LBWG memo 24

Imaging large areas with WSClean+IDG on a GPU

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WSClean has the functionality to use the new IDG algorithm and to leverage power of a GPUs. Both can give a significant boost in imaging speed. WSClean also can deconvolves sources somewhat better than DDFacet when they are more extended, and has multiscale functionality.

An initial test on a single Leiden node seems promising: a 25000 x 25000 pixel image with 0.1 ”/px took 48 hours to make (no multiscale, 0.4” resolution). This was with WSClean 2.7.2.

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wsclean −no−update−model−required −minuv−l 1500 −size 25000 25000 −reorder
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Figure 1 shows a zoom in of the field, comparing the image obtained from LoTSS at 6”, with the images obtained with DDFacet at 1” and WSClean at 0.4”. The 1” image took of the order of $4 - 5$ days to make, whereas the $0.4''$ image only took 48 hours. Both are the same size of 25000×25000 pixels. The GPU version at the moment is not significantly faster than the CPU version. This was imaged on a 24 core node with 386 GB of RAM.

TEC screens with IDG

IDG's main purpose was to apply various corrections on the fly when gridding. This means corrections can be applied in the form of TEC screens and gain screens. More detailed information about the format of these screens can be found on the WSClean wiki.

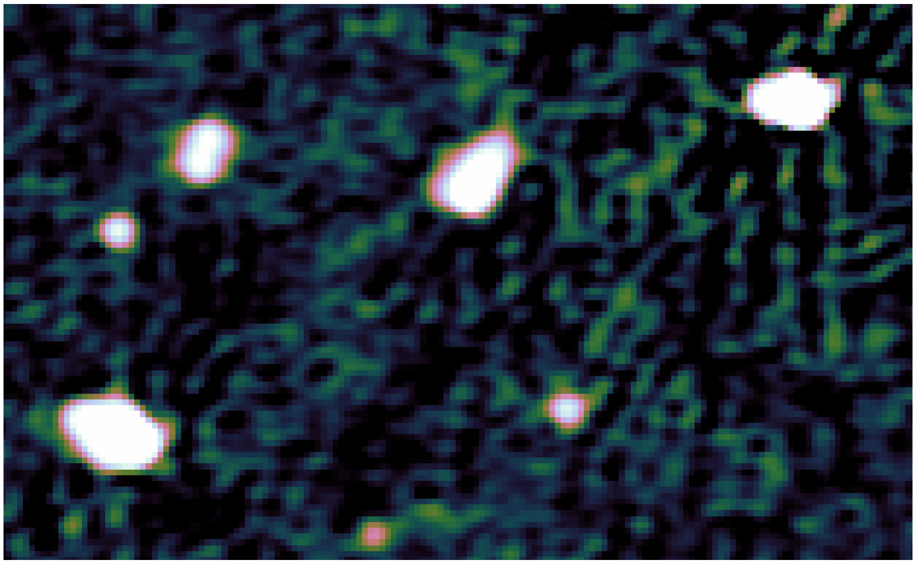
Testing reveals that these screens are sensitive to outliers and jumps in the TEC, as well as spatial discontinuities. Therefore, both will need to be removed, before applying the solutions as a screen. The reasons are:

1. A “jump” in TEC represents a 2π phase wrap, or a multiple thereof, i.e. the solve converged to a local minimum, which is incorrect. When directly applying such jumpy solutions, it may not prove problematic, but if this is interpolated, the interpolated values are wrong.
2. Abrupt changes, e.g. when using nearest neigbour interpolation, cause ringing in the Fourier domain, degrading the quality of the solutions.

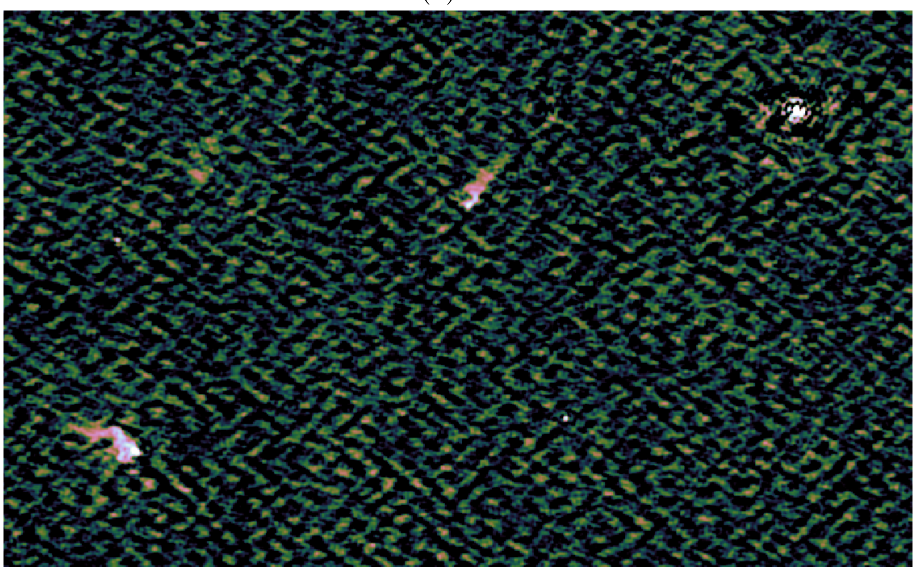
Smoothing and dejumping the solutions takes care of the first issue. The second issue is resolved with radial basis function interpolation. At the moment this has limited the direction dependent solutions to sources that are 50 mJy/beam or brighter in terms of peak flux, at 1”. Solutions on fainter sources turned out to be too noisy or jumpy.

Imaging far down the beam

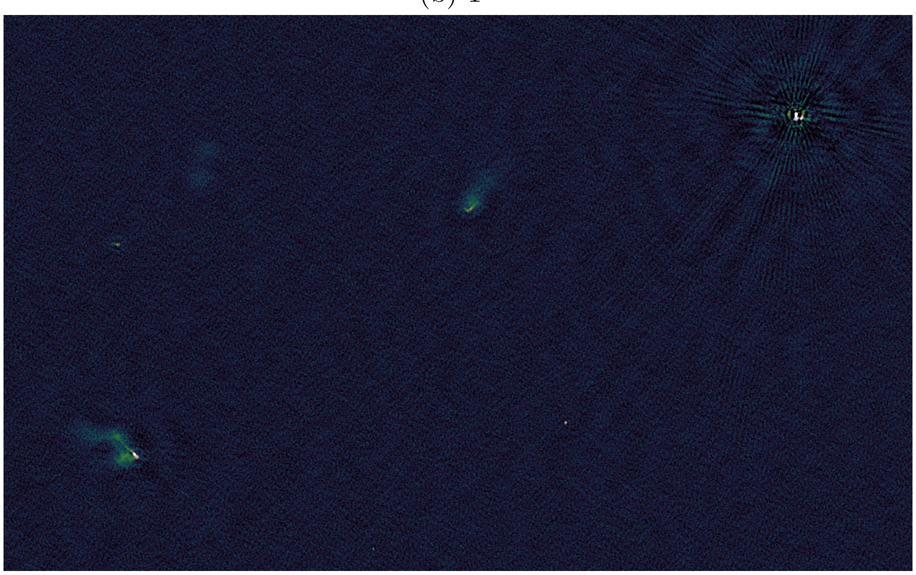
Imaging large regions far down the beam, e.g. $> 1.5\,\mathrm{deg}$ away from the phase center, seems to easily diverge. Setting a low mgain of 0.5 in WSClean and/or reigning back parallel deconvolution, seems to stabilize a lot of regions. An initial guess as to why is that beam corrections are getting large in these areas, reducing the margin for error significantly.



(a) 6”



(b) 1”



(c) 0.3”

Figure 1: Comparison between a 6″, 1″ and 0.4″ resolution map. The same region is shown in all images, on a arcsinh colour scale ranging from −0.0001 to 0.003 Jy/beam.