

Save to a DataLab HDF5 file

Parameters

filename – HDF5 filename. If *None*, a file dialog is opened.

Raises

IOError – if filename is invalid or file cannot be saved.

open_h5_files(*h5files: list[str] | None = None, import_all: bool | None = None, reset_all: bool | None = None*) → *None*

Open a DataLab HDF5 file or import from any other HDF5 file.

Parameters

- **h5files** – HDF5 filenames (optionally with dataset name, separated by “:”)
- **import_all** – Import all datasets from HDF5 files
- **reset_all** – Reset all application data before importing

browse_h5_files(*filenames: list[str], reset_all: bool*) → *None*

Browse HDF5 files

Parameters

- **filenames** – HDF5 filenames
- **reset_all** – Reset all application data before importing

import_h5_file(*filename: str, reset_all: bool | None = None*) → *None*

Import HDF5 file into DataLab

Parameters

- **filename** – HDF5 filename (optionally with dataset name,
- " (separated by) – “)
- **reset_all** – Delete all DataLab signals/images before importing data

add_object(*obj*: *SignalObj* | *ImageObj*) → *None*

Add object - signal or image

Parameters

obj – object to add (signal or image)

load_from_files(*filenames*: *list[str]*) → *None*

Open objects from files in current panel (signals/images)

Parameters

filenames – list of filenames

load_from_directory(*path*: *str*) → *None*

Open objects from directory in current panel (signals/images).

Parameters

path – directory path

get_version() → *str*

Return DataLab public version.

Returns

DataLab version

close_application() → *None*

Close DataLab application

raise_window() → *None*

Raise DataLab window

add_signal(*title*: *str*, *xdata*: *ndarray*, *ydata*: *ndarray*, *xunit*: *str* | *None* = *None*, *yunit*: *str* | *None* = *None*, *xlabel*: *str* | *None* = *None*, *ylabel*: *str* | *None* = *None*) → *bool*

Add signal data to DataLab.

Parameters

- **title** – Signal title
- **xdata** – X data
- **ydata** – Y data
- **xunit** – X unit. Defaults to None.
- **yunit** – Y unit. Defaults to None.
- **xlabel** – X label. Defaults to None.
- **ylabel** – Y label. Defaults to None.

Returns

True if signal was added successfully, False otherwise

Raises

- **ValueError** – Invalid xdata dtype
- **ValueError** – Invalid ydata dtype

add_image(*title*: *str*, *data*: *ndarray*, *xunit*: *str* | *None* = *None*, *yunit*: *str* | *None* = *None*, *zunit*: *str* | *None* = *None*, *xlabel*: *str* | *None* = *None*, *ylabel*: *str* | *None* = *None*, *zlabel*: *str* | *None* = *None*) → *bool*

Add image data to DataLab.

Parameters

- **title** – Image title
- **data** – Image data
- **xunit** – X unit. Defaults to None.
- **yunit** – Y unit. Defaults to None.
- **zunit** – Z unit. Defaults to None.
- **xlabel** – X label. Defaults to None.
- **ylabel** – Y label. Defaults to None.
- **zlabel** – Z label. Defaults to None.

Returns

True if image was added successfully, False otherwise

Raises

ValueError – Invalid data dtype

play_demo() → **None**

Play demo

show_tour() → **None**

Show tour

static test_segfault_error() → **None**

Generate errors (both fault and traceback)

show() → **None**

Reimplement QMainWindow method

close_properly() → **bool**

Close properly

Returns

True if closed properly, False otherwise

closeEvent(event: QCloseEvent) → **None**

Reimplement QMainWindow method

3.8 Panel

The `cdl.core.gui.panel` package provides the **panel objects** for signals and images.

Three types of panels are available:

- `cdl.core.gui.panel.signal.SignalPanel`: Signal panel
- `cdl.core.gui.panel.image.ImagePanel`: Image panel
- `cdl.core.gui.panel.macro.MacroPanel`: Macro panel

Signal and Image Panels are called **Data Panels** and are used to display and handle signals and images in the main window of DataLab.

Data Panels rely on the `cdl.core.gui.panel.base.ObjectProp` class (managing the object properties) and a set of modules to handle the GUI features:

- `cdl.core.gui.actionhandler`: Application actions (menus, toolbars, context menu)

- `cdl.core.gui.objectview`: Widgets to display object (signal/image) trees
- `cdl.core.gui.plothandler`: *PlotPy* items for representing signals and images
- `cdl.core.gui.processor`: Processor (computation)
- `cdl.core.gui.panel.roieditor`: ROI editor

The Macro Panel is used to display and run macros. It relies on the `cdl.core.gui.macroeditor` module to handle the macro edition and execution.

3.8.1 Base features

`cdl.core.gui.panel.base.is_plot_item_serializable(item: ShapeTypes) → bool`

Return True if plot item is serializable

class `cdl.core.gui.panel.base.ObjectProp(panel: BaseDataPanel, paramclass: SignalObj | ImageObj)`

Object handling panel properties

add_button(button)

Add additional button on bottom of properties panel

set_param_label(param: SignalObj | ImageObj)

Set computing parameters label

update_properties_from(param: SignalObj | ImageObj | None = None)

Update properties from signal/image dataset

class `cdl.core.gui.panel.base.AbstractPanelMeta(name, bases, namespace, /, **kwargs)`

Mixed metaclass to avoid conflicts

class `cdl.core.gui.panel.base.AbstractPanel(parent)`

Object defining DataLab panel interface, based on a vertical QSplitter widget

A panel handle an object list (objects are signals, images, macros...). Each object must implement `cdl.core.gui.ObjItf` interface

get_serializable_name(obj: ObjItf) → str

Return serializable name of object

serialize_object_to_hdf5(obj: ObjItf, writer: NativeH5Writer) → None

Serialize object to HDF5 file

deserialize_object_from_hdf5(reader: NativeH5Reader, name: str) → ObjItf

Deserialize object from a HDF5 file

abstract serialize_to_hdf5(writer: NativeH5Writer) → None

Serialize whole panel to a HDF5 file

abstract deserialize_from_hdf5(reader: NativeH5Reader) → None

Deserialize whole panel from a HDF5 file

abstract create_object() → ObjItf

Create and return object

abstract add_object(obj: ObjItf) → None

Add object to panel

abstract remove_all_objects()

Remove all objects

class `cdl.core.gui.panel.base.ResultData`(*results: list[ResultShape | ResultProperties] = None, xlabel: list[str] = None, ylabel: list[str] = None*)

Result data associated to a shapetype

`cdl.core.gui.panel.base.create_resultdata_dict`(*objs: list[SignalObj | ImageObj]*) → dict[str, ResultData]

Return result data dictionary

Parameters

objs – List of objects

Returns

keys are result categories, values are ResultData

Return type

Result data dictionary

class `cdl.core.gui.panel.base.PasteMetadataParam`

Paste metadata parameters

keep_roi

Default: True.

Type

`guidata.dataset.dataitems.BoolItem`

keep_resultshapes

Default: False.

Type

`guidata.dataset.dataitems.BoolItem`

keep_annotations

Default: True.

Type

`guidata.dataset.dataitems.BoolItem`

keep_resultproperties

Default: False.

Type

`guidata.dataset.dataitems.BoolItem`

keep_other

Default: True.

Type

`guidata.dataset.dataitems.BoolItem`

classmethod `create`(*keep_roi: bool, keep_resultshapes: bool, keep_annotations: bool, keep_resultproperties: bool, keep_other: bool*) → `cdl.core.gui.panel.base.PasteMetadataParam`

Returns a new instance of `PasteMetadataParam` with the fields set to the given values.

Parameters

- **keep_roi** (*bool*) – Default: True.

- **keep_resultshapes** (*bool*) – Default: False.
- **keep_annotations** (*bool*) – Default: True.
- **keep_resultproperties** (*bool*) – Default: False.
- **keep_other** (*bool*) – Default: True.

Returns

New instance of *PasteMetadataParam*.

class `cdl.core.gui.panel.base.BaseDataPanel`(*parent: QWidget*)

Object handling the item list, the selected item properties and plot

abstract static `get_roieditor_class()` → *Type[TypeROIEditor]*

Return ROI editor class

closeEvent(*event*)

Reimplement QMainWindow method

plot_item_parameters_changed(*item: CurveItem | MaskedImageItem | LabelItem*) → *None*

Plot items changed: update metadata of all objects from plot items

plot_item_moved(*item: LabelItem, x0: float, y0: float, x1: float, y1: float*) → *None*

Plot item moved: update metadata of all objects from plot items

Parameters

- **item** – Plot item
- **x0** – new x0 coordinate
- **y0** – new y0 coordinate
- **x1** – new x1 coordinate
- **y1** – new y1 coordinate

serialize_object_to_hdf5(*obj: TypeObj, writer: NativeH5Writer*) → *None*

Serialize object to HDF5 file

serialize_to_hdf5(*writer: NativeH5Writer*) → *None*

Serialize whole panel to a HDF5 file

deserialize_from_hdf5(*reader: NativeH5Reader*) → *None*

Deserialize whole panel from a HDF5 file

create_object() → *TypeObj*

Create object (signal or image)

Returns

SignalObj or ImageObj object

add_object(*obj: TypeObj, group_id: str | None = None, set_current: bool = True*) → *None*

Add object

Parameters

- **obj** – SignalObj or ImageObj object
- **group_id** – group id
- **set_current** – if True, set the added object as current

remove_all_objects() → *None*

Remove all objects

setup_panel() → *None*

Setup panel

refresh_plot(*what: str, update_items: bool = True, force: bool = False*) → *None*

Refresh plot. This method simply emits the signal SIG_REFRESH_PLOT which is connected to the method *PlotHandler.refresh_plot*.

Parameters

- **what** – string describing the objects to refresh. Valid values are “selected” (refresh the selected objects), “all” (refresh all objects), “existing” (refresh existing plot items), or an object uuid.
- **update_items** – if True, update the items. If False, only show the items (do not update them, except if the option “Use reference item LUT range” is enabled and more than one item is selected). Defaults to True.
- **force** – if True, force refresh even if auto refresh is disabled, and refresh all items associated to objects (even the hidden ones, e.g. when selecting multiple images of the same size and position). Defaults to False.

Raises

ValueError – if *what* is not a valid value

manual_refresh() → *None*

Manual refresh

get_category_actions(*category: ActionCategory*) → *list[QAction]*

Return actions for category

get_context_menu() → *QMenu*

Update and return context menu

add_group(*title: str, select: bool = False*) → *ObjectGroup*

Add group

Parameters

- **title** – group title
- **select** – if True, select the group in the tree view. Defaults to False.

Returns

Created group object

duplicate_object() → *None*

Duplication signal/image object

copy_metadata() → *None*

Copy object metadata

paste_metadata(*param: PasteMetadataParam | None = None*) → *None*

Paste metadata to selected object(s)

remove_object(*force: bool = False*) → *None*

Remove signal/image object

Parameters

force – if True, remove object without confirmation. Defaults to False.

delete_all_objects() → *None*

Confirm before removing all objects

delete_metadata(*refresh_plot: bool = True, keep_roi: bool | None = None*) → *None*

Delete metadata of selected objects

Parameters

- **refresh_plot** – Refresh plot. Defaults to True.
- **keep_roi** – Keep regions of interest, if any. Defaults to None (ask user).

add_annotations_from_items(*items: list, refresh_plot: bool = True*) → *None*

Add object annotations (annotation plot items).

Parameters

- **items** – annotation plot items
- **refresh_plot** – refresh plot. Defaults to True.

update_metadata_view_settings() → *None*

Update metadata view settings

copy_titles_to_clipboard() → *None*

Copy object titles to clipboard (for reproducibility)

new_group() → *None*

Create a new group

rename_selected_object_or_group(*new_name: str | None = None*) → *None*

Rename selected object or group

Parameters

new_name – new name (default: None, i.e. ask user)

abstract get_newparam_from_current(*newparam: NewSignalParam | NewImageParam | None = None*)
→ *NewSignalParam | NewImageParam | None*

Get new object parameters from the current object.

Parameters

newparam – new object parameters. If None, create a new one.

Returns

New object parameters

abstract new_object(*newparam: NewSignalParam | NewImageParam | None = None, addparam: gds.DataSet | None = None, edit: bool = True, add_to_panel: bool = True*) → *TypeObj | None*

Create a new object (signal/image).

Parameters

- **newparam** – new object parameters
- **addparam** – additional parameters
- **edit** – Open a dialog box to edit parameters (default: True)
- **add_to_panel** – Add object to panel (default: True)

Returns

New object

set_current_object_title(*title: str*) → *None*

Set current object title

load_from_directory(*directory: str | None = None*) → *list*[TypeObj]

Open objects from directory (signals or images, depending on the panel), add them to DataLab and return them. If the directory is not specified, ask the user to select a directory.

Parameters

directory – directory name

Returns

list of new objects

load_from_files(*filenames: list[str] | None = None, ignore_unknown: bool = False*) → *list*[TypeObj]

Open objects from file (signals/images), add them to DataLab and return them.

Parameters

- **filenames** – File names
- **ignore_unknown** – if True, ignore unknown file types (default: False)

Returns

list of new objects

save_to_files(*filenames: list[str] | str | None = None*) → *None*

Save selected objects to files (signal/image).

Parameters

filenames – File names

handle_dropped_files(*filenames: list[str] | None = None*) → *None*

Handle dropped files

Parameters

filenames – File names

Returns

None

exec_import_wizard() → *None*

Execute import wizard

import_metadata_from_file(*filename: str | None = None*) → *None*

Import metadata from file (JSON).

Parameters

filename – File name

export_metadata_from_file(*filename: str | None = None*) → *None*

Export metadata to file (JSON).

Parameters

filename – File name

selection_changed(*update_items: bool = False*) → *None*

Object selection changed: update object properties, refresh plot and update object view.

Parameters

update_items – Update plot items (default: False)

properties_changed() → *None*

The properties 'Apply' button was clicked: update object properties, refresh plot and update object view.

add_plot_items_to_dialog(*dlg: PlotDialog, oids: list[str]*) → *None*

Add plot items to dialog

Parameters

- **dlg** – Dialog
- **oids** – Object IDs

open_separate_view(*oids: list[str] | None = None, edit_annotations: bool = False*) → *PlotDialog | None*

Open separate view for visualizing selected objects

Parameters

- **oids** – Object IDs (default: *None*)
- **edit_annotations** – Edit annotations (default: *False*)

Returns

Instance of *PlotDialog*

create_new_dialog(*edit: bool = False, toolbar: bool = True, title: str | None = None, name: str | None = None, options: dict | None = None*) → *PlotDialog | None*

Create new pop-up signal/image plot dialog.

Parameters

- **edit** – Edit mode
- **toolbar** – Show toolbar
- **title** – Dialog title
- **name** – Dialog object name
- **options** – Plot options

Returns

Plot dialog instance

get_roi_editor_output(*extract: bool*) → *tuple[TypeROI, bool] | None*

Get ROI data (array) from specific dialog box.

Parameters

extract – Extract ROI from data

Returns

A tuple containing the ROI object and a boolean indicating whether the dialog was accepted or not.

get_objects_with_dialog(*title: str, comment: str = "", nb_objects: int = 1, parent: QWidget | None = None*) → *TypeObj | None*

Get object with dialog box.

Parameters

- **title** – Dialog title
- **comment** – Optional dialog comment
- **nb_objects** – Number of objects to select

- **parent** – Parent widget

Returns

Object(s) (signal(s) or image(s), or None if dialog was canceled)

add_objprop_buttons() → *None*

Insert additional buttons in object properties panel

show_results() → *None*

Show results

plot_results() → *None*

Plot results

delete_results() → *None*

Delete results

add_label_with_title(*title: str | None = None*) → *None*

Add a label with object title on the associated plot

Parameters

title – Label title. Defaults to None. If None, the title is the object title.

3.8.2 Signal panel

```
class cdl.core.gui.panel.signal.SignalPanel(parent: QW.QWidget, dockableplotwidget:  
                                             DockablePlotWidget, panel_toolbar: QW.QToolBar)
```

Object handling the item list, the selected item properties and plot, specialized for Signal objects

PARAMCLASS

Signal object

uuid

Default: None.

Type

guidata.dataset.dataitems.StringItem

xydata

Default: None.

Type

guidata.dataset.dataitems.FloatArrayItem

metadata

Default: {}.

Type

guidata.dataset.dataitems.DictItem

title

Signal title. Default: 'Untitled'.

Type

guidata.dataset.dataitems.StringItem

xlabel

Title. Default: ''.

Type

guidata.dataset.dataitems.StringItem

xunit

Default: ‘.’.

Type`guidata.dataset.dataitems.StringItem`**ylabel**

Title. Default: ‘.’.

Type`guidata.dataset.dataitems.StringItem`**yunit**

Default: ‘.’.

Type`guidata.dataset.dataitems.StringItem`**autoscale**

Default: True.

Type`guidata.dataset.dataitems.BoolItem`**xscalelog**

Default: False.

Type`guidata.dataset.dataitems.BoolItem`**xscalemin**

Lower bound. Default: None.

Type`guidata.dataset.dataitems.FloatItem`**xscalemax**

Upper bound. Default: None.

Type`guidata.dataset.dataitems.FloatItem`**yscalelog**

Default: False.

Type`guidata.dataset.dataitems.BoolItem`**yscalemin**

Lower bound. Default: None.

Type`guidata.dataset.dataitems.FloatItem`**yscalemax**

Upper bound. Default: None.

Type`guidata.dataset.dataitems.FloatItem`alias of `SignalObj`

classmethod `PARAMCLASS.create`(*uuid*: *str*, *xydata*: *numpy.ndarray*, *metadata*: *dict*, *title*: *str*, *xlabel*: *str*, *xunit*: *str*, *ylabel*: *str*, *yunit*: *str*, *autoscale*: *bool*, *xscalelog*: *bool*, *xscalemin*: *float*, *xscalemax*: *float*, *yscalelog*: *bool*, *yscalemin*: *float*, *yscalemax*: *float*) → `cdl.core.model.signal.SignalObj`

Returns a new instance of `SignalObj` with the fields set to the given values.

Parameters

- **uuid** (*str*) – Default: None.
- **xydata** (*numpy.ndarray*) – Default: None.
- **metadata** (*dict*) – Default: {}.
- **title** (*str*) – Signal title. Default: 'Untitled'.
- **xlabel** (*str*) – Title. Default: ''.
- **xunit** (*str*) – Default: ''.
- **ylabel** (*str*) – Title. Default: ''.
- **yunit** (*str*) – Default: ''.
- **autoscale** (*bool*) – Default: True.
- **xscalelog** (*bool*) – Default: False.
- **xscalemmin** (*float*) – Lower bound. Default: None.
- **xscalemmax** (*float*) – Upper bound. Default: None.
- **yscalelog** (*bool*) – Default: False.
- **yscalemmin** (*float*) – Lower bound. Default: None.
- **yscalemmax** (*float*) – Upper bound. Default: None.

Returns

New instance of SignalObj.

IO_REGISTRY

alias of SignalIORegistry

static get_roieditor_class() → *Type[SignalROIEditor]*

Return ROI editor class

get_newparam_from_current (*newparam: NewSignalParam | None = None, title: str | None = None*) → *NewSignalParam | None*

Get new object parameters from the current object.

Parameters

- **newparam** (*guidata.dataset.DataSet*) – new object parameters. If None, create a new one.
- **title** – new object title. If None, use the current object title, or the default title.

Returns

New object parameters

new_object (*newparam: NewSignalParam | None = None, addparam: gds.DataSet | None = None, edit: bool = True, add_to_panel: bool = True*) → *SignalObj | None*

Create a new object (signal).

Parameters

- **newparam** (*guidata.dataset.DataSet*) – new object parameters
- **addparam** (*guidata.dataset.DataSet*) – additional parameters
- **edit** (*bool*) – Open a dialog box to edit parameters (default: True)

- **add_to_panel** (*bool*) – Add the new object to the panel (default: True)

Returns

New object

toggle_anti_aliasing(*state: bool*) → None

Toggle anti-aliasing on/off

Parameters**state** – state of the anti-aliasing**reset_curve_styles**() → None

Reset curve styles

3.8.3 Image panel

class `cdl.core.gui.panel.image.ImagePanel`(*parent: QW.QWidget, dockableplotwidget: DockablePlotWidget, panel_toolbar: QW.QToolBar*)

Object handling the item list, the selected item properties and plot, specialized for Image objects

PARAMCLASS

Image object

uuid

Default: None.

Type`guidata.dataset.dataitems.StringItem`**data**

Default: None.

Type`guidata.dataset.dataitems.FloatArrayItem`**metadata**

Default: {}.

Type`guidata.dataset.dataitems.DictItem`**x0**X₀. Default: 0.0.**Type**`guidata.dataset.dataitems.FloatItem`**y0**Y₀. Default: 0.0.**Type**`guidata.dataset.dataitems.FloatItem`**dx**

x. Float, non zero. Default: 1.0.

Type`guidata.dataset.dataitems.FloatItem`**dy**

y. Float, non zero. Default: 1.0.

Type`guidata.dataset.dataitems.FloatItem`**title**

Image title. Default: 'Untitled'.

Type`guidata.dataset.dataitems.StringItem`**xlabel**

Title. Default: ''.

Type`guidata.dataset.dataitems.StringItem`**xunit**

Default: ''.

Type`guidata.dataset.dataitems.StringItem`**ylabel**

Title. Default: ''.

Type`guidata.dataset.dataitems.StringItem`**yunit**

Default: ''.

Type`guidata.dataset.dataitems.StringItem`**zlabel**

Title. Default: ''.

Type`guidata.dataset.dataitems.StringItem`**zunit**

Default: ''.

Type`guidata.dataset.dataitems.StringItem`**autoscale**

Default: True.

Type`guidata.dataset.dataitems.BoolItem`**xscalelog**

Default: False.

Type`guidata.dataset.dataitems.BoolItem`**xscalemin**

Lower bound. Default: None.

Type`guidata.dataset.dataitems.FloatItem`**xscalemax**

Upper bound. Default: None.

Type`guidata.dataset.dataitems.FloatItem`

yscalelog

Default: False.

Type

`guidata.dataset.dataitems.BoolItem`

yscalemin

Lower bound. Default: None.

Type

`guidata.dataset.dataitems.FloatItem`

yscalemax

Upper bound. Default: None.

Type

`guidata.dataset.dataitems.FloatItem`

zscalemin

Lower bound. Default: None.

Type

`guidata.dataset.dataitems.FloatItem`

zscalemax

Upper bound. Default: None.

Type

`guidata.dataset.dataitems.FloatItem`

alias of `ImageObj`

classmethod `PARAMCLASS.create`(*uuid*: *str*, *data*: *numpy.ndarray*, *metadata*: *dict*, *x0*: *float*, *y0*: *float*, *dx*: *float*, *dy*: *float*, *title*: *str*, *xlabel*: *str*, *xunit*: *str*, *ylabel*: *str*, *yunit*: *str*, *zlabel*: *str*, *zunit*: *str*, *autoscale*: *bool*, *yscalelog*: *bool*, *yscalemin*: *float*, *yscalemax*: *float*, *yscalelog*: *bool*, *yscalemin*: *float*, *yscalemax*: *float*, *zscalemin*: *float*, *zscalemax*: *float*) → `cdl.core.model.image.ImageObj`

Returns a new instance of `ImageObj` with the fields set to the given values.

Parameters

- **uuid** (*str*) – Default: None.
- **data** (*numpy.ndarray*) – Default: None.
- **metadata** (*dict*) – Default: {}.
- **x0** (*float*) – X_0 . Default: 0.0.
- **y0** (*float*) – Y_0 . Default: 0.0.
- **dx** (*float*) – x . Float, non zero. Default: 1.0.
- **dy** (*float*) – y . Float, non zero. Default: 1.0.
- **title** (*str*) – Image title. Default: 'Untitled'.
- **xlabel** (*str*) – Title. Default: ''.
- **xunit** (*str*) – Default: ''.
- **ylabel** (*str*) – Title. Default: ''.
- **yunit** (*str*) – Default: ''.
- **zlabel** (*str*) – Title. Default: ''.

- **zunit** (*str*) – Default: ‘’.
- **autoscale** (*bool*) – Default: True.
- **xscaleg** (*bool*) – Default: False.
- **xscalegmin** (*float*) – Lower bound. Default: None.
- **xscalegmax** (*float*) – Upper bound. Default: None.
- **yscaleg** (*bool*) – Default: False.
- **yscalegmin** (*float*) – Lower bound. Default: None.
- **yscalegmax** (*float*) – Upper bound. Default: None.
- **zscalegmin** (*float*) – Lower bound. Default: None.
- **zscalegmax** (*float*) – Upper bound. Default: None.

Returns

New instance of ImageObj.

IO_REGISTRY

alias of ImageIORegistry

static get_roieditor_class() → *Type[ImageROIEditor]*

Return ROI editor class

plot_lut_changed(*plot: BasePlot*) → *None*

The LUT of the plot has changed: updating image objects accordingly

Parameters

plot – Plot object

get_newparam_from_current(*newparam: NewImageParam | None = None, title: str | None = None*) → *NewImageParam | None*

Get new object parameters from the current object.

Parameters

- **newparam** (*guidata.dataset.DataSet*) – new object parameters. If None, create a new one.
- **title** – new object title. If None, use the current object title, or the default title.

Returns

New object parameters

new_object(*newparam: NewImageParam | None = None, addparam: gds.DataSet | None = None, edit: bool = True, add_to_panel: bool = True*) → *ImageObj | None*

Create a new object (image).

Parameters

- **newparam** (*Daguidata.dataset.datatypes.DataSettaSet*) – new object parameters
- **addparam** (*guidata.dataset.DataSet*) – additional parameters
- **edit** (*bool*) – Open a dialog box to edit parameters (default: True)
- **add_to_panel** (*bool*) – Add the object to the panel (default: True)

Returns

New object

toggle_show_contrast(*state: bool*) → *None*

Toggle show contrast option

3.8.4 Macro panel

class `cdl.core.gui.panel.macro.MacroTabs`(*parent=None*)

Macro tabwidget

Parameters

parent (*QWidget*) – Parent widget

clear() → *None*

Override Qt method

contextMenuEvent(*event*)

Override Qt method

add_tab(*macro: Macro*) → *int*

Add tab

Parameters

macro – Macro object

Returns

Number of the tab (starting at 1)

Return type

int

remove_tab(*number: int*) → *None*

Remove tab

Parameters

number – Number of the tab (starting at 1)

get_widget(*number: int*) → *CodeEditor*

Return macro editor widget at number

Parameters

number – Number of the tab (starting at 1)

Returns

Macro editor widget

set_current_number(*number: int*) → *None*

Set current tab number

Parameters

number – Number of the tab (starting at 1)

get_current_number() → *int*

Return current tab number

Returns

Number of the tab (starting at 1)

Return type

int

set_tab_title(*number: int, name: str*) → *None*

Set tab title

Parameters

- **number** – Number of the tab (starting at 1)
- **name** – Macro name

class `cdl.core.gui.panel.macro.MacroPanel`(*parent: QWidget | None = None*)

Macro Panel widget

Parameters

parent (*QWidget*) – Parent widget

update_color_mode() → *None*

Update color mode according to the current theme

get_serializable_name(*obj: Macro*) → *str*

Return serializable name of object

serialize_to_hdf5(*writer: NativeH5Writer*) → *None*

Serialize whole panel to a HDF5 file

Parameters

writer – HDF5 writer

deserialize_from_hdf5(*reader: NativeH5Reader*) → *None*

Deserialize whole panel from a HDF5 file

Parameters

reader – HDF5 reader

create_object() → *Macro*

Create object.

Returns

Macro object

add_object(*obj: Macro*) → *None*

Add object.

Parameters

obj – Macro object

remove_all_objects() → *None*

Remove all objects

setup_actions() → *None*

Setup macro menu actions

get_macro(*number_or_title: int | str | None = None*) → *Macro | None*

Return macro at number (if number is None, return current macro)

Parameters

number – Number of the macro (starting at 1) or title of the macro. Defaults to None (current macro).

Returns

Macro object or None (if not found)

get_number_from_title(*title: str*) → int | None

Return macro number from title

Parameters

title – Title of the macro

Returns

Number of the macro (starting at 1) or None (if not found)

get_number_from_macro(*macro: Macro*) → int | None

Return macro number from macro object

Parameters

macro – Macro object

Returns

Number of the macro (starting at 1) or None (if not found)

get_macro_titles() → list[str]

Return list of macro titles

macro_contents_changed() → None

One of the macro contents has changed

run_macro(*number_or_title: int | str | None = None*) → None

Run current macro

Parameters

number – Number of the macro (starting at 1). Defaults to None (run current macro, or does nothing if there is no macro).

stop_macro(*number_or_title: int | str | None = None*) → None

Stop current macro

Parameters

number – Number of the macro (starting at 1). Defaults to None (run current macro, or does nothing if there is no macro).

macro_state_changed(*orig_macro: Macro, state: bool*) → None

Macro state has changed (True: started, False: stopped)

Parameters

- **orig_macro** – Macro object
- **state** – State of the macro

add_macro() → Macro

Add macro, optionally with name

Returns

Macro object

macro_name_changed(*name: str*) → None

Macro name has been changed

Parameters

name – New name of the macro

rename_macro(*number*: *int* | *None* = *None*, *title*: *str* | *None* = *None*) → *None*

Rename macro

Parameters

- **number** – Number of the macro (starting at 1). Defaults to *None*.
- **title** – Title of the macro. Defaults to *None*.

export_macro_to_file(*number_or_title*: *int* | *str* | *None* = *None*, *filename*: *str* | *None* = *None*) → *None*

Export macro to file

Parameters

- **number_or_title** – Number of the macro (starting at 1) or title of the macro. Defaults to *None*.
- **filename** – Filename. Defaults to *None*.

Raises

ValueError – If title is not found

import_macro_from_file(*filename*: *str* | *None* = *None*) → *int*

Import macro from file

Parameters

filename – Filename. Defaults to *None*.

Returns

Number of the macro (starting at 1)

remove_macro(*number_or_title*: *int* | *str* | *None* = *None*) → *None*

Remove macro

Parameters

number_or_title – Number of the macro (starting at 1) or title of the macro. Defaults to *None*.

3.9 Action handler

The `cdl.core.gui.actionhandler` module handles all application actions (menus, toolbars, context menu). These actions point to DataLab panels, processors, objecthandler, ...

3.9.1 Utility classes

class `cdl.core.gui.actionhandler.SelectCond`

Signal or image select conditions

static **always**(*selected_groups*: *list*[*ObjectGroup*], *selected_objects*: *list*[*SignalObj* | *ImageObj*]) → *bool*

Always true

static **exactly_one**(*selected_groups*: *list*[*ObjectGroup*], *selected_objects*: *list*[*SignalObj* | *ImageObj*])
→ *bool*

Exactly one signal or image is selected

```
static exactly_one_group(selected_groups: list[ObjectGroup], selected_objects: list[SignalObj | ImageObj]) → bool
```

Exactly one group is selected

```
static exactly_one_group_or_one_object(selected_groups: list[ObjectGroup], selected_objects: list[SignalObj | ImageObj]) → bool
```

Exactly one group or one signal or image is selected

```
static at_least_one_group_or_one_object(sel_groups: list[ObjectGroup], sel_objects: list[SignalObj | ImageObj]) → bool
```

At least one group or one signal or image is selected

```
static at_least_one(sel_groups: list[ObjectGroup], sel_objects: list[SignalObj | ImageObj]) → bool
```

At least one signal or image is selected

```
static at_least_two(sel_groups: list[ObjectGroup], sel_objects: list[SignalObj | ImageObj]) → bool
```

At least two signals or images are selected

```
static with_roi(selected_groups: list[ObjectGroup], selected_objects: list[SignalObj | ImageObj]) → bool
```

At least one signal or image has a ROI

```
class cdl.core.gui.actionhandler.ActionCategory(value, names=None, *, module=None, qualname=None, type=None, start=1, boundary=None)
```

Action categories

3.9.2 Handler classes

```
class cdl.core.gui.actionhandler.SignalActionHandler(panel: SignalPanel | ImagePanel, panel_toolbar: QW.QToolBar, view_toolbar: QW.QToolBar)
```

Object handling signal panel GUI interactions: actions, menus, ...

```
create_first_actions()
```

Create actions that are added to the menus in the first place

```
create_last_actions()
```

Create actions that are added to the menus in the end

```
add_action(action: QAction, select_condition: Callable | None = None) → None
```

Add action to list of actions.

Parameters

- **action** – action to add
- **select_condition** – condition to enable action. Defaults to None. If None, action is enabled if at least one object is selected.

```
add_to_action_list(action: QAction, category: ActionCategory | None = None, pos: int | None = None, sep: bool = False) → None
```

Add action to list of actions.

Parameters

- **action** – action to add

- **category** – action category. Defaults to None. If None, action is added to the current category.
- **pos** – add action to menu at this position. Defaults to None. If None, action is added at the end of the list.
- **sep** – add separator before action in menu (or after if pos is positive). Defaults to False.

create_all_actions()

Create all actions

new_action(title: *str*, position: *int* | *None* = *None*, separator: *bool* = *False*, triggered: *Callable* | *None* = *None*, toggled: *Callable* | *None* = *None*, shortcut: *QShortcut* | *None* = *None*, icon_name: *str* | *None* = *None*, tip: *str* | *None* = *None*, select_condition: *Callable* | *str* | *None* = *None*, context_menu_pos: *int* | *None* = *None*, context_menu_sep: *bool* = *False*, toolbar_pos: *int* | *None* = *None*, toolbar_sep: *bool* = *False*, toolbar_category: *ActionCategory* | *None* = *None*) → *QAction*

Create new action and add it to list of actions.

Parameters

- **title** – action title
- **position** – add action to menu at this position. Defaults to None.
- **separator** – add separator before action in menu (or after if pos is positive). Defaults to False.
- **triggered** – triggered callback. Defaults to None.
- **toggled** – toggled callback. Defaults to None.
- **shortcut** – shortcut. Defaults to None.
- **icon_name** – icon name. Defaults to None.
- **tip** – tooltip. Defaults to None.
- **select_condition** – selection condition. Defaults to None. If str, must be the name of a method of SelectCond, i.e. one of “always”, “exactly_one”, “exactly_one_group”, “at_least_one_group_or_one_object”, “at_least_one”, “at_least_two”, “with_roi”.
- **context_menu_pos** – add action to context menu at this position. Defaults to None.
- **context_menu_sep** – add separator before action in context menu (or after if context_menu_pos is positive). Defaults to False.
- **toolbar_pos** – add action to toolbar at this position. Defaults to None.
- **toolbar_sep** – add separator before action in toolbar (or after if toolbar_pos is positive). Defaults to False.
- **toolbar_category** – toolbar category. Defaults to None. If toolbar_pos is not None, this specifies the category of the toolbar. If None, defaults to ActionCategory.VIEW_TOOLBAR if the current category is ActionCategory.VIEW, else to ActionCategory.PANEL_TOOLBAR.

Returns

New action

new_category(category: *ActionCategory*) → *Generator*[*None*, *None*, *None*]

Context manager for creating a new menu.

Parameters**category** – Action category**Yields**

None

new_menu(*title: str, icon_name: str | None = None*) → Generator[None, None, None]

Context manager for creating a new menu.

Parameters

- **title** – Menu title
- **icon_name** – Menu icon name. Defaults to None.

Yields

None

selected_objects_changed(*selected_groups: list[ObjectGroup], selected_objects: list[SignalObj | ImageObj]*) → None

Update actions based on selected objects.

Parameters

- **selected_groups** – selected groups
- **selected_objects** – selected objects

```
class cdl.core.gui.actionhandler.ImageActionHandler(panel: SignalPanel | ImagePanel, panel_toolbar: QW.QToolBar, view_toolbar: QW.QToolBar)
```

Object handling image panel GUI interactions: actions, menus, ...

create_first_actions()

Create actions that are added to the menus in the first place

create_last_actions()

Create actions that are added to the menus in the end

add_action(*action: QAction, select_condition: Callable | None = None*) → None

Add action to list of actions.

Parameters

- **action** – action to add
- **select_condition** – condition to enable action. Defaults to None. If None, action is enabled if at least one object is selected.

```
add_to_action_list(action: QAction, category: ActionCategory | None = None, pos: int | None = None, sep: bool = False) → None
```

Add action to list of actions.

Parameters

- **action** – action to add
- **category** – action category. Defaults to None. If None, action is added to the current category.
- **pos** – add action to menu at this position. Defaults to None. If None, action is added at the end of the list.
- **sep** – add separator before action in menu (or after if pos is positive). Defaults to False.

create_all_actions()

Create all actions

new_action(title: *str*, position: *int* | *None* = *None*, separator: *bool* = *False*, triggered: *Callable* | *None* = *None*, toggled: *Callable* | *None* = *None*, shortcut: *QShortcut* | *None* = *None*, icon_name: *str* | *None* = *None*, tip: *str* | *None* = *None*, select_condition: *Callable* | *str* | *None* = *None*, context_menu_pos: *int* | *None* = *None*, context_menu_sep: *bool* = *False*, toolbar_pos: *int* | *None* = *None*, toolbar_sep: *bool* = *False*, toolbar_category: *ActionCategory* | *None* = *None*) → *QAction*

Create new action and add it to list of actions.

Parameters

- **title** – action title
- **position** – add action to menu at this position. Defaults to *None*.
- **separator** – add separator before action in menu (or after if pos is positive). Defaults to *False*.
- **triggered** – triggered callback. Defaults to *None*.
- **toggled** – toggled callback. Defaults to *None*.
- **shortcut** – shortcut. Defaults to *None*.
- **icon_name** – icon name. Defaults to *None*.
- **tip** – tooltip. Defaults to *None*.
- **select_condition** – selection condition. Defaults to *None*. If *str*, must be the name of a method of *SelectCond*, i.e. one of “always”, “exactly_one”, “exactly_one_group”, “at_least_one_group_or_one_object”, “at_least_one”, “at_least_two”, “with_roi”.
- **context_menu_pos** – add action to context menu at this position. Defaults to *None*.
- **context_menu_sep** – add separator before action in context menu (or after if context_menu_pos is positive). Defaults to *False*.
- **toolbar_pos** – add action to toolbar at this position. Defaults to *None*.
- **toolbar_sep** – add separator before action in toolbar (or after if toolbar_pos is positive). Defaults to *False*.
- **toolbar_category** – toolbar category. Defaults to *None*. If toolbar_pos is not *None*, this specifies the category of the toolbar. If *None*, defaults to *ActionCategory.VIEW_TOOLBAR* if the current category is *ActionCategory.VIEW*, else to *ActionCategory.PANEL_TOOLBAR*.

Returns

New action

new_category(category: *ActionCategory*) → *Generator*[*None*, *None*, *None*]

Context manager for creating a new menu.

Parameters

category – Action category

Yields

None

new_menu(title: *str*, icon_name: *str* | *None* = *None*) → *Generator*[*None*, *None*, *None*]

Context manager for creating a new menu.

Parameters

- **title** – Menu title
- **icon_name** – Menu icon name. Defaults to None.

Yields

None

selected_objects_changed(*selected_groups*: *list*[*ObjectGroup*], *selected_objects*: *list*[*SignalObj* | *ImageObj*]) → None

Update actions based on selected objects.

Parameters

- **selected_groups** – selected groups
- **selected_objects** – selected objects

3.10 Object view

The `cdl.core.gui.objectview` module provides widgets to display object (signal/image) trees.

Note: This module provides tree widgets to display signals, images and groups. It is important to note that, by design, the user can only select either individual signals/images or groups, but not both at the same time. This is an important design choice, as it allows to simplify the user experience, and to avoid potential confusion between the two types of selection.

3.10.1 Simple object tree

class `cdl.core.gui.objectview.SimpleObjectTree`(*parent*: *QW.QWidget*, *objmodel*: *ObjectModel*)

Base object handling panel list widget, object (sig/ima) lists

initialize_from(*sobjlist*: *SimpleObjectTree*) → None

Init from another SimpleObjectList, without making copies of objects

iter_items(*item*: *QTreeWidgetItem* | None = None) → *Iterator*[*QTreeWidgetItem*]

Recursively iterate over all items

get_item_from_id(*item_id*) → *QTreeWidgetItem*

Return *QTreeWidgetItem* from id (stored in item's data)

get_current_item_id(*object_only*: *bool* = False) → *str* | None

Return current item id

set_current_item_id(*uuid*: *str*, *extend*: *bool* = False) → None

Set current item by id

get_current_group_id() → *str*

Return current group ID

get_sel_group_items() → *list*[*QTreeWidgetItem*]

Return selected group items

get_sel_group_uuids() → list[str]

Return selected group uuids

get_sel_object_items() → list[QTreeWidgetItem]

Return selected object items

get_sel_object_uuids(include_groups: bool = False) → list[str]

Return selected objects uuids.

Parameters

include_groups – If True, also return objects from selected groups.

Returns

List of selected objects uuids.

get_sel_objects(include_groups: bool = False) → list[SignalObj | ImageObj]

Return selected objects.

If include_groups is True, also return objects from selected groups.

get_sel_groups() → list[ObjectGroup]

Return selected groups

populate_tree() → None

Populate tree with objects

update_tree() → None

Update tree

add_group_item(group: ObjectGroup) → None

Add group item

add_object_item(obj: SignalObj | ImageObj, group_id: str, set_current: bool = True) → None

Add item

update_item(uuid: str) → None

Update item

remove_item(oid: str, refresh: bool = True) → None

Remove item

item_double_clicked(item: QTreeWidgetItem) → None

Item was double-clicked: open a pop-up plot dialog

contextMenuEvent(event: QContextMenuEvent) → None

Override Qt method

3.10.2 Get object dialog

```
class cdl.core.gui.objectview.GetObjectsDialog(parent: QW.QWidget, panel: BaseDataPanel, title: str,
                                              comment: str = "", nb_objects: int = 1, minimum_size:
                                              tuple[int, int] | None = None)
```

Dialog box showing groups and objects (signals or images) to select one, or more.

Parameters

- **parent** – parent widget
- **panel** – data panel

- **title** – dialog title
- **comment** – optional dialog comment
- **nb_objects** – number of objects to select (default: 1)
- **minimum_size** – minimum size (width, height)

get_selected_objects() → list[*SignalObj* | *ImageObj*]

Return selected objects

3.10.3 Object view

class `cdl.core.gui.objectview.ObjectView`(parent: *QW.QWidget*, objmodel: *ObjectModel*)

Object handling panel list widget, object (sig/ima) lists

paintEvent(event)

Reimplement Qt method

dragEnterEvent(event: *QDragEnterEvent*) → None

Reimplement Qt method

dragLeaveEvent(event: *QDragLeaveEvent*) → None

Reimplement Qt method

dragMoveEvent(event: *QDragMoveEvent*) → None

Reimplement Qt method

get_all_group_uuids() → list[str]

Return all group uuids, in a list ordered by group position in the tree

get_all_object_uuids() → dict[str, list[str]]

Return all object uuids, in a dictionary that maps group uuids to the list of object uuids in each group, in the correct order

dropEvent(event: *QDropEvent*) → None

Reimplement Qt method

get_current_object() → *SignalObj* | *ImageObj* | None

Return current object

set_current_object(obj: *SignalObj* | *ImageObj*) → None

Set current object

item_selection_changed() → None

Refreshing the selection of objects and groups, emitting the SIG_SELECTION_CHANGED signal which triggers the update of the object properties panel, the plot items and the actions of the toolbar and menu bar.

This method is called when the user selects or deselects items in the tree. It is also called when the user clicks on an item that was already selected.

This method emits the SIG_SELECTION_CHANGED signal.

select_objects(selection: list[*SignalObj* | *ImageObj* | int | str]) → None

Select multiple objects

Parameters

selection – list of objects, object numbers (1 to N) or object uuids

select_groups(groups: *list*[ObjectGroup | int | str] | None = None) → None

Select multiple groups

Parameters

groups – list of groups, group numbers (1 to N), group names or None (select all groups). Defaults to None.

move_up()

Move selected objects/groups up

move_down()

Move selected objects/groups down

3.11 Plot handler

The `cdl.core.gui.plothandler` module provides plot handlers for signal and image panels, that is, classes handling PlotPy plot items for representing signals and images.

3.11.1 Signal plot handler

class `cdl.core.gui.plothandler.SignalPlotHandler`(panel: BaseDataPanel, plotwidget: PlotWidget)

Object handling signal plot items, plot dialogs, plot options

toggle_anti_aliasing(state: bool) → None

Toggle anti-aliasing

Parameters

state – if True, enable anti-aliasing

get_current_plot_options() → PlotOptions

Return standard signal/image plot options

add_shapes(oid: str, do_autoscale: bool = False) → None

Add geometric shape items associated to computed results and annotations, for the object with the given uuid

cleanup_dataview() → None

Clean up data view

clear() → None

Clear plot items

get(key: str, default: TypePlotItem | None = None) → TypePlotItem | None

Return item associated to object uuid. If the key is not found, default is returned if given, otherwise None is returned.

get_obj_from_item(item: TypePlotItem) → TypeObj | None

Return object associated to plot item

Parameters

item – plot item

Returns

Object associated to plot item

reduce_shown_oids(oids: list[str]) → list[str]

Reduce the number of shown objects to visible items only. The base implementation is to show only the first selected item if the option “Show first only” is enabled.

Parameters

oids – list of object uuids

Returns

Reduced list of object uuids

refresh_plot(what: str, update_items: bool = True, force: bool = False) → None

Refresh plot.

Parameters

- **what** – string describing the objects to refresh. Valid values are “selected” (refresh the selected objects), “all” (refresh all objects), “existing” (refresh existing plot items), or an object uuid.
- **update_items** – if True, update the items. If False, only show the items (do not update them, except if the option “Use reference item LUT range” is enabled and more than one item is selected). Defaults to True.
- **force** – if True, force refresh even if auto refresh is disabled, and refresh all items associated to objects (even the hidden ones, e.g. when selecting multiple images of the same size and position). Defaults to False.

Raises

ValueError – if *what* is not a valid value

remove_all_shape_items() → None

Remove all geometric shapes associated to result items

remove_item(oid: str) → None

Remove plot item associated to object uuid

set_auto_refresh(auto_refresh: bool) → None

Set auto refresh mode.

Parameters

auto_refresh – if True, refresh plot items automatically

set_show_first_only(show_first_only: bool) → None

Set show first only mode.

Parameters

show_first_only – if True, show only the first selected item

static update_item_according_to_ref_item(item: TypePlotItem, ref_item: TypePlotItem) → None

Update plot item according to reference item

update_resultproperty_from_plot_item(item: LabelItem) → None

Update result property from plot item

3.11.2 Image plot handler

class `cdl.core.gui.plothandler.ImagePlotHandler`(*panel*: `BaseDataPanel`, *plotwidget*: `PlotWidget`)

Object handling image plot items, plot dialogs, plot options

static `update_item_according_to_ref_item`(*item*: `MaskedImageItem`, *ref_item*: `MaskedImageItem`)
→ `None`

Update plot item according to reference item

reduce_shown_oids(*oids*: `list[str]`) → `list[str]`

Reduce the number of shown objects to visible items only. The base implementation is to show only the first selected item if the option “Show first only” is enabled.

Parameters

oids – list of object uuids

Returns

Reduced list of object uuids

refresh_plot(*what*: `str`, *update_items*: `bool = True`, *force*: `bool = False`) → `None`

Refresh plot.

Parameters

- **what** – string describing the objects to refresh. Valid values are “selected” (refresh the selected objects), “all” (refresh all objects), “existing” (refresh existing plot items), or an object uuid.
- **update_items** – if True, update the items. If False, only show the items (do not update them, except if the option “Use reference item LUT range” is enabled and more than one item is selected). Defaults to True.
- **force** – if True, force refresh even if auto refresh is disabled, and refresh all items associated to objects (even the hidden ones, e.g. when selecting multiple images of the same size and position). Defaults to False.

Raises

ValueError – if *what* is not a valid value

cleanup_dataview() → `None`

Clean up data view

get_current_plot_options() → `PlotOptions`

Return standard signal/image plot options

add_shapes(*oid*: `str`, *do_autoscale*: `bool = False`) → `None`

Add geometric shape items associated to computed results and annotations, for the object with the given uuid

clear() → `None`

Clear plot items

get(*key*: `str`, *default*: `TypePlotItem | None = None`) → `TypePlotItem | None`

Return item associated to object uuid. If the key is not found, default is returned if given, otherwise None is returned.

get_obj_from_item(*item*: `TypePlotItem`) → `TypeObj | None`

Return object associated to plot item

Parameters**item** – plot item**Returns**

Object associated to plot item

remove_all_shape_items() → *None*

Remove all geometric shapes associated to result items

remove_item(oid: str) → *None*

Remove plot item associated to object uuid

set_auto_refresh(auto_refresh: bool) → *None*

Set auto refresh mode.

Parameters**auto_refresh** – if True, refresh plot items automatically**set_show_first_only(show_first_only: bool)** → *None*

Set show first only mode.

Parameters**show_first_only** – if True, show only the first selected item**update_resultproperty_from_plot_item(item: LabelItem)** → *None*

Update result property from plot item

3.12 ROI editor

The `cdl.core.gui.roieditor` module provides the ROI editor widgets for signals and images.

3.12.1 Signal ROI editor

class `cdl.core.gui.roieditor.SignalROIEditor`(parent: *PlotDialog*, obj: *TypeObj*, extract: *bool*, item: *TypePlotItem* | *None* = *None*)

Signal ROI Editor

get_obj_roi_class() → *type[SignalROI]*

Get object ROI class

add_tools_to_plot_dialog() → *None*

Add tools to plot dialog

manually_add_roi() → *None*

Manually add segment ROI

create_coordinate_based_roi_actions() → *list[QAction]*

Create coordinate-based ROI actions

setup_widget() → *None*

Setup ROI editor widget

update_roi_titles()

Update ROI annotation titles

3.12.2 Image ROI editor

class `cdl.core.gui.roieditor.ImageROIEditor`(parent: *PlotDialog*, obj: *TypeObj*, extract: *bool*, item: *TypePlotItem* | *None* = *None*)

Image ROI Editor

get_obj_roi_class() → *type[ImageROI]*

Get object ROI class

add_tools_to_plot_dialog() → *None*

Add tools to plot dialog

manually_add_roi(roi_type: *Literal*['rectangle', 'circle', 'polygon']) → *None*

Manually add image ROI

create_coordinate_based_roi_actions() → *list[QAction]*

Create coordinate-based ROI actions

setup_widget() → *None*

Setup ROI editor widget

update_roi_titles() → *None*

Update ROI annotation titles

3.13 Processor

The `cdl.core.gui.processor` package provides the **processor objects** for signals and images.

Processor objects are the bridge between the computation modules (in `cdl.computation`) and the GUI modules (in `cdl.core.gui`). They are used to call the computation functions and to update the GUI from inside the data panel objects.

When implementing a processing feature in DataLab, the steps are usually the following:

- Add an action in the `cdl.core.gui.actionhandler` module to trigger the processing feature from the GUI (e.g. a menu item or a toolbar button).
- Implement the computation function in the `cdl.computation` module (that would eventually call the algorithm from the `cdl.algorithms` module).
- Implement the processor object method in this package to call the computation function and eventually update the GUI.

The processor objects are organized in submodules according to their purpose.

The following submodules are available:

- `cdl.core.gui.processor.base`: Common processing features
- `cdl.core.gui.processor.signal`: Signal processing features
- `cdl.core.gui.processor.image`: Image processing features

3.13.1 Common features

class `cdl.core.gui.processor.base.Worker`

Multiprocessing worker, to run long-running tasks in a separate process

static `create_pool()` → `None`

Create multiprocessing pool

static `terminate_pool(wait: bool = False)` → `None`

Terminate multiprocessing pool.

Parameters

wait – wait for all tasks to finish. Defaults to False.

restart_pool() → `None`

Terminate and recreate the pool

run(*func: Callable, args: tuple[Any]*) → `None`

Run computation.

Parameters

- **func** – function to run
- **args** – arguments

close() → `None`

Close worker: close pool properly and wait for all tasks to finish

is_computation_finished() → `bool`

Return True if computation is finished.

Returns

True if computation is finished

Return type

`bool`

get_result() → `CompOut`

Return computation result.

Returns

computation result

Return type

`CompOut`

`cdl.core.gui.processor.base.is_pairwise_mode()` → `bool`

Return True if operation mode is pairwise.

Returns

True if operation mode is pairwise

Return type

`bool`

class `cdl.core.gui.processor.base.BaseProcessor`(*panel: SignalPanel | ImagePanel, plotwidget: PlotWidget*)

Object handling data processing: operations, processing, analysis.

Parameters

- **panel** – panel
- **plotwidget** – plot widget

close()

Close processor properly

set_process_isolation_enabled(*enabled: bool*) → *None*

Set process isolation enabled.

Parameters

enabled – enabled

has_param_defaults(*paramclass: type[DataSet]*) → *bool*

Return True if parameter defaults are available.

Parameters

paramclass – parameter class

Returns

True if parameter defaults are available

Return type

bool

update_param_defaults(*param: DataSet*) → *None*

Update parameter defaults.

Parameters

param – parameters

init_param(*param: DataSet, paramclass: type[DataSet], title: str, comment: str | None = None*) → *tuple[bool, DataSet]*

Initialize processing parameters.

Parameters

- **param** – parameter
- **paramclass** – parameter class
- **title** – title
- **comment** – comment

Returns

Tuple (edit, param) where edit is True if parameters have been edited, False otherwise.

compute_11(*func: Callable, param: DataSet | None = None, paramclass: DataSet | None = None, title: str | None = None, comment: str | None = None, edit: bool | None = None*) → *None*

Compute 11 function: 1 object in → 1 object out.

Parameters

- **func** – function
- **param** – parameter
- **paramclass** – parameter class
- **title** – title
- **comment** – comment
- **edit** – edit parameters

compute_1n(*funcs*: *list*[*Callable*] | *Callable*, *params*: *list* | *None* = *None*, *title*: *str* | *None* = *None*, *edit*: *bool* | *None* = *None*) → *None*

Compute 1n function: 1 object in → n objects out.

Parameters

- **funcs** – list of functions
- **params** – list of parameters
- **title** – title
- **edit** – edit parameters

handle_output(*compout*: *CompOut*, *context*: *str*, *progress*: *QW.QProgressDialog*) → *SignalObj* | *ImageObj* | *ResultShape* | *ResultProperties* | *None*

Handle computation output: if error, display error message, if warning, display warning message.

Parameters

- **compout** – computation output
- **context** – context (e.g. “Computing: Gaussian filter”)
- **progress** – progress dialog

Returns

a signal or image object, or a result shape object,
or None if error

Return type

Output object

compute_10(*func*: *Callable*, *param*: *DataSet* | *None* = *None*, *paramclass*: *DataSet* | *None* = *None*, *title*: *str* | *None* = *None*, *comment*: *str* | *None* = *None*, *edit*: *bool* | *None* = *None*) → dict[*str*, *ResultShape* | *ResultProperties*]

Compute 10 function: 1 object in → 0 object out (the result of this method is stored in original object’s metadata).

Parameters

- **func** – function to execute
- **param** – parameters. Defaults to None.
- **paramclass** – parameters class. Defaults to None.
- **title** – title of progress bar. Defaults to None.
- **comment** – comment. Defaults to None.
- **edit** – if True, edit parameters. Defaults to None.

Returns

object uuid, values: *ResultShape* or
ResultProperties objects)

Return type

Dictionary of results (keys

compute_n1(*name*: *str*, *func*: *Callable*, *param*: *DataSet* | *None* = *None*, *paramclass*: *DataSet* | *None* = *None*, *title*: *str* | *None* = *None*, *comment*: *str* | *None* = *None*, *func_objs*: *Callable* | *None* = *None*, *edit*: *bool* | *None* = *None*) → *None*

Compute n1 function: $N(\geq 2)$ objects in \rightarrow 1 object out.

Parameters

- **name** – name of function
- **func** – function to execute
- **param** – parameters. Defaults to None.
- **paramclass** – parameters class. Defaults to None.
- **title** – title of progress bar. Defaults to None.
- **comment** – comment. Defaults to None.
- **func_objs** – function to execute on objects. Defaults to None.
- **edit** – if True, edit parameters. Defaults to None.

compute_n1n(*obj2*: *Obj* | *list*[*Obj*] | *None*, *obj2_name*: *str*, *func*: *Callable*, *param*: *gds.DataSet* | *None* = *None*, *paramclass*: *gds.DataSet* | *None* = *None*, *title*: *str* | *None* = *None*, *comment*: *str* | *None* = *None*, *edit*: *bool* | *None* = *None*) \rightarrow *None*

Compute n1n function: $N(\geq 1)$ objects + 1 object in \rightarrow N objects out.

Examples: subtract, divide

Parameters

- **obj2** – second object (or list of objects in case of pairwise operation mode)
- **obj2_name** – name of second object
- **func** – function to execute
- **param** – parameters. Defaults to None.
- **paramclass** – parameters class. Defaults to None.
- **title** – title of progress bar. Defaults to None.
- **comment** – comment. Defaults to None.
- **edit** – if True, edit parameters. Defaults to None.

abstract compute_arithmetic(*obj2*: *Obj* | *None* = *None*, *param*: *ArithmeticParam* | *None* = *None*) \rightarrow *None*

Compute arithmetic operation

abstract compute_sum() \rightarrow *None*

Compute sum

abstract compute_normalize(*param*: *NormalizeParam* | *None* = *None*) \rightarrow *None*

Normalize data

abstract compute_average() \rightarrow *None*

Compute average

abstract compute_product() \rightarrow *None*

Compute product

abstract compute_difference(*obj2*: *Obj* | *list*[*Obj*] | *None* = *None*) \rightarrow *None*

Compute difference

abstract compute_quadratic_difference(obj2: *Obj* | *list[Obj]* | *None = None*) → *None*

Compute quadratic difference

abstract compute_division(obj2: *Obj* | *list[Obj]* | *None = None*) → *None*

Compute division

abstract compute_swap_axes() → *None*

Swap data axes

abstract compute_inverse() → *None*

Compute inverse

abstract compute_abs() → *None*

Compute absolute value

abstract compute_re() → *None*

Compute real part

abstract compute_im() → *None*

Compute imaginary part

abstract compute_astype() → *None*

Convert data type

abstract compute_log10() → *None*

Compute Log10

abstract compute_exp() → *None*

Compute exponential

abstract compute_calibration(param=*None*) → *None*

Compute data linear calibration

abstract compute_clip(param: *ClipParam* | *None = None*) → *None*

Compute maximum data clipping

abstract compute_gaussian_filter(param: *GaussianParam* | *None = None*) → *None*

Compute gaussian filter

abstract compute_moving_average(param: *MovingAverageParam* | *None = None*) → *None*

Compute moving average

abstract compute_moving_median(param: *MovingMedianParam* | *None = None*) → *None*

Compute moving median

abstract compute_wiener() → *None*

Compute Wiener filter

abstract compute_fft() → *None*

Compute iFFT

abstract compute_ifft() → *None*

Compute FFT

abstract compute_addition_constant(param: *ConstantParam*) → *None*

Compute sum with a constant

abstract compute_difference_constant(*param*: *ConstantParam*) → *None*
Compute difference with a constant

abstract compute_product_constant(*param*: *ConstantParam*) → *None*
Compute product with a constant

abstract compute_division_constant(*param*: *ConstantParam*) → *None*
Compute division by a constant

compute_roi_extraction(*roi*: *TypeROI* | *None* = *None*) → *None*
Extract Region Of Interest (ROI) from data with:

- *cdl.computation.image.extract_single_roi()* for single ROI
- *cdl.computation.image.extract_multiple_roi()* for multiple ROIs

edit_regions_of_interest(*extract*: *bool* = *False*) → *TypeROI* | *None*
Define Region Of Interest (ROI).

Parameters
extract – If True, ROI is extracted from data. Defaults to False.

Returns
ROI object or None if ROI dialog has been canceled.

delete_regions_of_interest() → *None*
Delete Regions Of Interest

abstract compute_stats() → *dict*[*str*, *ResultShape*]
Compute data statistics

3.13.2 Signal processing features

class *cdl.core.gui.processor.signal.SignalProcessor*(*panel*: *SignalPanel* | *ImagePanel*, *plotwidget*: *PlotWidget*)

Object handling signal processing: operations, processing, analysis

compute_sum() → *None*
Compute sum with *cdl.computation.signal.compute_addition()*

compute_addition_constant(*param*: *ConstantParam* | *None* = *None*) → *None*
Compute sum with a constant with *cdl.computation.signal.compute_addition_constant()*

compute_average() → *None*
Compute average with *cdl.computation.signal.compute_addition()* and divide by the number of signals

compute_product() → *None*
Compute product with *cdl.computation.signal.compute_product()*

compute_product_constant(*param*: *ConstantParam* | *None* = *None*) → *None*
Compute product with a constant with *cdl.computation.signal.compute_product_constant()*

compute_swap_axes() → *None*
Swap data axes with *cdl.computation.signal.compute_swap_axes()*

compute_inverse() → None
 Compute inverse

compute_abs() → None
 Compute absolute value with `cdl.computation.signal.compute_abs()`

compute_re() → None
 Compute real part with `cdl.computation.signal.compute_re()`

compute_im() → None
 Compute imaginary part with `cdl.computation.signal.compute_im()`

compute_astype(*param*: DataTypeSParam | None = None) → None
 Convert data type with `cdl.computation.signal.compute_astype()`

compute_log10() → None
 Compute Log10 with `cdl.computation.signal.compute_log10()`

compute_exp() → None
 Compute Log10 with `cdl.computation.signal.compute_exp()`

compute_sqrt() → None
 Compute square root with `cdl.computation.signal.compute_sqrt()`

compute_power(*param*: PowerParam | None = None) → None
 Compute power with `cdl.computation.signal.compute_power()`

compute_arithmetic(*obj2*: SignalObj | None = None, *param*: ArithmeticParam | None = None) → None
 Compute arithmetic operation between two signals with `cdl.computation.signal.compute_arithmetic()`

compute_difference(*obj2*: SignalObj | list[SignalObj] | None = None) → None
 Compute difference between two signals with `cdl.computation.signal.compute_difference()`

compute_difference_constant(*param*: ConstantParam | None = None) → None
 Compute difference with a constant with `cdl.computation.signal.compute_difference_constant()`

compute_quadratic_difference(*obj2*: SignalObj | list[SignalObj] | None = None) → None
 Compute quadratic difference between two signals with `cdl.computation.signal.compute_quadratic_difference()`

compute_division(*obj2*: SignalObj | list[SignalObj] | None = None) → None
 Compute division between two signals with `cdl.computation.signal.compute_division()`

compute_division_constant(*param*: ConstantParam | None = None) → None
 Compute division by a constant with `cdl.computation.signal.compute_division_constant()`

compute_peak_detection(*param*: PeakDetectionParam | None = None) → None
 Detect peaks from data with `cdl.computation.signal.compute_peak_detection()`

compute_reverse_x() → None
 Reverse X axis with `cdl.computation.signal.compute_reverse_x()`

compute_cartesian2polar(*param*: AngleUnitParam | None = None) → None
 Convert cartesian to polar coordinates with `cdl.computation.signal.compute_cartesian2polar()`

compute_polar2cartesian(*param*: AngleUnitParam | None = None) → None
Convert polar to cartesian coordinates with `cdl.computation.signal.compute_polar2cartesian()`.

compute_normalize(*param*: NormalizeParam | None = None) → None
Normalize data with `cdl.computation.signal.compute_normalize()`

compute_derivative() → None
Compute derivative with `cdl.computation.signal.compute_derivative()`

compute_integral() → None
Compute integral with `cdl.computation.signal.compute_integral()`

compute_calibration(*param*: XYCalibrateParam | None = None) → None
Compute data linear calibration with `cdl.computation.signal.compute_calibration()`

compute_clip(*param*: ClipParam | None = None) → None
Compute maximum data clipping with `cdl.computation.signal.compute_clip()`

compute_offset_correction(*param*: ROIIDParam | None = None) → None
Compute offset correction with `cdl.computation.signal.compute_offset_correction()`

compute_gaussian_filter(*param*: GaussianParam | None = None) → None
Compute gaussian filter with `cdl.computation.signal.compute_gaussian_filter()`

compute_moving_average(*param*: MovingAverageParam | None = None) → None
Compute moving average with `cdl.computation.signal.compute_moving_average()`

compute_moving_median(*param*: MovingMedianParam | None = None) → None
Compute moving median with `cdl.computation.signal.compute_moving_median()`

compute_wiener() → None
Compute Wiener filter with `cdl.computation.signal.compute_wiener()`

compute_lowpass(*param*: LowPassFilterParam | None = None) → None
Compute high-pass filter with `cdl.computation.signal.compute_filter()`

compute_highpass(*param*: HighPassFilterParam | None = None) → None
Compute high-pass filter with `cdl.computation.signal.compute_filter()`

compute_bandpass(*param*: BandPassFilterParam | None = None) → None
Compute band-pass filter with `cdl.computation.signal.compute_filter()`

compute_bandstop(*param*: BandStopFilterParam | None = None) → None
Compute band-stop filter with `cdl.computation.signal.compute_filter()`

compute_fft(*param*: FFTParam | None = None) → None
Compute FFT with `cdl.computation.signal.compute_fft()`

compute_ifft(*param*: FFTParam | None = None) → None
Compute iFFT with `cdl.computation.signal.compute_ifft()`

compute_magnitude_spectrum(*param*: SpectrumParam | None = None) → None
Compute magnitude spectrum with `cdl.computation.signal.compute_magnitude_spectrum()`

compute_phase_spectrum() → None
Compute phase spectrum with `cdl.computation.signal.compute_phase_spectrum()`

compute_psd(*param*: SpectrumParam | None = None) → None
 Compute power spectral density with `cdl.computation.signal.compute_psd()`

compute_interpolation(*obj2*: SignalObj | None = None, *param*: InterpolationParam | None = None)
 Compute interpolation with `cdl.computation.signal.compute_interpolation()`

compute_resampling(*param*: ResamplingParam | None = None)
 Compute resampling with `cdl.computation.signal.compute_resampling()`

compute_detrending(*param*: DetrendingParam | None = None)
 Compute detrending with `cdl.computation.signal.compute_detrending()`

compute_convolution(*obj2*: SignalObj | None = None) → None
 Compute convolution with `cdl.computation.signal.compute_convolution()`

compute_windowing(*param*: WindowingParam | None = None) → None
 Compute windowing with `cdl.computation.signal.compute_windowing()`

compute_allan_variance(*param*: AllanVarianceParam | None = None) → None
 Compute Allan variance with `cdl.computation.signal.compute_allan_variance()`

compute_allan_deviation(*param*: AllanVarianceParam | None = None) → None
 Compute Allan deviation with `cdl.computation.signal.compute_allan_deviation()`

compute_overlapping_allan_variance(*param*: AllanVarianceParam | None = None) → None
 Compute overlapping Allan variance with `cdl.computation.signal.compute_overlapping_allan_variance()`

compute_modified_allan_variance(*param*: AllanVarianceParam | None = None) → None
 Compute modified Allan variance with `cdl.computation.signal.compute_modified_allan_variance()`

compute_hadamard_variance(*param*: AllanVarianceParam | None = None) → None
 Compute Hadamard variance with `cdl.computation.signal.compute_hadamard_variance()`

compute_total_variance(*param*: AllanVarianceParam | None = None) → None
 Compute total variance with `cdl.computation.signal.compute_total_variance()`

compute_time_deviation(*param*: AllanVarianceParam | None = None) → None
 Compute time deviation with `cdl.computation.signal.compute_time_deviation()`

compute_all_stability(*param*: AllanVarianceParam | None = None) → None
 Compute all stability analysis features using the following functions:

- `cdl.computation.signal.compute_allan_variance()`
- `cdl.computation.signal.compute_allan_deviation()`
- `cdl.computation.signal.compute_overlapping_allan_variance()`
- `cdl.computation.signal.compute_modified_allan_variance()`
- `cdl.computation.signal.compute_hadamard_variance()`
- `cdl.computation.signal.compute_total_variance()`
- `cdl.computation.signal.compute_time_deviation()`

compute_polyfit(*param*: PolynomialFitParam | None = None) → None
 Compute polynomial fitting curve

compute_fit(*title*: *str*, *fitdlgfunc*: *Callable*) → *None*

Compute fitting curve using an interactive dialog

Parameters

- **title** – Title of the dialog
- **fitdlgfunc** – Fitting dialog function

compute_multigaussianfit() → *None*

Compute multi-Gaussian fitting curve using an interactive dialog

compute_fwhm(*param*: *FWHMParm* | *None* = *None*) → *dict*[*str*, *ResultShape*]

Compute FWHM with `cdl.computation.signal.compute_fwhm()`

compute_fw1e2() → *dict*[*str*, *ResultShape*]

Compute FW at $1/e^2$ with `cdl.computation.signal.compute_fw1e2()`

compute_stats() → *dict*[*str*, *ResultProperties*]

Compute data statistics with `cdl.computation.signal.compute_stats()`

compute_histogram(*param*: *HistogramParam* | *None* = *None*) → *dict*[*str*, *ResultShape*]

Compute histogram with `cdl.computation.signal.compute_histogram()`

compute_contrast() → *dict*[*str*, *ResultProperties*]

Compute contrast with `cdl.computation.signal.compute_contrast()`

compute_x_at_minmax() → *dict*[*str*, *ResultProperties*]

Compute x at min/max with `cdl.computation.signal.compute_x_at_minmax()`

compute_x_at_y(*param*: *FindAbscissaParam* | *None* = *None*) → *dict*[*str*, *ResultProperties*]

Compute x at y with `cdl.computation.signal.compute_x_at_y()`.

compute_sampling_rate_period() → *dict*[*str*, *ResultProperties*]

Compute sampling rate and period (mean and std) with `cdl.computation.signal.compute_sampling_rate_period()`

compute_bandwidth_3db() → *None*

Compute bandwidth at -3dB with `cdl.computation.signal.compute_bandwidth_3db()`

compute_dynamic_parameters(*param*: *DynamicParam* | *None* = *None*) → *dict*[*str*, *ResultProperties*]

Compute Dynamic Parameters (ENOB, SINAD, THD, SFDR, SNR) with `cdl.computation.signal.compute_dynamic_parameters()`

3.13.3 Image processing features

class `cdl.core.gui.processor.image.ImageProcessor`(*panel*: *SignalPanel* | *ImagePanel*, *plotwidget*: *PlotWidget*)

Object handling image processing: operations, processing, analysis

compute_normalize(*param*: *NormalizeParam* | *None* = *None*) → *None*

Normalize data with `cdl.computation.image.compute_normalize()`

compute_sum() → *None*

Compute sum with `cdl.computation.image.compute_addition()`

compute_addition_constant(*param*: ConstantParam | None = None) → None
 Compute sum with a constant using `cdl.computation.image.compute_addition_constant()`

compute_average() → None
 Compute average with `cdl.computation.image.compute_addition()` and dividing by the number of images

compute_product() → None
 Compute product with `cdl.computation.image.compute_product()`

compute_product_constant(*param*: ConstantParam | None = None) → None
 Compute product with a constant using `cdl.computation.image.compute_product_constant()`

compute_logp1(*param*: LogP1Param | None = None) → None
 Compute base 10 logarithm using `cdl.computation.image.compute_logp1()`

compute_rotate(*param*: RotateParam | None = None) → None
 Rotate data arbitrarily using `cdl.computation.image.compute_rotate()`

compute_rotate90() → None
 Rotate data 90° with `cdl.computation.image.compute_rotate90()`

compute_rotate270() → None
 Rotate data 270° with `cdl.computation.image.compute_rotate270()`

compute_fliph() → None
 Flip data horizontally using `cdl.computation.image.compute_fliph()`

compute_flipv() → None
 Flip data vertically with `cdl.computation.image.compute_flipv()`

distribute_on_grid(*param*: GridParam | None = None) → None
 Distribute images on a grid

reset_positions() → None
 Reset image positions

compute_resize(*param*: ResizeParam | None = None) → None
 Resize image with `cdl.computation.image.compute_resize()`

compute_binning(*param*: BinningParam | None = None) → None
 Binning image with `cdl.computation.image.compute_binning()`

compute_line_profile(*param*: LineProfileParam | None = None) → None
 Compute profile along a vertical or horizontal line with `cdl.computation.image.compute_line_profile()`

compute_segment_profile(*param*: SegmentProfileParam | None = None) → None
 Compute profile along a segment with `cdl.computation.image.compute_segment_profile()`

compute_average_profile(*param*: AverageProfileParam | None = None) → None
 Compute average profile with `cdl.computation.image.compute_average_profile()`

compute_radial_profile(*param*: RadialProfileParam | None = None) → None
 Compute radial profile with `cdl.computation.image.compute_radial_profile()`

compute_histogram(*param*: HistogramParam | None = None) → None
 Compute histogram with `cdl.computation.image.compute_histogram()`

compute_swap_axes() → None
Swap data axes with `cdl.computation.image.compute_swap_axes()`.

compute_inverse() → None
Compute inverse

compute_abs() → None
Compute absolute value with `cdl.computation.image.compute_abs()`

compute_re() → None
Compute real part with `cdl.computation.image.compute_re()`

compute_im() → None
Compute imaginary part with `cdl.computation.image.compute_im()`

compute_astype(*param*: `DataTypeIParm` | `None = None`) → None
Convert data type with `cdl.computation.image.compute_astype()`

compute_log10() → None
Compute Log10 with `cdl.computation.image.compute_log10()`

compute_exp() → None
Compute Log10 with `cdl.computation.image.compute_exp()`

compute_arithmetic(*obj2*: `ImageObj` | `None = None`, *param*: `ArithmeticParam` | `None = None`) → None
Compute arithmetic operation between two images with `cdl.computation.image.compute_arithmetic()`

compute_difference(*obj2*: `ImageObj` | `list[ImageObj]` | `None = None`) → None
Compute difference between two images with `cdl.computation.image.compute_difference()`

compute_difference_constant(*param*: `ConstantParam` | `None = None`) → None
Compute difference with a constant with `cdl.computation.image.compute_difference_constant()`

compute_quadratic_difference(*obj2*: `ImageObj` | `list[ImageObj]` | `None = None`) → None
Compute quadratic difference between two images with `cdl.computation.image.compute_quadratic_difference()`

compute_division(*obj2*: `ImageObj` | `list[ImageObj]` | `None = None`) → None
Compute division between two images with `cdl.computation.image.compute_division()`

compute_division_constant(*param*: `ConstantParam` | `None = None`) → None
Compute division by a constant with `cdl.computation.image.compute_division_constant()`

compute_flatfield(*obj2*: `ImageObj` | `None = None`, *param*: `FlatFieldParam` | `None = None`) → None
Compute flat field correction with `cdl.computation.image.compute_flatfield()`

compute_calibration(*param*: `ZCalibrateParam` | `None = None`) → None
Compute data linear calibration with `cdl.computation.image.compute_calibration()`

compute_clip(*param*: `ClipParam` | `None = None`) → None
Compute maximum data clipping with `cdl.computation.image.compute_clip()`

compute_offset_correction(*param*: `ROI2DParam` | `None = None`) → None
Compute offset correction with `cdl.computation.image.compute_offset_correction()`

compute_gaussian_filter(*param*: GaussianParam | None = None) → None
 Compute gaussian filter with `cdl.computation.image.compute_gaussian_filter()`

compute_moving_average(*param*: MovingAverageParam | None = None) → None
 Compute moving average with `cdl.computation.image.compute_moving_average()`

compute_moving_median(*param*: MovingMedianParam | None = None) → None
 Compute moving median with `cdl.computation.image.compute_moving_median()`

compute_wiener() → None
 Compute Wiener filter with `cdl.computation.image.compute_wiener()`

compute_fft(*param*: FFTParam | None = None) → None
 Compute FFT with `cdl.computation.image.compute_fft()`

compute_ifft(*param*: FFTParam | None = None) → None
 Compute iFFT with `cdl.computation.image.compute_ifft()`

compute_magnitude_spectrum(*param*: SpectrumParam | None = None) → None
 Compute magnitude spectrum with `cdl.computation.image.compute_magnitude_spectrum()`

compute_phase_spectrum() → None
 Compute phase spectrum with `cdl.computation.image.compute_phase_spectrum()`

compute_psd(*param*: SpectrumParam | None = None) → None
 Compute Power Spectral Density (PSD) with `cdl.computation.image.compute_psd()`

compute_butterworth(*param*: ButterworthParam | None = None) → None
 Compute Butterworth filter with `cdl.computation.image.compute_butterworth()`

compute_threshold(*param*: ThresholdParam | None = None) → None
 Compute parametric threshold with `cdl.computation.image.threshold.compute_threshold()`

compute_threshold_isodata() → None
 Compute threshold using Isodata algorithm with `cdl.computation.image.threshold.compute_threshold_isodata()`

compute_threshold_li() → None
 Compute threshold using Li algorithm with `cdl.computation.image.threshold.compute_threshold_li()`

compute_threshold_mean() → None
 Compute threshold using Mean algorithm with `cdl.computation.image.threshold.compute_threshold_mean()`

compute_threshold_minimum() → None
 Compute threshold using Minimum algorithm with `cdl.computation.image.threshold.compute_threshold_minimum()`

compute_threshold_otsu() → None
 Compute threshold using Otsu algorithm with `cdl.computation.image.threshold.compute_threshold_otsu()`

compute_threshold_triangle() → None
 Compute threshold using Triangle algorithm with `cdl.computation.image.threshold.compute_threshold_triangle()`

compute_threshold_yen() → None

Compute threshold using Yen algorithm with `cdl.computation.image.threshold.compute_threshold_yen()`

compute_all_threshold() → None

Compute all threshold algorithms using the following functions:

- `cdl.computation.image.threshold.compute_threshold_isodata()`
- `cdl.computation.image.threshold.compute_threshold_li()`
- `cdl.computation.image.threshold.compute_threshold_mean()`
- `cdl.computation.image.threshold.compute_threshold_minimum()`
- `cdl.computation.image.threshold.compute_threshold_otsu()`
- `cdl.computation.image.threshold.compute_threshold_triangle()`
- `cdl.computation.image.threshold.compute_threshold_yen()`

compute_adjust_gamma(param: AdjustGammaParam | None = None) → None

Compute gamma correction with `cdl.computation.image.exposure.compute_adjust_gamma()`

compute_adjust_log(param: AdjustLogParam | None = None) → None

Compute log correction with `cdl.computation.image.exposure.compute_adjust_log()`

compute_adjust_sigmoid(param: AdjustSigmoidParam | None = None) → None

Compute sigmoid correction with `cdl.computation.image.exposure.compute_adjust_sigmoid()`

compute_rescale_intensity(param: RescaleIntensityParam | None = None) → None

Rescale image intensity levels with `py:func`cdl.computation.image.exposure.compute_rescale_intensity``

compute_equalize_hist(param: EqualizeHistParam | None = None) → None

Histogram equalization with `cdl.computation.image.exposure.compute_equalize_hist()`

compute_equalize_adapthist(param: EqualizeAdaptHistParam | None = None) → None

Adaptive histogram equalization with `cdl.computation.image.exposure.compute_equalize_adapthist()`

compute_denoise_tv(param: DenoiseTVParam | None = None) → None

Compute Total Variation denoising with `cdl.computation.image.restoration.compute_denoise_tv()`

compute_denoise_bilateral(param: DenoiseBilateralParam | None = None) → None

Compute bilateral filter denoising with `cdl.computation.image.restoration.compute_denoise_bilateral()`

compute_denoise_wavelet(param: DenoiseWaveletParam | None = None) → None

Compute Wavelet denoising with `cdl.computation.image.restoration.compute_denoise_wavelet()`

compute_denoise_tophat(param: MorphologyParam | None = None) → None

Denoise using White Top-Hat with `cdl.computation.image.restoration.compute_denoise_tophat()`

compute_all_denoise(params: list | None = None) → None

Compute all denoising filters using the following functions:

- `cdl.computation.image.restoration.compute_denoise_tv()`

- `cdl.computation.image.restoration.compute_denoise_bilateral()`
- `cdl.computation.image.restoration.compute_denoise_wavelet()`
- `cdl.computation.image.restoration.compute_denoise_tophat()`

compute_white_tophat(*param*: MorphologyParam | *None* = *None*) → *None*
 Compute White Top-Hat with `cdl.computation.image.morphology.compute_white_tophat()`

compute_black_tophat(*param*: MorphologyParam | *None* = *None*) → *None*
 Compute Black Top-Hat with `cdl.computation.image.morphology.compute_black_tophat()`

compute_erosion(*param*: MorphologyParam | *None* = *None*) → *None*
 Compute Erosion with `cdl.computation.image.morphology.compute_erosion()`

compute_dilation(*param*: MorphologyParam | *None* = *None*) → *None*
 Compute Dilation with `cdl.computation.image.morphology.compute_dilation()`

compute_opening(*param*: MorphologyParam | *None* = *None*) → *None*
 Compute morphological opening with `cdl.computation.image.morphology.compute_opening()`

compute_closing(*param*: MorphologyParam | *None* = *None*) → *None*
 Compute morphological closing with `cdl.computation.image.morphology.compute_closing()`

compute_all_morphology(*param*: MorphologyParam | *None* = *None*) → *None*
 Compute all morphology filters using the following functions:

- `cdl.computation.image.morphology.compute_white_tophat()`
- `cdl.computation.image.morphology.compute_black_tophat()`
- `cdl.computation.image.morphology.compute_erosion()`
- `cdl.computation.image.morphology.compute_dilation()`
- `cdl.computation.image.morphology.compute_opening()`
- `cdl.computation.image.morphology.compute_closing()`

compute_canny(*param*: CannyParam | *None* = *None*) → *None*
 Compute Canny filter with `cdl.computation.image.edges.compute_canny()`

compute_roberts() → *None*
 Compute Roberts filter with `cdl.computation.image.edges.compute_roberts()`

compute_prewitt() → *None*
 Compute Prewitt filter with `cdl.computation.image.edges.compute_prewitt()`

compute_prewitt_h() → *None*
 Compute Prewitt filter (horizontal) with `cdl.computation.image.edges.compute_prewitt_h()`

compute_prewitt_v() → *None*
 Compute Prewitt filter (vertical) with `cdl.computation.image.edges.compute_prewitt_v()`

compute_sobel() → *None*
 Compute Sobel filter with `cdl.computation.image.edges.compute_sobel()`

compute_sobel_h() → *None*
 Compute Sobel filter (horizontal) with `cdl.computation.image.edges.compute_sobel_h()`

compute_sobel_v() → None

Compute Sobel filter (vertical) with `cdl.computation.image.edges.compute_sobel_v()`

compute_scharr() → None

Compute Scharr filter with `cdl.computation.image.edges.compute_scharr()`

compute_scharr_h() → None

Compute Scharr filter (horizontal) with `cdl.computation.image.edges.compute_scharr_h()`

compute_scharr_v() → None

Compute Scharr filter (vertical) with `cdl.computation.image.edges.compute_scharr_v()`

compute_farid() → None

Compute Farid filter with `cdl.computation.image.edges.compute_farid()`

compute_farid_h() → None

Compute Farid filter (horizontal) with `cdl.computation.image.edges.compute_farid_h()`

compute_farid_v() → None

Compute Farid filter (vertical) with `cdl.computation.image.edges.compute_farid_v()`

compute_laplace() → None

Compute Laplace filter with `cdl.computation.image.edges.compute_laplace()`

compute_all_edges() → None

Compute all edges filters using the following functions:

- `cdl.computation.image.edges.compute_roberts()`
- `cdl.computation.image.edges.compute_prewitt()`
- `cdl.computation.image.edges.compute_prewitt_h()`
- `cdl.computation.image.edges.compute_prewitt_v()`
- `cdl.computation.image.edges.compute_sobel()`
- `cdl.computation.image.edges.compute_sobel_h()`
- `cdl.computation.image.edges.compute_sobel_v()`
- `cdl.computation.image.edges.compute_scharr()`
- `cdl.computation.image.edges.compute_scharr_h()`
- `cdl.computation.image.edges.compute_scharr_v()`
- `cdl.computation.image.edges.compute_farid()`
- `cdl.computation.image.edges.compute_farid_h()`
- `cdl.computation.image.edges.compute_farid_v()`
- `cdl.computation.image.edges.compute_laplace()`

compute_stats() → dict[str, ResultProperties]

Compute data statistics with `cdl.computation.image.compute_stats()`

compute_centroid() → dict[str, ResultShape]

Compute image centroid with `cdl.computation.image.compute_centroid()`

compute_enclosing_circle() → dict[str, ResultShape]

Compute minimum enclosing circle with `cdl.computation.image.compute_enclosing_circle()`

compute_peak_detection(*param*: [Peak2DDetectionParam](#) | *None* = *None*) → dict[str, *ResultShape*]
 Compute 2D peak detection with `cdl.computation.image.compute_peak_detection()`

compute_contour_shape(*param*: [ContourShapeParam](#) | *None* = *None*) → dict[str, *ResultShape*]
 Compute contour shape fit with `cdl.computation.image.detection.compute_contour_shape()`

compute_hough_circle_peaks(*param*: [HoughCircleParam](#) | *None* = *None*) → dict[str, *ResultShape*]
 Compute peak detection based on a circle Hough transform with `cdl.computation.image.compute_hough_circle_peaks()`

compute_blob_dog(*param*: [BlobDOGParam](#) | *None* = *None*) → dict[str, *ResultShape*]
 Compute blob detection using Difference of Gaussian method with `cdl.computation.image.detection.compute_blob_dog()`

compute_blob_doh(*param*: [BlobDOHParam](#) | *None* = *None*) → dict[str, *ResultShape*]
 Compute blob detection using Determinant of Hessian method with `cdl.computation.image.detection.compute_blob_doh()`

compute_blob_log(*param*: [BlobLOGParam](#) | *None* = *None*) → dict[str, *ResultShape*]
 Compute blob detection using Laplacian of Gaussian method with `cdl.computation.image.detection.compute_blob_log()`

compute_blob_opencv(*param*: [BlobOpenCVParam](#) | *None* = *None*) → dict[str, *ResultShape*]
 Compute blob detection using OpenCV with `cdl.computation.image.detection.compute_blob_opencv()`

3.14 Docks

The `cdl.core.gui.docks` module provides the dockable widgets for the DataLab main window.

3.14.1 Plot widget

class `cdl.core.gui.docks.DataLabPlotWidget`(*plot_type*: [PlotType](#))

DataLab PlotWidget

This class is a subclass of `plotpy.plot.PlotWidget` that provides a customized widget for DataLab, with a specific set of tools and a customized appearance.

Parameters

plot_type – Plot type

register_tools() → [None](#)

Register the plotting tools according to the plot type

3.14.2 Dockable plot widget

class `cdl.core.gui.docks.DockablePlotWidget`(*parent: QWidget, plot_type: PlotType*)

Docked plotting widget

Parameters

- **parent** – Parent widget
- **plot_type** – Plot type

setup_layout() → `None`

Setup layout

update_toolbar_position() → `None`

Update toolbar position

setup_plotwidget() → `None`

Setup plotting widget

update_color_mode() → `None`

Update plot widget styles according to application color mode

get_plot() → `BasePlot`

Return plot instance

update_watermark(plot: BasePlot) → `None`

Update watermark visibility

visibility_changed(enable: bool) → `None`

DockWidget visibility has changed

3.15 HDF5 I/O

The `cdl.core.gui.h5io` module provides the HDF5 file open/save into/from DataLab data model/main window.

class `cdl.core.gui.h5io.H5InputOutput`(*mainwindow: CDLMainWindow*)

Object handling HDF5 file open/save into/from DataLab data model/main window

Parameters

mainwindow – Main window

save_file(filename: str) → `None`

Save all signals and images from DataLab model into a HDF5 file

open_file(filename: str, import_all: bool, reset_all: bool) → `None`

Open HDF5 file

import_files(filenamees: list[str], import_all: bool, reset_all: bool) → `None`

Import HDF5 files

import_dataset_from_file(filename: str, dsetname: str) → `None`

Import dataset from HDF5 file

CONTRIBUTING

DataLab is **your** platform. If you want it to be improved, you **can** contribute to the project, whether you are a developer or not.

There are many ways to contribute to DataLab project, depending on how much time you have, your experience with open source projects, and your skills.

4.1 Share your ideas and experiences

Besides the classic bug reports and feature requests, you can share your ideas and experiences for improving DataLab. In particular, we are very interested in your feedback on the documentation and tutorials. Moreover, if you have a use case that you would like to share with the community, please let us know.

Without coding, you can contribute to DataLab project by:

- [Reporting a bug](#)
- [Suggesting an enhancement](#)
- [Suggesting a documentation topic](#)
- [Suggesting a tutorial topic](#)

4.2 Share your scientific/technical knowledge

Your technical or scientific knowledge is also very valuable to us, as you may directly contribute to the documentation or tutorials. Or, better, if you want to write a tutorial, we will be happy to help you.

Again without coding, you can contribute to DataLab project by:

- [Writing documentation](#)
- [Writing a tutorial](#)

4.3 Contribute to new features

Even if you are not a developer, you can contribute to the project by:

- Testing new features
- Writing and submitting new Plugins
- Writing and submitting macro-commands

4.4 Develop new features

If you are a developer, you can contribute to the core of the project by fixing bugs or implementing new features.

See *Contribute code* section for more information.

4.4.1 Contribute code

This page explains how you can contribute code to the project.

See also:

The *Coding guidelines* page presents the coding guidelines that you should follow when contributing to the project.

Fork the project

The first step is to fork the project on GitHub. You can do that by visiting [DataLab GitHub project](#) and clicking on the “Fork” button on the top right corner of the page.

Once you have forked the project, you will have a copy of the project in your own GitHub account. Then you can clone the project on your computer and start working on it.

Submit a pull request

Once you have made some changes, you can submit a pull request to the original project. To do that, go to your forked project on GitHub and click on the “Pull request” button on the top right corner of the page.

Then you will have to fill a form to describe your pull request. Once you have submitted the pull request, the project maintainers will review your changes and merge them if they are satisfied.

During the review process, the project maintainers will check that your code follows the coding guidelines and that it does not break the existing tests. If your code does not follow the coding guidelines, you will have to fix it before your pull request can be merged.

4.4.2 Coding guidelines

Generic coding guidelines

We follow the [PEP 8](#) coding style.

In particular, we are especially strict about the following guidelines:

- Limit all lines to a maximum of 79 characters.
- Respect the naming conventions (classes, functions, variables, etc.).
- Use specific exceptions instead of the generic [Exception](#).

To enforce these guidelines, the following tools are mandatory:

- [ruff](#) for code formatting and static code analysis.
- [pylint](#) for static code analysis.

ruff

If you are using [Visual Studio Code](#), the project settings will automatically format your code with *ruff* on save (you may also run the task “Run Ruff” to run *ruff* on the project).

To run *ruff*, run the following command:

```
ruff check
```

pylint

To run *pylint*, run the following command:

```
pylint datalab
```

If you are using [Visual Studio Code](#) on Windows, you may run the task “Run Pylint” to run *pylint* on the project.

Note: A *pylint* rating greater than 9/10 is required to merge a pull request.

Specific coding guidelines

In addition to the generic coding guidelines, we have the following specific guidelines:

- Write docstrings for all classes, methods and functions. The docstrings should follow the [Google style](#).
- Add typing annotations for all functions and methods. The annotations should use the future syntax (`from __future__ import annotations`)
- Try to keep the code as simple as possible. If you have to write a complex piece of code, try to split it into several functions or classes.
- Add as many comments as possible. The code should be self-explanatory, but it is always useful to add some comments to explain the general idea of the code, or to explain some tricky parts.
- Do not use `from module import *` statements, even in the `__init__` module of a package.

- Avoid using mixins (multiple inheritance) when possible. It is often possible to use composition instead of inheritance.
- Avoid using `__getattr__` and `__setattr__` methods. They are often used to implement lazy initialization, but this can be done in a more explicit way.

4.4.3 Git Workflow

This document describes the Git workflow used in the DataLab project, based on a `main` branch, a `develop` branch, and feature-specific branches. It also defines how bug fixes are managed.

Note: This workflow is a simplified version of the [Gitflow Workflow](#). It has been adapted to suit the needs of the DataLab project at the current stage of development. In the near future, we may consider adopting a more complex workflow, e.g. by adding release branches.

Branching Model

Main Branches

- `main`: Represents the stable, production-ready version of the project.
- `develop`: Used for ongoing development and integration of new features.

Feature Branches

- `develop/feature_name`: Used for the development of new features.
 - Created from `develop`.
 - Merged back into `develop` once completed.
 - Deleted after merging.

Bug Fix Branches

- `fix/xxx`: Used for general bug fixes that are not urgent.
 - Created from `develop`.
 - Merged back into `develop` once completed.
 - Deleted after merging.
- `hotfix/xxx`: Used for urgent production-critical fixes.
 - Created from `main`.
 - Merged back into `main`.
 - The fix is then cherry-picked into `develop`.
 - Deleted after merging.

Note: Hotfixes (high-priority fixes) will be integrated in the next maintenance release (X.Y.Z -> Z+1), while fixes (low-priority fixes) will be integrated in the next feature release (X.Y -> Y+1).

Workflow for New Features

1. Create a new feature branch from develop:

```
git checkout develop
git checkout -b develop/feature_name
```

2. Develop the feature and commit changes.
3. Merge the feature branch back into develop:

```
git checkout develop
git merge --no-ff develop/feature_name
```

4. Delete the feature branch:

```
git branch -d develop/feature_name
```

Warning: Do not leave feature branches unmerged for too long. Regularly rebase them on develop to minimize conflicts.

Workflow for Regular Bug Fixes

1. Create a bug fix branch from develop:

```
git checkout develop
git checkout -b fix/bug_description
```

2. Apply the fix and commit changes.
3. Merge the fix branch back into develop:

```
git checkout develop
git merge --no-ff fix/bug_description
```

4. Delete the fix branch:

```
git branch -d fix/bug_description
```

Warning: Do not create a fix/xxx branch from a develop/feature_name branch. Always branch from develop to ensure fixes are correctly propagated.

```
# Incorrect:
git checkout develop/feature_name
git checkout -b fix/wrong_branch
```

```
# Correct:
git checkout develop
git checkout -b fix/correct_branch
```

Workflow for Critical Hotfixes

1. Create a hotfix branch from main:

```
git checkout main
git checkout -b hotfix/critical_bug
```

2. Apply the fix and commit changes.
3. Merge the fix back into main:

```
git checkout main
git merge --no-ff hotfix/critical_bug
```

4. Cherry-pick the fix into develop:

```
git checkout develop
git cherry-pick <commit_hash>
```

5. Delete the hotfix branch:

```
git branch -d hotfix/critical_bug
```

Warning: Do not merge `fix/xxx` or `hotfix/xxx` directly into `main` without following the workflow. Ensure hotfixes are cherry-picked into `develop` to avoid losing fixes in future releases.

Best Practices

- Regularly **rebase feature branches** on `develop` to stay up to date:

```
git checkout develop/feature_name
git rebase develop
```

- Avoid long-lived branches to minimize merge conflicts.
- Ensure bug fixes in `main` are **always cherry-picked** to `develop`.
- Clearly differentiate between `fix/xxx` (non-urgent fixes) and `hotfix/xxx` (critical production fixes).

Takeaway

This workflow ensures a structured yet flexible development process while keeping `main` stable and `develop` always updated with the latest changes.

It also ensures that bug fixes are correctly managed and propagated across branches.

4.4.4 Setting up Development Environment

Getting started with DataLab development is easy.

Here is what you will need:

1. An integrated development environment (IDE) for Python. We recommend [Spyder](#) or [Visual Studio Code](#), but any IDE will do.
2. A Python distribution. We recommend [WinPython](#), on Windows, or [Anaconda](#), on Linux or Mac. But, again, any Python distribution will do.
3. A clean project structure (see below).
4. Test data (see below).
5. Environment variables (see below).
6. Third-party software (see below).

Development Environment

If you are using [Spyder](#), thank you for supporting the scientific open-source Python community!

If you are using Visual Studio Code, that's also an excellent choice (for other reasons). We recommend installing the following extensions:

Extension	Description
gettext	Gettext syntax highlighting
Pylance	Python language server
Python	Python extension
reStructuredText Syntax highlighting	reStructuredText syntax highlighting
Ruff	Extremely fast Python linter and code formatter
Todo Tree	Todo tree
Insert GUID	Insert GUID
XML Tools	XML Tools

Python Environment

DataLab requires the following :

- Python (e.g. WinPython)
- Additional Python packages

Installing all required packages :

```
pip install --upgrade -r dev\requirements.txt
```

See [Installation](#) for more details on reference Python and Qt versions.

If you are using [WinPython](#), thank you for supporting the scientific open-source Python community!

The following table lists the currently officially used Python distributions:

Python version	Status	WinPython version
3.9	OK	3.9.10.0
3.10	OK	3.10.11.1
3.11	OK	3.11.5.0
3.12	OK	3.12.3.0
3.13	OK	3.13.2.0

We strongly recommend using the `.dot` versions of WinPython which are lightweight and can be customized to your needs (using `pip install -r requirements.txt`).

We also recommend using a dedicated WinPython instance for DataLab.

Test data

DataLab test data are located in different folders, depending on their nature or origin.

Required data for unit tests are located in “`cdl\data\tests`” (public data).

A second folder `%CDL_DATA%` (optional) may be defined for additional tests which are still under development (or for confidential data).

Specific environment variables

Enable the “debug” mode (no stdin/stdout redirection towards internal console):

```
@REM Mode DEBUG
set DEBUG=1
```

Building PDF documentation requires LaTeX. On Windows, the following environment:

```
@REM LaTeX executable must be in Windows PATH, for mathematical equations rendering
@REM Example with MiKTeX :
set PATH=C:\\Apps\\miktex-portable\\texmf\\install\\miktex\\bin\\x64;%PATH%
```

Visual Studio Code configuration used in `launch.json` and `tasks.json` (examples) :

```
@REM Development environment
set CDL_PYTHONEXE=C:\\python-3.9.10.amd64\\python.exe
@REM Folder containing additional working test data
set CDL_DATA=C:\\Dev\\Projets\\CDL_data
```

Visual Studio Code `.env` file:

- This file is used to set environment variables for the application.
- It is used to set the `PYTHONPATH` environment variable to the root of the project.
- This is required to be able to import the project modules from within VS Code.
- To create this file, copy the `.env.template` file to `.env` (and eventually add your own paths).

Windows installer

The Windows installer is built using [WiX Toolset V4.0.5](#). Using the WiX Toolset requires [.NET SDK V6.0](#) minimum. You may install .NET SDK using winget:

```
winget install Microsoft.DotNet.SDK.8
```

Once .NET SDK is installed, the WiX Toolset can be installed and configured using the following commands:

```
dotnet tool install --global wix --version 4.0.5
wix extension add WixToolset.UI.wixext/4.0.5
```

First, you need to generate the installer script from a generic template:

```
python wix/makewxs.py
```

Building the installer is done using the following command:

```
wix build .\wix\DataLab.wxs -ext WixToolset.UI.wixext
```

Third-party Software

The following software may be required for maintaining the project:

Software	Description
gettext	Translations
Git	Version control system
ImageMagick	Image manipulation utilities
Inkscape	Vector graphics editor
MikTeX	LaTeX distribution on Windows

4.4.5 Roadmap

Future milestones

Features or enhancements

- Add support for data acquisition:
 - It would be nice to be able to acquire data from various sources (e.g. a camera, a digitizer, a spectrometer, etc.) directly from DataLab
 - This would allow to use DataLab as a data acquisition software, and to process the acquired data immediately after
 - Although there is currently no design for this feature, it could be implemented by creating a new plugin family, and by defining a common API for data acquisition plugins
 - One of the possible technical solutions could be to rely on [PyMoDAQ](#), a Python package for data acquisition, which is already compatible with various hardware devices - *how about a collaboration with the PyMoDAQ developers?*
- Create a DataLab math library:

- This library would be a Python package, and would contain all the mathematical functions and algorithms used in DataLab: - A low-level algorithms API operating on NumPy arrays - The base non-GUI data model of DataLab (e.g. signals, images) - A high-level computing API operating on DataLab objects (e.g. signals, images)
- It would be used by DataLab itself, but could also be used by third-party software (e.g. Jupyter notebooks, Spyder, Visual Studio Code, etc.)
- Finally, this library would be a good way to share DataLab's mathematical features with the scientific community: a collection of algorithms and functions that are well-tested, well-documented, and easy to use
- *Note:* it is already possible to use DataLab's processing features from outside DataLab by importing the *cdl* Python package, but this package also contains the GUI code, which is not always needed (e.g. when using DataLab from a Jupyter notebook). The idea here is to create a new package that would contain only the mathematical features of DataLab, without the GUI code.

Note: The DataLab math library could be an opportunity to reconsider the design of the DataLab processing functions. Currently, the processing functions working on signal and image objects rely on *guidata.dataset.DataSet* objects for input parameters. This is very convenient for the developer because it allows to create a GUI for the processing functions automatically, but it is not very flexible for the user because it forces to instantiate a *DataSet* object with the right parameters before calling the processing function (this can be cumbersome especially when dealing with simple processing functions requiring only a few parameters). Thus, it could be interesting to consider a more flexible and simple design, where the processing parameters would be passed as keyword arguments to the processing functions. The *DataSet* objects could be handled internally by the processing functions (e.g. by calling the *DataSet.create* method with the keyword arguments passed by the user). This would allow to keep the automatic GUI generation feature for the processing functions, but would also allow to call the processing functions directly with keyword arguments, without having to create a *DataSet* object first.

- Create a Jupyter plugin for interactive data analysis with DataLab:
 - Using DataLab from a Jupyter notebook is already possible, thanks to the remote control features (see [Remote controlling](#)), but it would be nice to have a dedicated plugin
 - This plugin would allow to use DataLab as a Jupyter kernel, and to display DataLab numerical results in Jupyter notebooks or the other way around (e.g. display Jupyter results in DataLab)
 - This plugin would also allow to use DataLab's processing features from Jupyter notebooks
 - A typical use case could also consist in using DataLab for manipulating signals or images efficiently, and using Jupyter for custom data analysis based on specific / home-made algorithms
 - This plugin could be implemented by using the Jupyter kernel interface (see above)
- Create a Spyder plugin for interactive data analysis connected with DataLab:
 - This is exactly the same use case as for the Jupyter plugin, but for Spyder
 - This plugin could also be implemented by using the Jupyter kernel interface (see above)
- Add support for time series (see [Issue #27](#))
- Add a Jupyter kernel interface to DataLab:
 - This would allow to use DataLab from other software, such as Jupyter notebooks, Spyder or Visual Studio Code
 - This would also allow to share data between DataLab and other software (e.g. display DataLab numerical results in Jupyter notebooks or the other way around, display Jupyter results in DataLab, etc.)

- After a first and quick look, it seems that the Jupyter kernel interface is not straightforward to implement, so that it may not be worth the effort (the communication between DataLab and Jupyter is currently already possible thanks to the remote control features)

Maintenance

- 2024: switch to gRPC for remote control (instead of XML-RPC), if there is a need for a more efficient communication protocol (see [Issue #18](#))
- 2025: drop PyQt5 support (end-of-life: mid-2025), and switch to PyQt6 ; this should be straightforward, thanks to the *qtpy* compatibility layer and to the fact that *PlotPyStack* is already compatible with PyQt6)

Other tasks

- Create a DataLab plugin template (see [Issue #26](#))

Past milestones

DataLab 0.11

- Add a drag-and-drop feature to the signal and image panels, to allow reordering signals and images (see [Issue #17](#))
- Add “Move up” and “Move down” buttons to the signal and image panels, to allow reordering signals and images (see [Issue #22](#))
- Add 1D convolution, interpolation, resampling and detrending features

DataLab 0.10

- Develop a very simple DataLab plugin to demonstrate the plugin system
- Serialize curve and image styles in HDF5 files
- Add an “Auto-refresh” global option, to be able to disable the automatic refresh of the main window when doing multiple processing steps, thus improving performance
- Improve curve readability (e.g. avoid dashed lines, use contrasted colors, and use anti-aliasing)

DataLab 0.9

- Python 3.11 is the new reference
- Run computations in a separate process:
 - Execute a “computing server” in background, in another process
 - For each computation, send serialized data and computing function to the server and wait for the result
 - It is then possible to stop any computation at any time by killing the server process and restarting it (eventually after incrementing the communication port number)
- Optimize image displaying performance
- Add preferences dialog box

- Add new image processing features: denoising...
- Image processing results: added support for polygon shapes (e.g. for contour detection)
- New plugin system: API for third-party extensions
 - Objective #1: a plugin must be manageable using a single Python script, which includes an extension of *ImageProcessor*, *ActionHandler* and new file format support
 - Objective #2: plugins must be simply stored in a folder which defaults to the user directory (same folder as “.DataLab.ini” configuration file)
- Add a macro-command system:
 - New embedded Python editor
 - Scripts using the same API as high-level applicative test scenarios
 - Support for macro recording
- Add an xmlrpc server to allow DataLab remote control:
 - Controlling DataLab main features (open a signal or an image, open a HDF5 file, etc.) and processing features (run a computation, etc.)
 - Take control of DataLab from a third-party software
 - Run interactive calculations from an IDE (e.g. Spyder or Visual Studio Code)

4.4.6 Changelog

See DataLab [roadmap page](#) for future and past milestones.

DataLab Version 0.19.0

New features and enhancements:

- Image operation features (“Operations” menu):
 - Renamed “Rotation” submenu to “Flip or rotation”
 - New “Flip diagonally” feature
- Signal processing features (“Processing” menu):
 - New “Convert to Cartesian coordinates” feature
 - New “Convert to polar coordinates” feature
- Signal analysis features (“Analysis” menu):
 - Renamed “X values at min/max” to “Abscissa of the minimum and maximum”
 - New “Abscissa at y=...” feature
- New “Open from directory” feature:
 - This feature allows to open multiple files from a directory at once, recursively (only the files with the supported extensions by the current panel are opened)
 - Add “Open from directory” action to the “File” menu for both Signal and Image panels
 - Add support for folders when dropping files in the Signal and Image panels
- Add 1/x operation to the “Operations” menu for both Signal and Image panels:

- This feature relies on the `numpy.reciprocal` function, and handles the case where the denominator is zero by catching warnings and replacing the `np.inf` values with `np.nan` values
- Add `compute_inverse` method for image and signal processors
- This closes [Issue #143](#) - New feature: $1/x$ for signals and images
- Public API (local or remote):
 - Add `add_group` method with `title` and `select` arguments to create a new group in a data panel (e.g. Signal or Image panel) and eventually select it after creation:
 - * Method was added to the following classes: `AbstractCDLControl`, `BaseDataPanel` and `RemoteClient`
 - * This closes the following issues:
 - [Issue #131](#) - `BaseDataPanel.add_group`: add `select` argument
 - [Issue #47](#) - Remote proxy / Public API: add `add_group` method
 - `AbstractCDLControl.get_object_uuids`: add an optional `group` argument (group ID, title or number) to eventually filter the objects by group (this closes [Issue #130](#))
- When opening an HDF5 file, the confirmation dialog box asking if current workspace should be cleared has a new possible answer “Ignore”:
 - Choosing “Ignore” will prevent the confirmation dialog box from being displayed again, and will choose the current setting (i.e. clear or not the workspace) for all subsequent file openings
 - Added a new “Clear workspace before loading HDF5 file” option in the “Settings” dialog box, to allow the user to change the current setting (i.e. clear or not the workspace) for all subsequent file openings
 - Added a new “Ask before clearing workspace” option in the “Settings” dialog box, to allow the user to disable or re-enable the confirmation dialog box asking if current workspace should be cleared when opening an HDF5 file
 - This closes [Issue #146](#) - Ask before clearing workspace when opening HDF5 file: add “Ignore” option to prevent dialog from being displayed again
- Object and group title renaming:
 - Removed “Rename group” feature from the “Edit” menu and context menu
 - Added “Rename object” feature to the “Edit” menu and context menu, with F2 shortcut, to rename the title of the selected object or group
 - This closes [Issue #148](#) - Rename signal/image/group title by pressing F2
- Region of Interest editor:
 - Regrouped the graphical actions (new rectangular ROI, new circular ROI, new polygonal ROI) in a single menu “Graphical ROI”
 - Added new “Coordinate-based ROI” menu to create a ROI using manual input of the coordinates:
 - * For signals, the ROI is defined by the start and end coordinates
 - * For images:
 - The rectangular ROI is defined by the top-left and bottom-right coordinates
 - The circular ROI is defined by the center and radius coordinates
 - The polygonal ROI is not supported yet
 - * This closes [Issue #145](#) - ROI editor: add manual input of the coordinates

Bug fixes:

- Fixed [Issue #141](#) - Image analysis: mask nan values when computing statistics, for example
- Fixed [Issue #144](#) - Average profile extraction: `ValueError` when selection rectangle is larger than the image

DataLab Version 0.18.2

General information:

- Python 3.13 is now supported, since the availability of the scikit-image V0.25 (see [Issue #104](#) - Python 3.13: `KeyError: 'area_bbox'`)

Enhancements:

- Added new “Keep results after computation” option in “Processing” section:
 - Before this change, when applying a processing feature (e.g. a filter, a threshold, etc.) on a signal or an image, the analysis results were removed from the object
 - This new option allows to keep the analysis results after applying a processing feature on a signal or an image. Even if the analysis results are not updated, they might be relevant in some use cases (e.g. when using the 2D peak detection feature on an image, and then applying a filter on the image, or summing two images, etc.)

Bug fixes:

- Fixed [Issue #138](#) - Image colormaps were no longer stored in metadata (and serialized in HDF5 files) since PlotPy v2.6.3 (this commit, specifically: [PlotPyStack/PlotPy@a37af8a](#))
- Fixed [Issue #137](#) - Arithmetic operations and signal interpolation: dialog box with parameters is not displayed
- Fixed [Issue #136](#) - When processing a signal or an image, the analysis result is kept from original object
 - Before this fix, when processing a signal or an image (e.g. when applying a filter, a threshold, etc.), the analysis result was kept from the original object, and was not updated with the new data. Thus the analysis result was not meaningful anymore, and was misleading the user.
 - This is now fixed: the analysis result is now removed when processing a signal or an image. However it is not recalculated automatically, because there is no way to know which analysis result should be recalculated (e.g. if the user has applied a filter, should the FWHM be recalculated?) - besides, the current implementation of the analysis features does not allow to recalculate the analysis results automatically when the data is modified. The user has to recalculate the analysis results manually if needed.
- Fixed [Issue #132](#) - Plot analysis results: “One curve per result title” mode ignores ROIs
 - Before this fix, the “One curve per result title” mode was ignoring ROIs, and was plotting the selected result for all objects (signals or images) without taking into account the ROI defined on the objects
 - This is now fixed: the “One curve per result title” mode now takes into account the ROI defined on the objects, and plots the selected result for each object (signal or image) and for each ROI defined on the object
- Fixed [Issue #128](#) - Support long object titles in Signal and Image panels
- Fixed [Issue #133](#) - Remove specific analysis results from metadata clipboard during copy operation
- Fixed [Issue #135](#) - Allow to edit ROI on multiple signals or images at once
 - Before this fix, the ROI editor was disabled when multiple signals or images were selected
 - This is now fixed: the ROI editor is now enabled when multiple signals or images are selected, and the ROI is applied to all selected signals or images (only the ROI of the first selected signal or image is taken into account)

- This new behavior is consistent with the ROI extraction feature, which allows to extract the ROI on multiple signals or images at once, based on the ROI defined on the first selected signal or image
- Image ROI features:
 - Fixed [Issue #120](#) - ROI extraction on multiple images: defined ROI should not be saved in the first selected object. The design choice is to save the defined ROI neither in the first nor in any of the selected objects: the ROI is only used for the extraction, and is not saved in any object
 - Fixed [Issue #121](#) - `AttributeError` when extracting multiple ROIs on a single image, if more than one image is selected
 - Fixed [Issue #122](#) - Image masks are not refreshed when removing metadata except for the active image
 - Fixed [Issue #123](#) - Image masks are not refreshed when pasting metadata on multiple images, except for the last image
- Text and CSV files:
 - Enhance text file reading by detecting data headers (using a list of typical headers from scientific instruments) and by allowing to skip the header when reading the file
 - Ignore encoding errors when reading files in both open feature and import wizard, hence allowing to read files with special characters without raising an exception
 - Fixed [Issue #124](#) - Text files: support locale decimal separator (different than .)
- Signal analysis features: fixed duplicate results when no ROI is defined
- Fixed [Issue #113](#) - Call to `RemoteClient.open_h5_files` (and `import_h5_file`) fails without passing the optional arguments
- Fixed [Issue #116](#) - `KeyError` exception when trying to remove a group after opening an HDF5 file

DataLab Version 0.18.1

Enhancements:

- FWHM computation now raises an exception when less than two points are found with zero-crossing method
- Improved result validation for array-like results by checking the data type of the result

Bug fixes:

- Fixed [Issue #106](#) - Analysis: coordinate shifted results on images with ROIs and shifted origin
- Fixed [Issue #107](#) - Wrong indices when extracting a profile from an image with a ROI
- Fixed [Issue #111](#) - Proxy `add_object` method does not support signal/image metadata (e.g. ROI)
- Test data plugin / “Create 2D noisy gauss image”: fixed amplitude calculation in `cdl.tests.data.create_2d_random` for non-integer data types

Documentation:

- Fixed path separators in plugin directory documentation
- Corrected left and right area descriptions in workspace documentation
- Updated Google style link in contributing guidelines
- Fixed various French translations in the documentation

DataLab Version 0.18.0

General information:

- PlotPy v2.7 is required for this release.
- Dropped support for Python 3.8.
- Python 3.13 is not supported yet, due to the fact that some dependencies are not compatible with this version.

New features and enhancements:

- New operation mode feature:
 - Added “Operation mode” feature to the “Processing” tab in the “Settings” dialog box
 - This feature allows to choose between “single” and “pairwise” operation modes for all basic operations (addition, subtraction, multiplication, division, etc.):
 - * “Single” mode: single operand mode (default mode: the operation is done on each object independently)
 - * “Pairwise” mode: pairwise operand mode (the operation is done on each pair of objects)
 - This applies to both signals and images, and to computations taking N inputs
 - Computations taking N inputs are the ones where:
 - * $N(\geq 2)$ objects in give N objects out
 - * $N(\geq 1)$ object(s) + 1 object in give N objects out
- New ROI (Region Of Interest) features:
 - New polygonal ROI feature
 - Complete redesign of the ROI editor user interfaces, improving ergonomics and consistency with the rest of the application
 - Major internal refactoring of the ROI system to make it more robust (more tests) and easier to maintain
- Implemented [Issue #102](#) - Launch DataLab using `dataLab` instead of `cdl`. Note that the `cdl` command is still available for backward compatibility.
- Implemented [Issue #101](#) - Configuration: set default image interpolation to anti-aliasing (5 instead of 0 for nearest). This change is motivated by the fact that a performance improvement was made in PlotPy v2.7 on Windows, which allows to use anti-aliasing interpolation by default without a significant performance impact.
- Implemented [Issue #100](#) - Use the same installer and executable on Windows 7 SP1, 8, 10, 11. Before this change, a specific installer was required for Windows 7 SP1, due to the fact that Python 3.9 and later versions are not supported on this platform. A workaround was implemented to make DataLab work on Windows 7 SP1 with Python 3.9.

Bug fixes:

- Fixed [Issue #103](#) - `proxy.add_annotations_from_items`: circle shape color seems to be ignored.

DataLab Version 0.17.1

PlotPy v2.6.2 is required for this release.

New features and enhancements:

- Image View:
 - Before this release, when selecting a high number of images (e.g. when selecting a group of images), the application was very slow because all the images were displayed in the image view, even if they were all superimposed on the same image
 - The workaround was to enable the “Show first only” option
 - Now, to improve performance, if multiple images are selected, only the last image of the selection is displayed in the image view if this last image has no transparency and if the other images are completely covered by this last image
- Clarification: action “Show first only” was renamed to “Show first object only”, and a new icon was added to the action
- API: added `width` and `height` properties to `ImageObj` class (returns the width and height of the image in physical units)
- Windows launcher “start.pyw”: writing a log file “datalab_error.log” when an exception occurs at startup

Bug fixes:

- Changing the color theme now correctly updates all DataLab’s user interface components without the need to restart the application

Other changes:

- OpenCV is now an optional dependency:
 - This change is motivated by the fact that the OpenCV conda package is not maintained on Windows (at least), which leads to an error when installing DataLab with conda
 - When OpenCV is not installed, only the “OpenCV blob detection” feature won’t work, and a warning message will be displayed when trying to use this feature

DataLab Version 0.17.0

PlotPy v2.6 is required for this release.

New features and enhancements:

- Menu “Computing” was renamed to “Analysis” for both Signal and Image panels, to better reflect the nature of the features in this menu
- Regions Of Interest (ROIs) are now taken into account everywhere in the application where it makes sense, and not only for the old “Computing” menu (now “Analysis”) features. This closes [Issue #93](#). If a signal or an image has an ROI defined:
 - Operations are done on the ROI only (except if the operation changes the data shape, or the pixel size for images)
 - Processing features are done on the ROI only (if the destination object data type is compatible with the source object data type, which excludes thresholding, for instance)
 - Analysis features are done on the ROI only, like before
- As a consequence of previous point, and for clarity:

- The “Edit Regions of interest” and “Remove all Regions of interest” features have been moved from the old “Computing” (now “Analysis”) menu to the “Edit” menu where all metadata-related features are located
- The “Edit Regions of interest” action has been added to both Signal and Image View vertical toolbars (in second position, after the “View in a new window” action)
- Following the bug fix on image data type conversion issues with basic operations, a new “Arithmetic operation” feature has been added to the “Operations” menu for both Signal and Image panels. This feature allows to perform linear operations on signals and images, with the following operations:
 - Addition: $\text{obj3} = (\text{obj1} + \text{obj2}) * a + b$
 - Subtraction: $\text{obj3} = (\text{obj1} - \text{obj2}) * a + b$
 - Multiplication: $\text{obj3} = (\text{obj1} * \text{obj2}) * a + b$
 - Division: $\text{obj3} = (\text{obj1} / \text{obj2}) * a + b$
- Improved “View in a new window” and “ROI editor” dialog boxes size management: default size won’t be larger than DataLab’s main window size
- ROI editor:
 - Added toolbars for both Signal and Image ROI editors, to allow to zoom in and out, and to reset the zoom level easily
 - Rearranged the buttons in the ROI editor dialog box for better ergonomics and consistency with the Annotations editor (“View in a new window” dialog box)
- Application color theme:
 - Added support for color theme (auto, light, dark) in the “Settings” dialog box
 - The color theme is applied without restarting the application

Bug fixes:

- Intensity profile / Segment profile extraction:
 - When extracting a profile on an image with a ROI defined, the associated PlotPy feature show a warning message (‘UserWarning: Warning: converting a masked element to nan.’) but the profile is correctly extracted and displayed, with NaN values where the ROI is not defined.
 - NaN values are now removed from the profile before plotting it
- Simple processing features with a one-to-one mapping with a Python function (e.g. `numpy.absolute`, `numpy.log10`, etc.) and without parameters: fix result object title which was systematically ending with “|” (the character that usually precedes the list of parameters)
- Butterworth filter: fix cutoff frequency ratio default value and valid range
- Fix actions refresh issue in Image View vertical toolbar:
 - When starting DataLab with the Signal Panel active, switching to the Image View was showing “View in a new window” or “Edit Regions of interest” actions enabled in the vertical toolbar, even if no image was displayed in the Image View
 - The Image View vertical toolbar is now correctly updated at startup
- View in a new window: cross section tools (intensity profiles) stayed disabled unless the user selected an image through the item list - this is now fixed
- Image View: “Show contrast panel” toolbar button was not enabled at startup, and was only enabled when at least one image was displayed in the Image View - it is now always enabled, as expected
- Image data type conversion:

- Previously, the data type conversion feature was common to signal and image processing features, i.e. a simple conversion of the data type using NumPy's `astype` method
- This was not sufficient for image processing features, in particular for integer images, because even if the result was correct from a numerical point of view, underflow or overflow could be legitimately seen as a bug from a mathematical point of view
- The image data type conversion feature now relies on the internal `clip_astype` function, which clips the data to the valid range of the target data type before converting it (in the case of integer images)
- Image ROI extraction issues:
 - Multiple regressions were introduced in version 0.16.0:
 - * Single circular ROI extraction was not working as expected (a rectangular ROI was extracted, with unexpected coordinates)
 - * Multiple circular ROI extraction lead to a rectangular ROI extraction
 - * Multiple ROI extraction was no longer cropping the image to the overall bounding box of the ROIs
 - These issues are now fixed, and unit tests have been added to prevent regressions:
 - * An independent test algorithm has been implemented to check the correctness of the ROI extraction in all cases mentioned above
 - * Tests cover both single and multiple ROI extraction, with circular and rectangular ROIs
- Overflow and underflow issues in some operations on integer images:
 - When processing integer images, some features were causing overflow or underflow issues, leading to unexpected results (correct results from a numerical point of view, but not from a mathematical point of view)
 - This issue only concerned basic operations (addition, subtraction, multiplication, division, and constant operations) - all the other features were already working as expected
 - This is now fixed as result output are now floating point images
 - Unit tests have been added to prevent regressions for all these operations

DataLab Version 0.16.4

This is a minor maintenance release.

Bug fixes:

- Requires PlotPy v2.4.1 or later to fix the following issues related to the contrast adjustment feature:
 - A regression was introduced in an earlier version of PlotPy: levels histogram was no longer removed from contrast adjustment panel when the associated image was removed from the plot
 - This is now fixed: when an image is removed, the histogram is removed as well and the contrast panel is refreshed (which was not the case even before the regression)
- Ignore `AssertionError` in `config_unit_test.py` when executing test suite on WSL

Documentation:

- Fix class reference in `Wrap11Func` documentation

DataLab Version 0.16.3

Bug fixes:

- Fixed [Issue #84](#) - Build issues with V0.16.1: signal name conflict, ...
 - This issue was intended to be fixed in version 0.16.2, but the fix was not complete
 - Thanks to [@rolandmas](#) for reporting the issue and for the help in investigating the problem and testing the fix
- Fixed [Issue #85](#) - Test data paths may be added multiple times to `cdl.utils.tests.TST_PATH`
 - This issue is related to [Issue #84](#)
 - Adding the test data paths multiple times to `cdl.utils.tests.TST_PATH` was causing the test data to be loaded multiple times, which lead to some tests failing (a simple workaround was added to V0.16.2: this issue is now fixed)
 - Thanks again to [@rolandmas](#) for reporting the issue in the context of the Debian packaging
- Fixed [Issue #86](#) - Average of N integer images overflows data type
- Fixed [Issue #87](#) - Image average profile extraction: `AttributeError` when trying to edit profile parameters
- Fixed [Issue #88](#) - Image segment profile: point coordinates inversion

DataLab Version 0.16.2

This release requires PlotPy v2.4.0 or later, which brings the following bug fixes and new features:

- New contrast adjustment features and bug fixes:
 - New layout: the vertical toolbar (which was constrained in a small area on the right side of the panel) is now a horizontal toolbar at the top of the panel, beside the title
 - New “Set range” button: allows the user to set manually the minimum and maximum values of the histogram range
 - Fixed histogram update issues when no image was currently selected (even if the an image was displayed and was selected before)
 - Histogram range was not updated when either the minimum or maximum value was set using the “Minimum value” or “Maximum value” buttons (which have been renamed to “Min.” and “Max.” in this release)
 - Histogram range was not updated when the “Set full range” button was clicked, or when the LUT range was modified using the “Scales / LUT range” form in “Properties” group box
- Image view context menu: new “Reverse X axis” feature

Minor new features and enhancements:

- Image file types:
 - Added native support for reading `.SPE`, `.GEL`, `.NDPI` and `.REC` image files
 - Added support for any `imageio`-supported file format through configuration file (entry `imageio_formats` may be customized to complement the default list of supported formats: see [documentation](#) for more details)

Bug fixes:

- Image Fourier analysis:
 - Fixed logarithmic scale for the magnitude spectrum (computing dB instead of natural logarithm)
 - Fixed PSD computation with logarithmic scale (computing dB instead of natural logarithm)

- Updated the documentation to explicitly mention that the logarithmic scale is in dB
- Fixed [Issue #82](#) - Macros are not renamed in DataLab after exporting them to Python scripts
- `ResultProperties` object can now be added to `SignalObj` or `ImageObj` metadata even outside a Qt event loop (because the label item is no longer created right away)
- Progress bar is now automatically closed as expected when an error occurs during a long operation (e.g. when opening a file)
- Difference, division...: dialog box for the second operand selection was allowing to select a group (only a signal or an image should be selected)
- When doing an operation which involves an object (signal or image) with higher order number than the current object (e.g. when subtracting an image with an image from a group below the current image), the resulting object's title now correctly refers to the order numbers of the objects involved in the operation (e.g., to continue with the subtraction example mentioned above, the resulting object's title was previously referring to the order number before the insertion of the resulting image)
- Added support for additional test data folder thanks to the `CDL_DATA` environment variable (useful for testing purposes, and especially in the context of Debian packaging)

DataLab Version 0.16.1

Since version 0.16.0, many validation functions have been added to the test suite. The percentage of validated compute functions has increased from 37% to 84% in this release.

NumPy 2.0 support has been added with this release.

Minor new features and enhancements:

- Signal and image moving average and median filters:
 - Added “Mode” parameter to choose the mode of the filter (e.g. “reflect”, “constant”, “nearest”, “mirror”, “wrap”)
 - The default mode is “reflect” for moving average and “nearest” for moving median
 - This allows to handle edge effects when filtering signals and images

Bug fixes:

- Fixed Canny edge detection to return binary image as `uint8` instead of `bool` (for consistency with other image processing features)
- Fixed Image normalization: lower bound was wrongly set for `maximum` method
- Fixed `ValueError` when computing PSD with logarithmic scale
- Fixed Signal derivative algorithm: now using `numpy.gradient` instead of a custom implementation
- Fixed SciPy's `cumtrapz` deprecation: use `cumulative_trapezoid` instead
- Curve selection now shows the individual points of the curve (before, only the curve line width was broadened)
- Windows installer: add support for unstable releases (e.g., 0.16.1.dev0), thus allowing to easily install the latest development version of DataLab on Windows
- Fixed [Issue #81](#) - When opening files, show progress dialog only if necessary
- Fixed [Issue #80](#) - Plotting results: support for two use cases
 - The features of the “Analysis” menu produce *results* (scalars): blob detection (circle coordinates), 2D peak detection (point coordinates), etc. Depending on the feature, result tables are displayed in the “Results” dialog box, and the results are also stored in the signal or image metadata: each line of the result table is

an individual result, and each column is a property of the result - some results may consist only of a single individual result (e.g., image centroid or curve FWHM), while others may consist of multiple individual results (e.g., blob detection, contour detection, etc.).

- Before this change, the “Plot results” feature only supported plotting the first individual result of a result table, as a function of the index (of the signal or image objects) or any of the columns of the result table. This was not sufficient for some use cases, where the user wanted to plot multiple individual results of a result table.
- Now, the “Plot results” feature supports two use cases:
 - * “One curve per result title”: Plotting the first individual result of a result table, as before
 - * “One curve per object (or ROI) and per result title”: Plotting all individual results of a result table, as a function of the index (of the signal or image objects) or any of the columns of the result table
- The selection of the use case is done in the “Plot results” dialog box
- The default use case is “One curve per result title” if the result table has only one line, and “One curve per object (or ROI) and per result title” otherwise

DataLab Version 0.16.0

New features and enhancements:

- Major user interface overhaul:
 - The menu bar and toolbars have been reorganized to make the application more intuitive and easier to use
 - Operations and processing features have been regrouped in submenus
 - All visualization-related actions are now grouped in the plot view vertical toolbar
 - Clarified the “Annotations” management (new buttons, toolbar action...)
- New validation process for signal and image features:
 - Before this release, DataLab’s validation process was exclusively done from the programmer’s point of view, by writing unit tests and integration tests, thus ensuring that the code was working as expected (i.e. that no exception was raised and that the behavior was correct)
 - With this release, a new validation process has been introduced, from the user’s point of view, by adding new validation functions (marked with the `@pytest.mark.validation` decorator) in the test suite
 - A new “Validation” section in the documentation explains how validation is done and contains a list of all validation functions with the statistics of the validation process (generated from the test suite)
 - The validation process is a work in progress and will be improved in future versions
- “Properties” group box:
 - Added “Scales” tab, to show and set the plot scales:
 - * X, Y for signals
 - * X, Y, Z (LUT range) for images
- View options:
 - New “Show first only” option in the “View” menu, to show only the first curve (or image) when multiple curves (or images) are displayed in the plot view
 - New (movable) label for FWHM computations, additional to the existing segment annotation
- I/O features:

- Added support for reading and writing .MAT files (MATLAB format)
- Create a new group when opening a file containing multiple signals or images (e.g. CSV file with multiple curves)
- Add support for binary images
- Signal ROI extraction: added new dialog box to manually edit the ROI lower and upper bounds after defining the ROI graphically

New **Signal** operations, processing and analysis features:

Menu	Submenu	Features
New Op- era- tions Op- era- tions	New signal	Exponential, pulse, polynomial, experimental (manual input) Exponential, Square root, Power
	Operations with a constant	+, -, *, /
Pro- cess- ing	Axis Trans- formation	Reverse X-axis
Pro- cess- ing	Level Adjust- ment	Offset correction
Pro- cess- ing	Fourier analy- sis	Power spectrum, Phase spectrum, Magnitude spectrum, Power spectral density
Pro- cess- ing	Frequency fil- ters	Low-pass, High-pass, Band-pass, Band-stop
Pro- cess- ing		Windowing (Hanning, Hamming, Blackman, Blackman-Harris, Nuttall, Flat-top...)
Pro- cess- ing	Fit	Linear fit, Sinusoidal fit, Exponential fit, CDF fit
Anal- ysis		FWHM (Zero-crossing method), X value @ min/max, Sampling period/frequency, Dynamic parameters (ENOB, SNR, SINAD, THD, SFDR), -3dB bandwidth, Contrast

New **Image** operations, processing and analysis features:

Menu	Submenu	Features
Operations		Exponential
Operations	Intensity profiles	Profile along a segment
Operations	Operations with a constant	+, -, *, /
Processing	Level Adjustment	Normalization, Clipping, Offset correction
Processing	Fourier analysis	Power spectrum, Phase spectrum, Magnitude spectrum, Power spectral density
Processing	Thresholding	Parametric, ISODATA, Li, Mean, Minimum, Otsu, Triangle, Yen

Bug fixes:

- Fixed a performance issue due to an unnecessary refresh of the plot view when adding a new signal or image
- Fixed [Issue #77](#) - Intensity profiles: unable to accept dialog the second time
- Fixed [Issue #75](#) - View in a new window: curve anti-aliasing is not enabled by default
- Annotations visibility is now correctly saved and restored:
 - Before this release, when modifying the annotations visibility in the separate plot view, the visibility was not saved and restored when reopening the plot view
 - This has been [fixed upstream](#) in PlotPy (v2.3.3)

DataLab Version 0.15.1

Bug fixes:

- Fixed [Issue #68](#) - Slow loading of even simple plots:
 - On macOS, the user experience was degraded when handling even simple plots
 - This was due to the way macOS handles the pop-up windows, e.g. when refreshing the plot view (“Creating plot items” progress bar), hence causing a very annoying flickering effect and a global slowdown of the application
 - This is now fixed by showing the progress bar only after a short delay (1s), that is when it is really needed (i.e. for long operations)
 - Thanks to [@marcel-goldschen-ohm](#) for the very thorough feedback and the help in testing the fix
- Fixed [Issue #69](#) - Annotations should be read-only in Signal/Image View
 - Regarding the annotations, DataLab’s current behavior is the following:
 - * Annotations are created only when showing the signal/image in a separate window (double-click on the object, or “View” > “View in a new window”)
 - * When displaying the objects in either the “Signal View” or the “Image View”, the annotations should be read-only (i.e. not movable, nor resizable or deletable)
 - However, some annotations were still deletable in the “Signal View” and the “Image View”: this is now fixed

- Note that the fact that annotations can't be created in the "Signal View" or the "Image View" is a limitation of the current implementation, and may be improved in future versions

DataLab Version 0.15.0

New installer for the stand-alone version on Windows:

- The stand-alone version on Windows is now distributed as an MSI installer (instead of an EXE installer)
- This avoids the false positive detection of the stand-alone version as a potential threat by some antivirus software
- The program will install files and shortcuts:
 - For current user, if the user has no administrator privileges
 - For all users, if the user has administrator privileges
 - Installation directory may be customized
- MSI installer allows to integrate DataLab's installation seamlessly in an organization's deployment system

New features and enhancements:

- Added support for large text/CSV files:
 - Files over 1 GB (and with reasonable number of lines) can now be imported as signals or images without crashing the application or even slowing it down
 - The file is read by chunks and, for signals, the data is downsampled to a reasonable number of points for visualization
 - Large files are supported when opening a file (or dragging and dropping a file in the Signal Panel) and when importing a file in the Text Import Wizard
- Auto downsampling feature:
 - Added "Auto downsampling" feature to signal visualization settings (see "Settings" dialog box)
 - This feature allows to automatically downsample the signal data for visualization when the number of points is too high and would lead to a slow rendering
 - The downsampling factor is automatically computed based on the configured maximum number of points to display
 - This feature is enabled by default and may be disabled in the signal visualization settings
- CSV format handling:
 - Improved support for CSV files with a header row (column names)
 - Added support for CSV files with empty columns
- Open/save file error handling:
 - Error messages are now more explicit when opening or saving a file fails
 - Added a link to the folder containing the file in the error message
- Added "Plugins and I/O formats" page to the Installation and Configuration Viewer (see "Help" menu)
- Reset DataLab configuration:
 - In some cases, it may be useful to reset the DataLab configuration file to its default values (e.g. when the configuration file is corrupted)
 - Added new `--reset` command line option to remove the configuration folder

- Added new “Reset DataLab” Start Menu shortcut to the Windows installer

Bug fixes:

- Fixed [Issue #64](#) - HDF5 browser does not show datasets with 1x1 size:
 - HDF5 datasets with a size of 1x1 were not shown in the HDF5 browser
 - Even if those datasets should not be considered as signals or images, they are now shown in the HDF5 browser (but not checkable, i.e. not importable as signals or images)

DataLab Version 0.14.2

API changes required for fixing support for multiple signals loading feature:

- Merged `open_object` and `open_objects` methods to `load_from_files` in proxy classes, main window and data panels
- For consistency's sake: merged `save_object` and `save_objects` into `save_to_files`
- To sum up, those changes lead to the following situation:
 - `load_from_files`: load a sequence of objects from multiple files
 - `save_to_files`: save a sequence of objects to multiple files (at the moment, it only supports saving a single object to a single file, but it may be extended in the future to support saving multiple objects to a single file)

Bug fixes:

- Fixed [Issue #61](#) - Text file import wizard: application crash when importing a multiple curve text file:
 - This issue concerns a use case where the text file contains multiple curves
 - This is now fixed and an automatic test has been added to prevent regressions

DataLab Version 0.14.1

New domain name: datalab-platform.com

New features:

- Added support for colormap inversion in Image View:
 - New “Invert colormap” entry in plot context menu, image parameters, and in the default image view settings
 - This requires `PlotPy` v2.3 or later
- HDF5 Browser:
 - Added “Show array” button at the corner of the “Group” and “Attributes” tabs, to show the array in a separate window (useful for copy/pasting data to other applications, for instance)
 - Attributes: added support for more scalar data types
- Testability and maintainability:
 - DataLab's unit tests are now using `pytest`. This has required a lot of work for the transition, especially to readapt the tests so that they may be executed in the same process. For instance, a particular attention has been given to sandboxing the tests, so that they do not interfere with each other.
 - Added continuous integration (CI) with GitHub Actions
 - For this release, test coverage is 87%

- Text file import assistant:
 - Drastically improved the performance of the array preview when importing large text files (no more progress bar, and the preview is now displayed almost instantaneously)

Bug fixes:

- XML-RPC server was not shut down properly when closing DataLab
- Fixed test-related issues: some edge cases were hidden by the old test suite, and have been revealed by the transition to `pytest`. This has led to some bug fixes and improvements in the code.
- On Linux, when running a computation on a signal or an image, and on rare occasions, the computation was stuck as if it was running indefinitely. Even though the graphical user interface was still responsive, the computation was not progressing and the user had to cancel the operation and restart it. This was due to the start method of the separate process used for the computation (default method was “fork” on Linux). This is now fixed by using the “spawn” method instead, which is the recommended method for latest versions of Python on Linux when multithreading is involved.
- Fixed [Issue #60](#) - `OSError: Invalid HDF5 file [...] when trying to open an HDF5 file with an extension other than “.h5”`
- Image Region of Interest (ROI) extraction: when modifying the image bounds in the confirmation dialog box, the ROI was not updated accordingly until the operation was run again
- Deprecation issues:
 - Fixed `scipy.ndimage.filters` deprecation warning
 - Fixed `numpy.fromstring` deprecation warning

DataLab Version 0.14.0

New features:

- New “Histogram” feature in “Analysis” menu:
 - Added histogram computation feature for both signals and images
 - The histogram is computed on the regions of interest (ROI) if any, or on the whole signal/image if no ROI is defined
 - Editable parameters: number of bins, lower and upper bounds
- HDF5 browser:
 - Improved tree view layout (more compact and readable)
 - Multiple files can now be opened at once, using the file selection dialog box
 - Added tabs with information below the graphical preview:
 - * Group info: path, textual preview, etc.
 - * Attributes info: name, value
 - Added “Show only supported data” check box: when checked, only supported data (signals and images) are shown in the tree view
 - Added “Show values” check box, to show/hide the values in the tree view
- Macro Panel:
 - Macro commands are now numbered, starting from 1, like signals and images
- Remote control API (`RemoteProxy` and `LocalProxy`):

- `get_object_titles` method now accepts “macro” as panel name and returns the list of macro titles
- New `run_macro`, `stop_macro` and `import_macro_from_file` methods

Bug fixes:

- Stand-alone version - Integration in Windows start menu:
 - Fixed “Uninstall” shortcut (unclickable due to a generic name)
 - Translated “Browse installation directory” and “Uninstall” shortcuts
- Fixed [Issue #55](#) - Changing image bounds in Image View has no effect on the associated image object properties
- Fixed [Issue #56](#) - “Test data” plugin: `AttributeError: 'NoneType' object has no attribute 'data'` when canceling “Create image with peaks”
- Fixed [Issue #57](#) - Circle and ellipse result shapes are not transformed properly
- Curve color and style cycle:
 - Before this release, this cycle was handled by the same mechanism either for the Signal Panel or the HDF5 Browser, which was not the expected behavior
 - Now, the cycle is handled separately: the HDF5 Browser or the Text Import Wizard use always the same color and style for curves, and they don’t interfere with the Signal Panel cycle

DataLab Version 0.12.0

Clarity-Enhanced Interface Update:

- The tabs used to switch between the data panels (signals and images) and the visualization components (“Curve panel” and “Image panel”) have been renamed to “Signal Panel” and “Image Panel” (instead of “Signals” and “Images”)
- The visualization components have been renamed to “Signal View” and “Image View” (instead of “Curve panel” and “Image panel”)
- The data panel toolbar has been renamed to “Signal Toolbar” and “Image Toolbar” (instead of “Signal Processing Toolbar” and “Image Processing Toolbar”)
- Ergonomics improvements: the “Signal Panel” and “Image Panel” are now displayed on the left side of the main window, and the “Signal View” and “Image View” are displayed on the right side of the main window. This reduces the distance between the list of objects (signals and images) and the associated actions (toolbars and menus), and makes the interface more intuitive and easier to use

New tour and demo feature:

- When starting DataLab for the first time, an optional tour is now shown to the user to introduce the main features of the application
- The tour can be started again at any time from the “?” menu
- Also added a new “Demo” feature to the “?” menu

New Binder environment to test DataLab online without installing anything

Documentation:

- New text tutorials are available:
 - Measuring Laser Beam Size
 - DataLab and Spyder: a perfect match
- “Getting started” section: added more explanations and links to the tutorials

- New “Contributing” section explaining how to contribute to DataLab, whether you are a developer or not
- New “Macros” section explaining how to use the macro commands feature
- Added “Copy” button to code blocks in the documentation

New features:

- New “Text file import assistant” feature:
 - This feature allows to import text files as signals or images
 - The user can define the source (clipboard or text file)
 - Then, it is possible to define the delimiter, the number of rows to skip, the destination data type, etc.
- Added menu on the “Signal Panel” and “Image Panel” tabs corner to quickly access the most used features (e.g. “Add”, “Remove”, “Duplicate”, etc.)
- Intensity profile extraction feature:
 - Added graphical user interface to extract intensity profiles from images, for both line and averaged profiles
 - Parameters are still directly editable by the user (“Edit profile parameters” button)
 - Parameters are now stored from one profile extraction to another
- Statistics feature:
 - Added $\langle y \rangle$ / (y) to the signal “Statistics” result table (in addition to the mean, median, standard deviation, etc.)
 - Added peak-to-peak to the signal and image “Statistics” result table
- Curve fitting feature: fit results are now stored in a dictionary in the signal metadata (instead of being stored individually in the signal metadata)
- Window state:
 - The toolbars and dock widgets state (visibility, position, etc.) are now stored in the configuration file and restored at startup (size and position were already stored and restored)
 - This implements part of [Issue #30](#) - Save/restore main window layout

Bug fixes:

- Fixed [Issue #41](#) - Radial profile extraction: unable to enter user-defined center coordinates
- Fixed [Issue #49](#) - Error when trying to open a (UTF-8 BOM) text file as an image
- Fixed [Issue #51](#) - Unexpected dimensions when adding new ROI on an image with X/Y arbitrary units (not pixels)
- Improved plot item style serialization management:
 - Before this release, the plot item style was stored in the signal/image metadata only when saving the workspace to an HDF5 file. So, when modifying the style of a signal/image from the “Parameters” button (view toolbar), the style was not kept in some cases (e.g. when duplicating the signal/image).
 - Now, the plot item style is stored in the signal/image metadata whenever the style is modified, and is restored when reloading the workspace
- Handled `ComplexWarning` cast warning when adding regions of interest (ROI) to a signal with complex data

DataLab Version 0.11.0

New features:

- Signals and images may now be reordered in the tree view:
 - Using the new “Move up” and “Move down” actions in the “Edit” menu (or using the corresponding toolbar buttons):
 - This fixes [Issue #22](#) - Add “move up/down” actions in “Edit” menu, for signals/images and groups
- Signals and images may also be reordered using drag and drop:
 - Signals and images can be dragged and dropped inside their own panel to change their order
 - Groups can also be dragged and dropped inside their panel
 - The feature also supports multi-selection (using the standard Ctrl and Shift modifiers), so that multiple signals/images/groups can be moved at once, not necessarily with contiguous positions
 - This fixes [Issue #17](#) - Add Drag and Drop feature to Signals/Images tree views
- New 1D interpolation features:
 - Added “Interpolation” feature to signal panel’s “Processing” menu
 - Methods available: linear, spline, quadratic, cubic, barycentric and PCHIP
 - Thanks to [@marcel-goldschen-ohm](#) for the contribution to spline interpolation
 - This fixes [Issue #20](#) - Add 1D interpolation features
- New 1D resampling feature:
 - Added “Resampling” feature to signal panel’s “Processing” menu
 - Same interpolation methods as for the “Interpolation” feature
 - Possibility to specify the resampling step or the number of points
 - This fixes [Issue #21](#) - Add 1D resampling feature
- New 1D convolution feature:
 - Added “Convolution” feature to signal panel’s “Operation” menu
 - This fixes [Issue #23](#) - Add 1D convolution feature
- New 1D detrending feature:
 - Added “Detrending” feature to signal panel’s “Processing” menu
 - Methods available: linear or constant
 - This fixes [Issue #24](#) - Add 1D detrending feature
- 2D analysis results:
 - Before this release, 2D analysis results such as contours, blobs, etc. were stored in image metadata dictionary as coordinates (x0, y0, x1, y1, ...) even for circles and ellipses (i.e. the coordinates of the bounding rectangles).
 - For convenience, the circle and ellipse coordinates are now stored in image metadata dictionary as (x0, y0, radius) and (x0, y0, a, b, theta) respectively.
 - These results are also shown as such in the “Results” dialog box (either at the end of the computing process or when clicking on the “Show results” button).

- This fixes [Issue #32](#) - Contour detection: show circle (x, y, r) and ellipse (x, y, a, b, theta) instead of (x0, y0, x1, y1, ...)
- 1D and 2D analysis results:
 - Additionally to the previous enhancement, more analysis results are now shown in the “Results” dialog box
 - This concerns both 1D (FWHM...) and 2D analysis results (contours, blobs...):
 - * Segment results now also show length (L) and center coordinates (Xc, Yc)
 - * Circle and ellipse results now also show area (A)
- Added “Plot results” entry in “Analysis” menu:
 - This feature allows to plot analysis results (1D or 2D)
 - It creates a new signal with X and Y axes corresponding to user-defined parameters (e.g. X = indices and Y = radius for circle results)
- Increased default width of the object selection dialog box:
 - The object selection dialog box is now wider by default, so that the full signal/image/group titles may be more easily readable
- Delete metadata feature:
 - Before this release, the feature was deleting all metadata, including the Regions Of Interest (ROI) metadata, if any.
 - Now a confirmation dialog box is shown to the user before deleting all metadata if the signal/image has ROI metadata: this allows to keep the ROI metadata if needed.
- Image profile extraction feature: added support for masked images (when defining regions of interest, the areas outside the ROIs are masked, and the profile is extracted only on the unmasked areas, or averaged on the unmasked areas in the case of average profile extraction)
- Curve style: added “Reset curve styles” in “View” menu. This feature allows to reset the curve style cycle to its initial state.
- Plugin base classe `PluginBase`:
 - Added `edit_new_signal_parameters` method for showing a dialog box to edit parameters for a new signal
 - Added `edit_new_image_parameters` method for showing a dialog box to edit parameters for a new image (updated the `cdl_testdata.py` plugin accordingly)
- Signal and image computations API (`cdl.computations`):
 - Added wrappers for signal and image 1 -> 1 computations
 - These wrappers aim at simplifying the creation of a basic computation function operating on DataLab’s native objects (`SignalObj` and `ImageObj`) from a function operating on NumPy arrays
 - This simplifies DataLab’s internals and makes it easier to create new computing features inside plugins
 - See the `cdl_custom_func.py` example plugin for a practical use case
- Added “Radial profile extraction” feature to image panel’s “Operation” menu:
 - This feature allows to extract a radially averaged profile from an image
 - The profile is extracted around a user-defined center (x0, y0)
 - The center may also be computed (centroid or image center)

- Automated test suite:
 - Since version 0.10, DataLab’s proxy object has a `toggle_auto_refresh` method to toggle the “Auto-refresh” feature. This feature may be useful to improve performance during the execution of test scripts
 - Test scenarios on signals and images are now using this feature to improve performance
- Signal and image metadata:
 - Added “source” entry to the metadata dictionary, to store the source file path when importing a signal or an image from a file
 - This field is kept while processing the signal/image, in order to keep track of the source file path

Documentation:

- New [Tutorial section](#) in the documentation:
 - This section provides a set of tutorials to learn how to use DataLab
 - The following video tutorials are available:
 - * Quick demo
 - * Adding your own features
 - The following text tutorials are available:
 - * Processing a spectrum
 - * Detecting blobs on an image
 - * Measuring Fabry-Perot fringes
 - * Prototyping a custom processing pipeline
- New [API section](#) in the documentation:
 - This section explains how to use DataLab as a Python library, by covering the following topics:
 - * How to use DataLab algorithms on NumPy arrays
 - * How to use DataLab computation features on DataLab objects (signals and images)
 - * How to use DataLab I/O features
 - * How to use proxy objects to control DataLab remotely
 - This section also provides a complete API reference for DataLab objects and features
 - This fixes [Issue #19](#) - Add API documentation (data model, functions on arrays or signal/image objects, ...)

Bug fixes:

- Fixed [Issue #29](#) - Polynomial fit error: `QDialog [...] argument 1 has an unexpected type 'SignalProcessor'`
- Image ROI extraction feature:
 - Before this release, when extracting a single circular ROI from an image with the “Extract all ROIs into a single image object” option enabled, the result was a single image without the ROI mask (the ROI mask was only available when extracting ROI with the option disabled)
 - This was leading to an unexpected behavior, because one could interpret the result (a square image without the ROI mask) as the result of a single rectangular ROI
 - Now, when extracting a single circular ROI from an image with the “Extract all ROIs into a single image object” option enabled, the result is a single image with the ROI mask (as if the option was disabled)

- This fixes [Issue #31](#) - Single circular ROI extraction: automatically switch to `extract_single_roi` function
- Analysis on circular ROI:
 - Before this release, when running computations on a circular ROI, the results were unexpected in terms of coordinates (results seemed to be computed in a region located above the actual ROI).
 - This was due to a regression introduced in an earlier release.
 - Now, when defining a circular ROI and running computations on it, the results are computed on the actual ROI
 - This fixes [Issue #33](#) - Analysis on circular ROI: unexpected results
- Contour detection on ROI:
 - Before this release, when running contour detection on a ROI, some contours were detected outside the ROI (it may be due to a limitation of the `scikit-image find_contours` function).
 - Now, thanks a workaround, the erroneous contours are filtered out.
 - A new test module `cdl.tests.features.images.contour_fabryperot_app` has been added to test the contour detection feature on a Fabry-Perot image (thanks to [@emarin2642](#) for the contribution)
 - This fixes [Issue #34](#) - Contour detection: unexpected results outside ROI
- Analysis result merging:
 - Before this release, when doing a 1->N computation (sum, average, product) on a group of signals/images, the analysis results associated to each signal/image were merged into a single result, but only the type of result present in the first signal/image was kept.
 - Now, the analysis results associated to each signal/image are merged into a single result, whatever the type of result is.
- Fixed [Issue #36](#) - “Delete all” action enable state is sometimes not refreshed
- Image X/Y swap: when swapping X and Y axes, the regions of interest (ROI) were not removed and not swapped either (ROI are now removed, until we implement the swap feature, if requested)
- “Properties” group box: the “Apply” button was enabled by default, even when no property was modified, which was confusing for the user (the “Apply” button is now disabled by default, and is enabled only when a property is modified)
- Fixed proxy `get_object` method when there is no object to return (None is returned instead of an exception)
- Fixed `IndexError: list index out of range` when performing some operations or computations on groups of signals/images (e.g. “ROI extraction”, “Peak detection”, “Resize”, etc.)
- Drag and drop from a file manager: filenames are now sorted alphabetically

DataLab Version 0.10.1

Note: V0.10.0 was almost immediately replaced by V0.10.1 due to a last minute bug fix

New features:

- Features common to signals and images:
 - Added “Real part” and “Imaginary part” features to “Operation” menu
 - Added “Convert data type” feature to “Operation” menu
- Features added following user requests (12/18/2023 meetup @ CEA):

- Curve and image styles are now saved in the HDF5 file:
 - * Curve style covers the following properties: color, line style, line width, marker style, marker size, marker edge color, marker face color, etc.
 - * Image style covers the following properties: colormap, interpolation, etc.
 - * Those properties were already persistent during the working session, but were lost when saving and reloading the HDF5 file
 - * Now, those properties are saved in the HDF5 file and are restored when reloading the HDF5 file
 - New profile extraction features for images:
 - * Added “Line profile” to “Operations” menu, to extract a profile from an image along a row or a column
 - * Added “Average profile” to “Operations” menu, to extract the average profile on a rectangular area of an image, along a row or a column
 - Image LUT range (contrast/brightness settings) is now saved in the HDF5 file:
 - * As for curve and image styles, the LUT range was already persistent during the working session, but was lost when saving and reloading the HDF5 file
 - * Now, the LUT range is saved in the HDF5 file and is restored when reloading it
 - Added “Auto-refresh” and “Refresh manually” actions in “View” menu (and main toolbar):
 - * When “Auto-refresh” is enabled (default), the plot view is automatically refreshed when a signal/image is modified, added or removed. Even though the refresh is optimized, this may lead to performance issues when working with large datasets.
 - * When disabled, the plot view is not automatically refreshed. The user must manually refresh the plot view by clicking on the “Refresh manually” button in the main toolbar or by pressing the standard refresh key (e.g. “F5”).
 - Added `toggle_auto_refresh` method to DataLab proxy object:
 - * This method allows to toggle the “Auto-refresh” feature from a macro-command, a plugin or a remote control client.
 - * A context manager `context_no_refresh` is also available to temporarily disable the “Auto-refresh” feature from a macro-command, a plugin or a remote control client. Typical usage:
- ```
with proxy.context_no_refresh():
 # Do something without refreshing the plot view
 proxy.compute_fft() # (...) ````
```
- Improved curve readability:
    - \* Until this release, the curve style was automatically set by cycling through **PlotPy** predefined styles
    - \* However, some styles are not suitable for curve readability (e.g. “cyan” and “yellow” colors are not readable on a white background, especially when combined with a “dashed” line style)
    - \* This release introduces a new curve style management with colors which are distinguishable and accessible, even to color vision deficiency people
  - Added “Curve anti-aliasing” feature to “View” menu (and toolbar):
    - This feature allows to enable/disable curve anti-aliasing (default: enabled)
    - When enabled, the curve rendering is smoother but may lead to performance issues when working with large datasets (that’s why it can be disabled)

- Added `toggle_show_titles` method to DataLab proxy object. This method allows to toggle the “Show graphical object titles” feature from a macro-command, a plugin or a remote control client.
- Remote client is now checking the server version and shows a warning message if the server version may not be fully compatible with the client version.

Bug fixes:

- Image contour detection feature (“Analysis” menu):
  - The contour detection feature was not taking into account the “shape” parameter (circle, ellipse, polygon) when computing the contours. The parameter was stored but really used only when calling the feature a second time.
  - This unintentional behavior led to an `AssertionError` when choosing “polygon” as the contour shape and trying to compute the contours for the first time.
  - This is now fixed (see [Issue #9](#) - Image contour detection: `AssertionError` when choosing “polygon” as the contour shape)
- Keyboard shortcuts:
  - The keyboard shortcuts for “New”, “Open”, “Save”, “Duplicate”, “Remove”, “Delete all” and “Refresh manually” actions were not working properly.
  - Those shortcuts were specific to each signal/image panel, and were working only when the panel on which the shortcut was pressed for the first time was active (when activated from another panel, the shortcut was not working and a warning message was displayed in the console, e.g. `QAction::event: Ambiguous shortcut overload: Ctrl+C`)
  - Besides, the shortcuts were not working at startup (when no panel had focus).
  - This is now fixed: the shortcuts are now working whatever the active panel is, and even at startup (see [Issue #10](#) - Keyboard shortcuts not working properly: `QAction::event: Ambiguous shortcut overload: Ctrl+C`)
- “Show graphical object titles” and “Auto-refresh” actions were not working properly:
  - The “Show graphical object titles” and “Auto-refresh” actions were only working on the active signal/image panel, and not on all panels.
  - This is now fixed (see [Issue #11](#) - “Show graphical object titles” and “Auto-refresh” actions were working only on current signal/image panel)
- Fixed [Issue #14](#) - Saving/Reopening HDF5 project without cleaning-up leads to `ValueError`
- Fixed [Issue #15](#) - MacOS: 1. `pip install cdl` error - 2. Missing menus:
  - Part 1: `pip install cdl` error on MacOS was actually an issue from **PlotPy** (see [this issue](#)), and has been fixed in PlotPy v2.0.3 with an additional compilation flag indicating to use C++11 standard
  - Part 2: Missing menus on MacOS was due to a PyQt/MacOS bug regarding dynamic menus
- HDF5 file format: when importing an HDF5 dataset as a signal or an image, the dataset attributes were systematically copied to signal/image metadata: we now only copy the attributes which match standard data types (integers, floats, strings) to avoid errors when serializing/deserializing the signal/image object
- Installation/configuration viewer: improved readability (removed syntax highlighting)
- PyInstaller specification file: added missing `skimage` data files manually in order to continue supporting Python 3.8 (see [Issue #12](#) - Stand-alone version on Windows 7: missing `api-ms-win-core-path-l1-1-0.dll`)
- Fixed [Issue #13](#) - ArchLinux: `qt.qpa.plugin: Could not load the Qt platform plugin "xcb" in ""` even though it was found

## DataLab Version 0.9.2

Bug fixes:

- Region of interest (ROI) extraction feature for images:
  - ROI extraction was not working properly when the “Extract all ROIs into a single image object” option was enabled if there was only one defined ROI. The result was an image positioned at the origin (0, 0) instead of the expected position (x0, y0) and the ROI rectangle itself was not removed as expected. This is now fixed (see [Issue #6](#) - ‘Extract multiple ROI’ feature: unexpected result for a single ROI)
  - ROI rectangles with negative coordinates were not properly handled: ROI extraction was raising a `ValueError` exception, and the image mask was not displayed properly. This is now fixed (see [Issue #7](#) - Image ROI extraction: `ValueError: zero-size array to reduction operation minimum which has no identity`)
  - ROI extraction was not taking into account the pixel size (dx, dy) and the origin (x0, y0) of the image. This is now fixed (see [Issue #8](#) - Image ROI extraction: take into account pixel size)
- Macro-command console is now read-only:
  - The macro-command panel Python console is currently not supporting standard input stream (`stdin`) and this is intended (at least for now)
  - Set Python console read-only to avoid confusion

## DataLab Version 0.9.1

Bug fixes:

- French translation is not available on Windows/Stand alone version:
  - Locale was not properly detected on Windows for stand-alone version (frozen with `pyinstaller`) due to an issue with `locale.getlocale()` (function returning `None` instead of the expected locale on frozen applications)
  - This is ultimately a `pyinstaller` issue, but a workaround has been implemented in `guidata V3.2.2` (see [guidata issue #68](#) - Windows: gettext translation is not working on frozen applications)
  - [Issue #2](#) - French translation is not available on Windows Stand alone version
- Saving image to JPEG2000 fails for non integer data:
  - JPEG2000 encoder does not support non integer data or signed integer data
  - Before, DataLab was showing an error message when trying to save incompatible data to JPEG2000: this was not a consistent behavior with other standard image formats (e.g. PNG, JPG, etc.) for which DataLab was automatically converting data to the appropriate format (8-bit unsigned integer)
  - Current behavior is now consistent with other standard image formats: when saving to JPEG2000, DataLab automatically converts data to 8-bit unsigned integer or 16-bit unsigned integer (depending on the original data type)
  - [Issue #3](#) - Save image to JPEG2000: ‘`OSError: encoder error -2 when writing image file`’
- Windows stand-alone version shortcuts not showing in current user start menu:
  - When installing DataLab on Windows from a non-administrator account, the shortcuts were not showing in the current user start menu but in the administrator start menu instead (due to the elevated privileges of the installer and the fact that the installer does not support installing shortcuts for all users)
  - Now, the installer *does not* ask for elevated privileges anymore, and shortcuts are installed in the current user start menu (this also means that the current user must have write access to the installation directory)

- In future releases, the installer will support installing shortcuts for all users if there is a demand for it (see [Issue #5](#))
- [Issue #4](#) - Windows: stand-alone version shortcuts not showing in current user start menu
- Installation and configuration window for stand-alone version:
  - Do not show ambiguous error message ‘Invalid dependencies’ anymore
  - Dependencies are supposed to be checked when building the stand-alone version
- Added PDF documentation to stand-alone version:
  - The PDF documentation was missing in previous release
  - Now, the PDF documentation (in English and French) is included in the stand-alone version

## DataLab Version 0.9.0

New dependencies:

- DataLab is now powered by [PlotPyStack](#):
  - [PythonQwt](#)
  - [guidata](#)
  - [PlotPy](#)
- [opencv-python](#) (algorithms for image processing)

New reference platform:

- DataLab is validated on Windows 11 with Python 3.11 and PyQt 5.15
- DataLab is also compatible with other OS (Linux, MacOS) and other Python-Qt bindings and versions (Python 3.8-3.12, PyQt6, PySide6)

New features:

- DataLab is a platform:
  - Added support for plugins
    - \* Custom processing features available in the “Plugins” menu
    - \* Custom I/O features: new file formats can be added to the standard I/O features for signals and images
    - \* Custom HDF5 features: new HDF5 file formats can be added to the standard HDF5 import feature
    - \* More features to come...
  - Added remote control feature: DataLab can be controlled remotely via a TCP/IP connection (see [Remote control](#))
  - Added macro commands: DataLab can be controlled via a macro file (see [Macro commands](#))
- General features:
  - Added settings dialog box (see “Settings” entry in “File” menu):
    - \* General settings
    - \* Visualization settings
    - \* Processing settings
    - \* Etc.

- New default layout: signal/image panels are on the right side of the main window, visualization panels are on the left side with a vertical toolbar
- Signal/Image features:
  - Added process isolation: each signal/image is processed in a separate process, so that DataLab does not freeze anymore when processing large signals/images
  - Added support for groups: signals and images can be grouped together, and operations can be applied to all objects in a group, or between groups
  - Added warning and error dialogs with detailed traceback links to the source code (warnings may be optionally ignored)
  - Drastically improved performance when selecting objects
  - Optimized performance when showing large images
  - Added support for dropping files on signal/image panel
  - Added “Analysis parameters” group box to show last result input parameters
  - Added “Copy titles to clipboard” feature in “Edit” menu
  - For every single processing feature (operation, processing and analysis menus), the entered parameters (dialog boxes) are stored in cache to be used as defaults the next time the feature is used
- Signal processing:
  - Added support for optional FFT shift (see Settings dialog box)
- Image processing:
  - Added pixel binning operation (X/Y binning factors, operation: sum, mean...)
  - Added “Distribute on a grid” and “Reset image positions” in operation menu
  - Added Butterworth filter
  - Added exposure processing features:
    - \* Gamma correction
    - \* Logarithmic correction
    - \* Sigmoid correction
  - Added restoration processing features:
    - \* Total variation denoising filter (TV Chambolle)
    - \* Bilateral filter (denoising)
    - \* Wavelet denoising filter
    - \* White Top-Hat denoising filter
  - Added morphological transforms (disk footprint):
    - \* White Top-Hat
    - \* Black Top-Hat
    - \* Erosion
    - \* Dilation
    - \* Opening
    - \* Closing

- Added edge detection features:
  - \* Roberts filter
  - \* Prewitt filter (vertical, horizontal, both)
  - \* Sobel filter (vertical, horizontal, both)
  - \* Scharr filter (vertical, horizontal, both)
  - \* Farid filter (vertical, horizontal, both)
  - \* Laplace filter
  - \* Canny filter
- Contour detection: added support for polygonal contours (in addition to circle and ellipse contours)
- Added circle Hough transform (circle detection)
- Added image intensity levels rescaling
- Added histogram equalization
- Added adaptative histogram equalization
- Added blob detection methods:
  - \* Difference of Gaussian
  - \* Determinant of Hessian method
  - \* Laplacian of Gaussian
  - \* Blob detection using OpenCV
- Result shapes and annotations are now transformed (instead of removed) when executing one of the following operations:
  - \* Rotation (arbitrary angle,  $+90^\circ$ ,  $-90^\circ$ )
  - \* Symetry (vertical/horizontal)
- Added support for optional FFT shift (see Settings dialog box)
- Console: added configurable external editor (default: VSCode) to follow the traceback links to the source code

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**Note:** DataLab was created by [CODRA/Pierre Raybaut](#) in 2023. It is developed and maintained by DataLab Platform Developers.

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## PYTHON MODULE INDEX

### C

- `cdl.algorithms`, 199
- `cdl.algorithms.coordinates`, 215
- `cdl.algorithms.datatypes`, 214
- `cdl.algorithms.image`, 208
- `cdl.algorithms.signal`, 200
- `cdl.computation`, 298
- `cdl.computation.base`, 298
- `cdl.computation.image`, 329
- `cdl.computation.image.detection`, 365
- `cdl.computation.image.edges`, 361
- `cdl.computation.image.exposure`, 352
- `cdl.computation.image.morphology`, 360
- `cdl.computation.image.restoration`, 356
- `cdl.computation.image.threshold`, 350
- `cdl.computation.signal`, 304
- `cdl.core.gui`, 393
- `cdl.core.gui.actionhandler`, 418
- `cdl.core.gui.docks`, 447
- `cdl.core.gui.h5io`, 448
- `cdl.core.gui.main`, 394
- `cdl.core.gui.objectview`, 423
- `cdl.core.gui.panel`, 400
- `cdl.core.gui.panel.base`, 401
- `cdl.core.gui.panel.image`, 411
- `cdl.core.gui.panel.macro`, 415
- `cdl.core.gui.panel.signal`, 408
- `cdl.core.gui.plothandler`, 426
- `cdl.core.gui.processor`, 430
- `cdl.core.gui.processor.base`, 431
- `cdl.core.gui.processor.image`, 440
- `cdl.core.gui.processor.signal`, 436
- `cdl.core.gui.roieditor`, 429
- `cdl.obj`, 259
- `cdl.param`, 217
- `cdl.plugins`, 129
- `cdl.proxy`, 374