
LBWG memo 28

Weighting in the selfcal loop (loop 3)

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The problem

The selfcal/CLEAN hybrid loop in the difmap version of loop 3, which makes hybrid images at a given position, is quite complex but currently consists of:

- Impose a taper `selftaper 0.5, 0.025` to weight down baselines shorter than $25k\lambda$
- Do two sets of selfcal/CLEAN iterations using uniform weighting, with phase only selfcal
- Do one set of selfcal/CLEAN iterations using natural weighting, and phase-only selfcal
- Do a loop of amplitude self-calibration
- Produce the final map

This has in the past worked well for datasets containing ST001. However, when imaging all of the core stations, the source structure disappears and one is left with a blank map and large artefacts at the edge of the image.

What is causing the problem

Fig. 1 shows the problem on a dataset from an LBCS calibrator which consists of a close double radio source. What seems to be happening here is that the natural weighting is seriously degrading the image in the dataset with the CS stations left in. This is happening despite the `selftaper` in the difmap script weighting down the short baselines by 0.5 at $25k\lambda = 50\text{km}$ - i.e. it appears that even a Gaussian taper at 50km is being overwhelmed by the number of short baselines and the high flux on them (I think this target is close to some moderately bright sources). Once amplitude selfcal is turned on, the source is lost completely. After flagging some of the high points at short baselines, matters improve somewhat in that the source structure is preserved, but the image is still degraded. In the dataset with ST001 instead of the core stations (middle row), there is still some effect, although the structure of the source is still hanging on even after amplitude selfcal. In the last row, with the dataset with the CS, the uniform-only weighting seems to have got rid of the short baselines enough for the source structure to be preserved.

Solution

We need to think carefully about what combination of data weighting and `selftaper` is used. Unless there are shown to be datasets where it doesn't work, it might be best to delete the loop with the natural weighting but retain the `selftaper`.

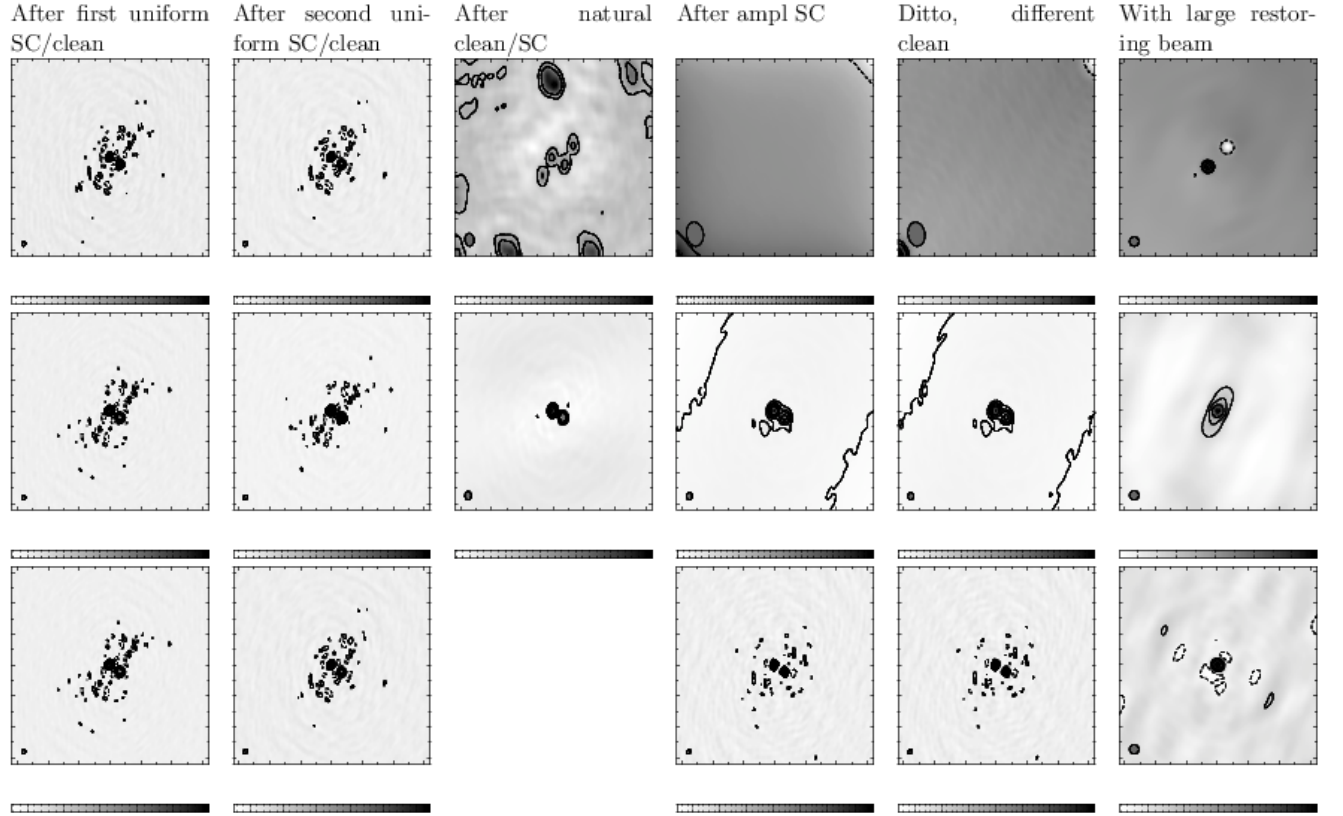


Figure 1: Images at various stages of the loop3 (`selfcal_difmap.py`) for (top) dataset containing core stations, (middle) dataset containing ST001 only, and (bottom) dataset containing core stations, but with the natural weighting loop deleted from the script and uniform weighting only