

PRISim vs pyuvsim 1.1 reference simulation comparison

Daniya Seitova

ABSTRACT

This memo presents the first out of three comparisons between PRISim and pyuvsim reference simulations. We compare the reference simulations in the image domain and discovered that they differ very slightly. An analysis of the uvw coordinates of baselines also shows systematic differences. The most likely explanation is a difference in phasing of the data.

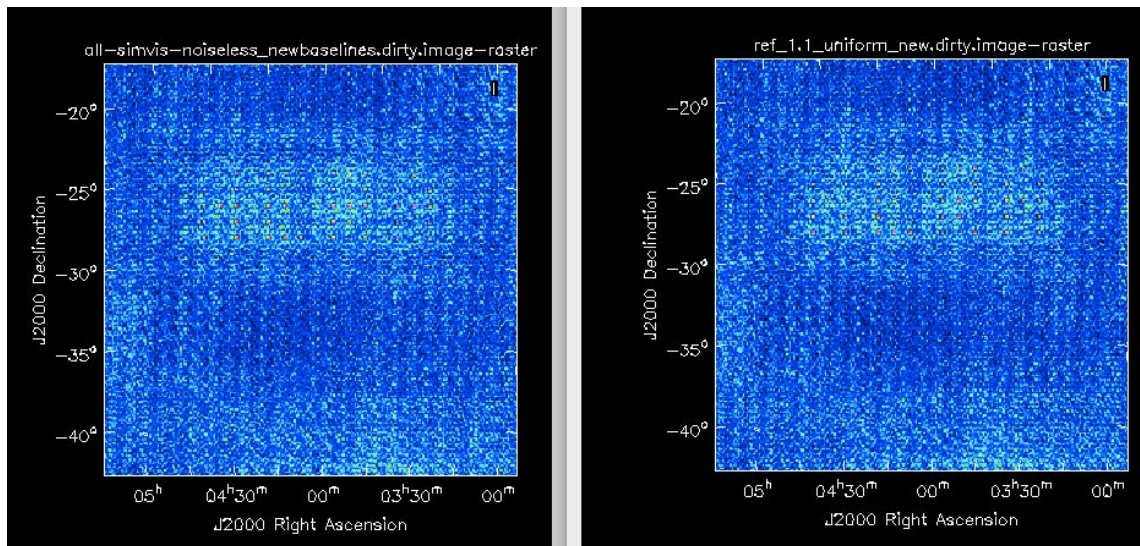
1. Introduction

PRISim and pyuvsim both created a simulation of identical sources (spelling out the word “HERA”). PRISim reference simulation contains 1 time, 2 frequencies, 1 polarization and 3828 baselines. Pyuvsim reference simulation contains 1 time, 1 frequency, 4 polarizations and 3916 baselines. For a fair comparison, we selected in both reference simulations only 1 time, 1 frequency, 1 polarization and 3828 baselines (includes only cross correlated antennas). This is one of the three initial comparisons that we are going to conduct between pyuvsim and PRISim reference simulations.

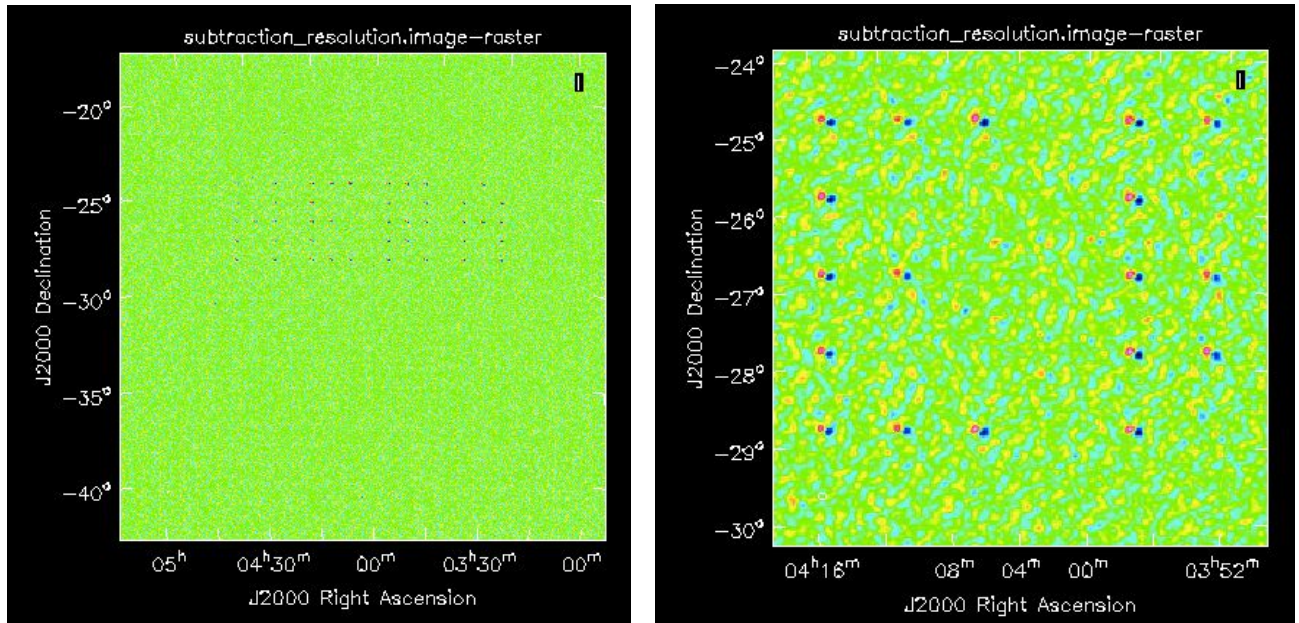
2. Discussion

2.1 Image comparison

To compare 1.1 pyuvsim and PRISim simulations, we first plotted CASA images of both data sets.



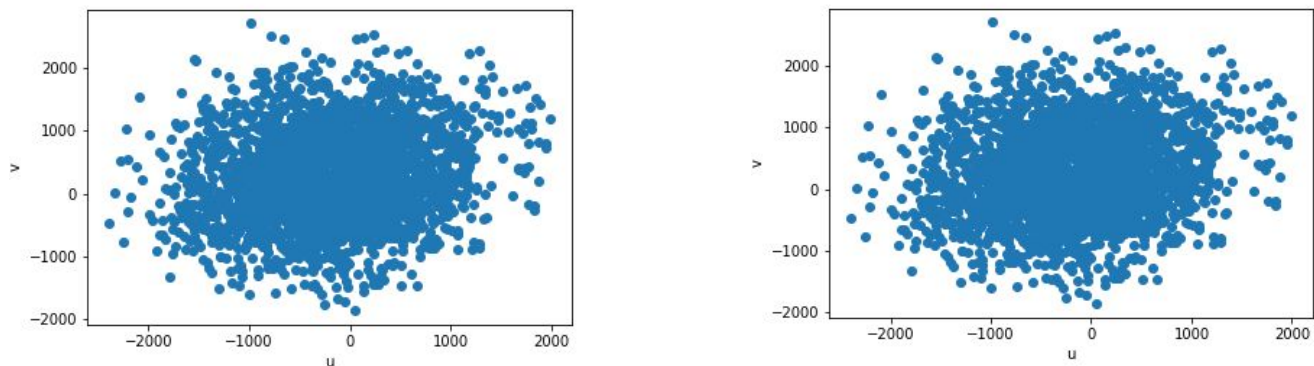
Using immath, we subtract the images and can see that the sources (spelling out the word “HERA”) are almost but not exactly in the same place.

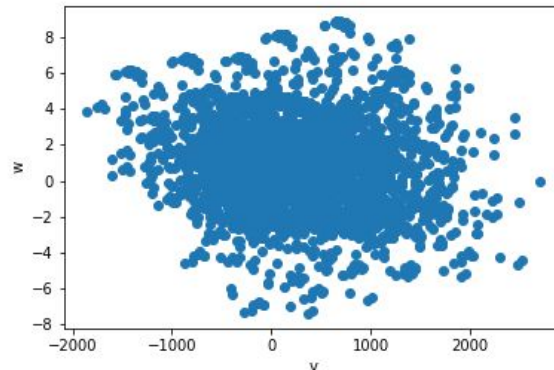
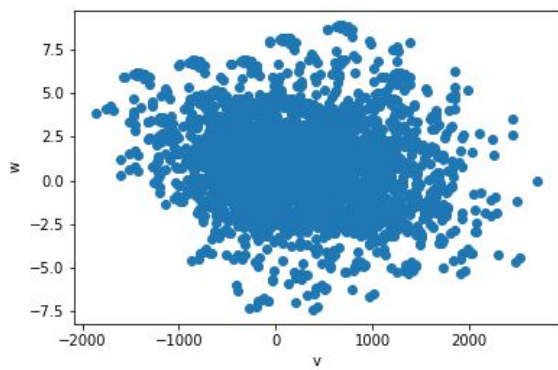
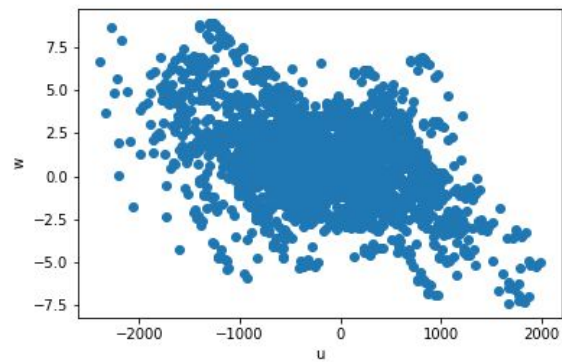
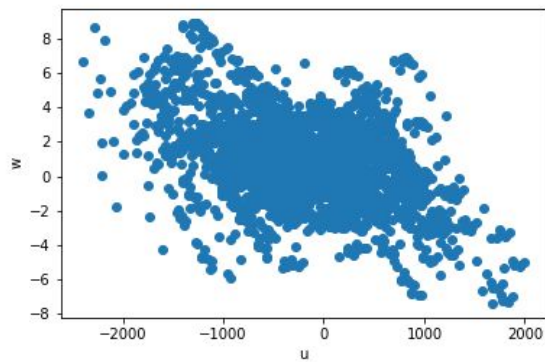


The reason the sources differ by a tiny amount could be the difference in phasing between pyuvsim and PRISim. Source coordinates were defined in RA/dec, but then phased to the local frame by each code.

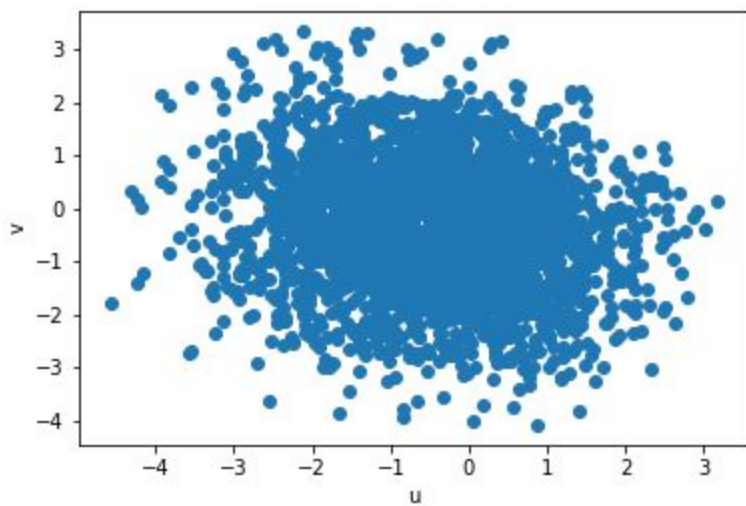
2.2 UVW comparison

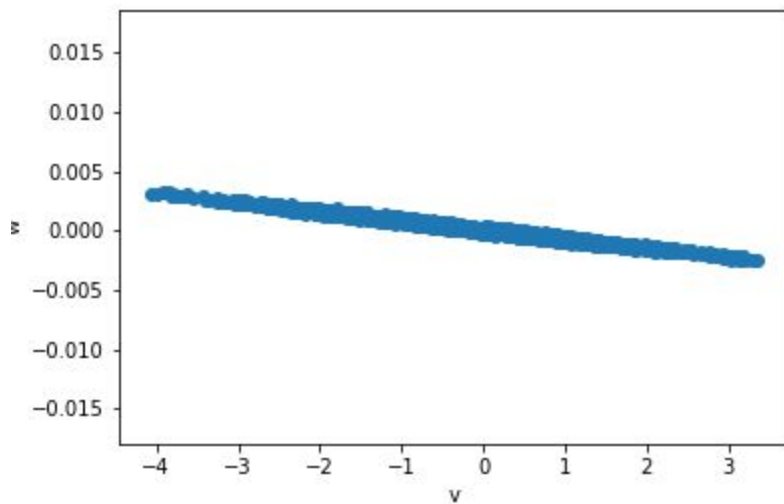
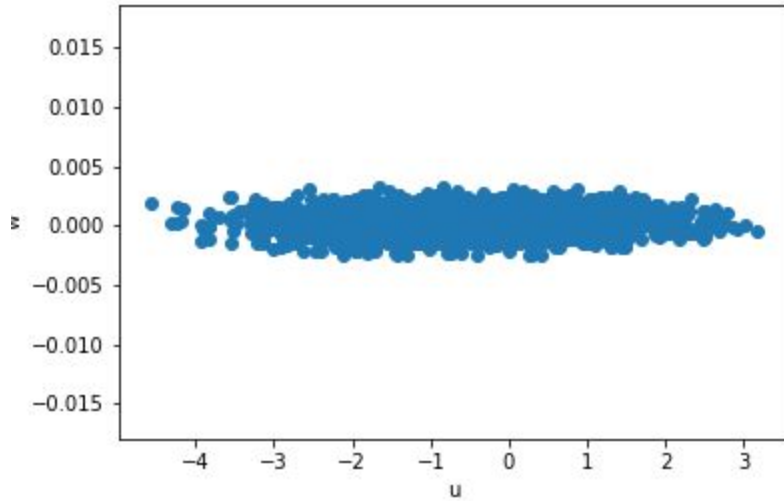
First, we compared antenna positions to confirm that the codes are simulating the same physical array. They agreed to a machine precision. To check that the difference is in phasing, we then moved on to compare pyuvsim and PRISim uvw positions.





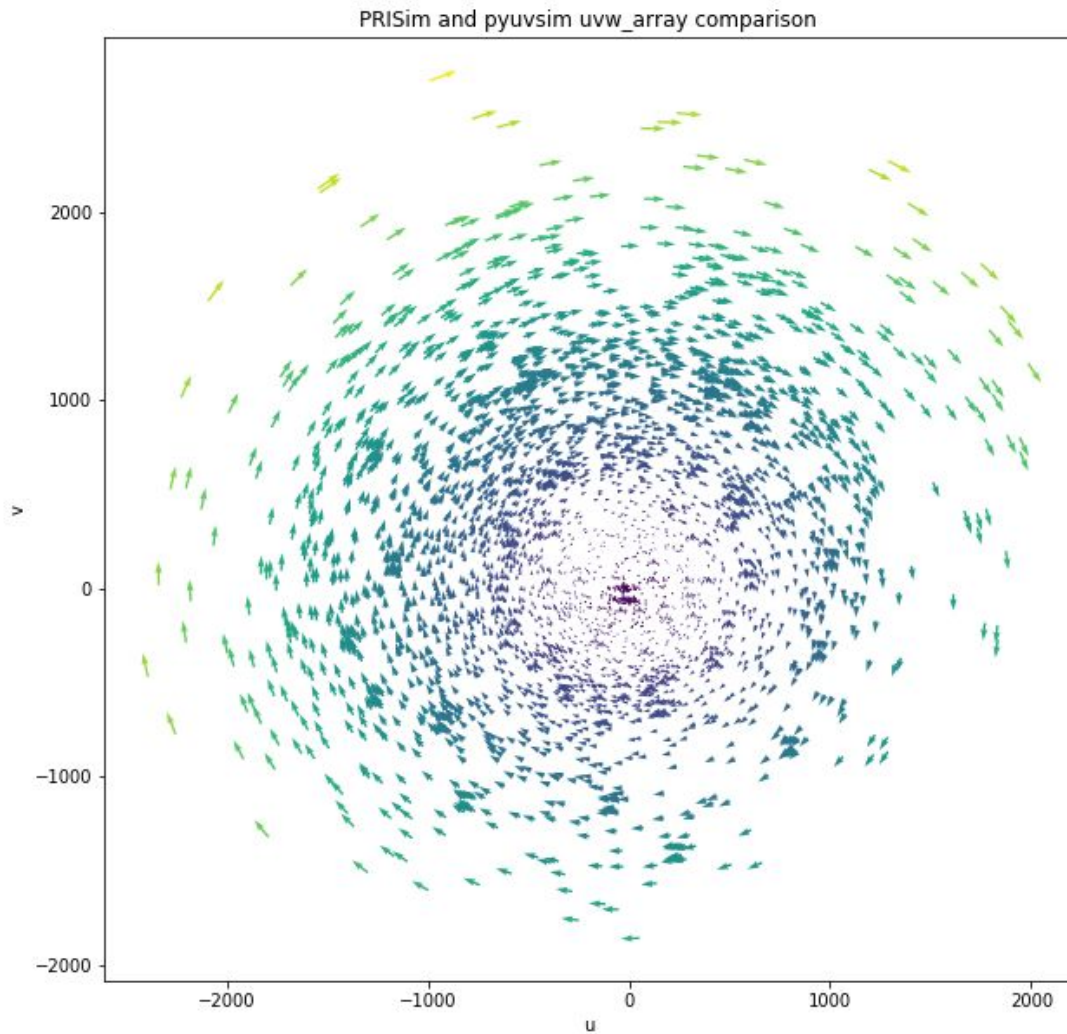
We then plotted the difference of uvw positions (pyuvsim - PRISim) and we can see that they differ slightly:





We can see that uvw positions are slightly different, but it's not clear how. Therefore, instead of plotting simply the difference between uvw arrays like we did above, we plotted vectors of differences between uv points. The size and orientation of each vector was determined by the difference between corresponding uv points in each reference simulation. We also color coded the vectors by size, to make sure that 2 vectors next to

each other don't get confused by a longer single vector. Thus this plot should make our analysis easier, as we can see below:



We can see in the plot above that the difference in uvw positions increase the further you are from the center, and smaller in the center. This plot suggests that the difference in uvw positions is due to the difference in phasing, since the antenna positions of both simulations agree.

3. Conclusion

In CASA images we can see that the sources differ very slightly in the sky. However, antenna positions comparison showed that the antenna positions in both reference simulations agree to machine precision. However, uvw positions of pyuvsim and PRISim reference simulations differ slightly. A small difference in the phasing between the two codes is therefore the most likely explanation.