Facet Based Imaging

Sebastiaan van der Tol

vdtol@strw.leidenuniv.nl

Leiden Observatory

Leiden University

Direction Dependent Gains

Direction Dependent Gain effects include

- LOFAR Beam
- Ionosphere

Furthermore, the beam and ionosphere are varying over time.
Direction Dependent Gain => Corrected data does not exist.

Solutions

Direction Dependent Gain can not be dealt with by correcting the data. Other solutions are needed:

- Correct image afterwards
- A-projection
- Facets

A-projection

A-projection algorithm by Sanjay Bhatnagar:

- Low computational cost
- Already partly implementation for LOFAR Beam,
- requires low level software changes of gridder
- supports Clean

Facet Based Imaging

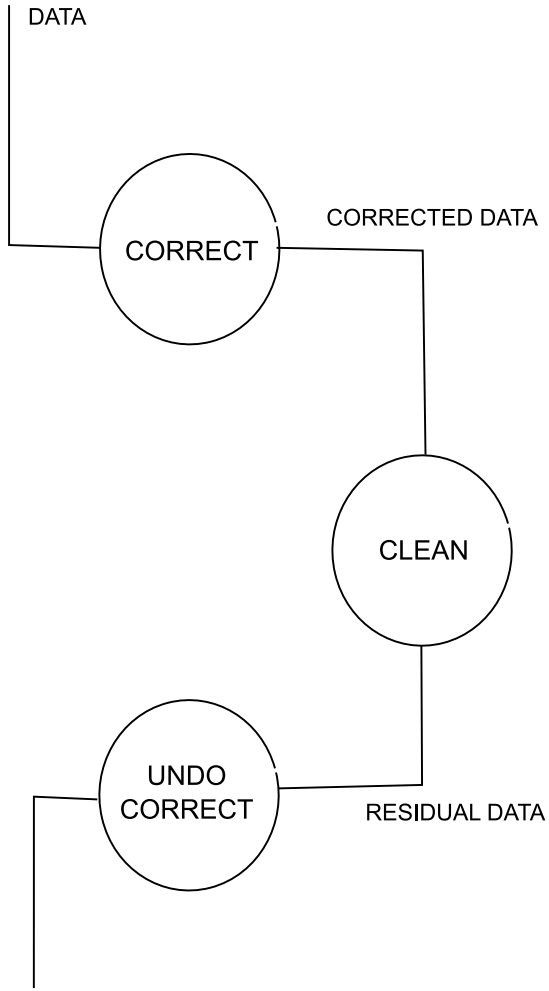
Facet Based Imaging as implemented by Huib Intema

- Computational cost is higher
- Can be implemented by high level scripts
- Needs additional loop to implement clean

SPAM facet based imaging

- Make dirty images for each facet
- Sort facets by peak flux
- Do partial clean on brightest facet
- Put facet back in list ordered by (residual) brightness
- Continue with next brightest facet, stop stop when threshold reached

SPAM Dataflow

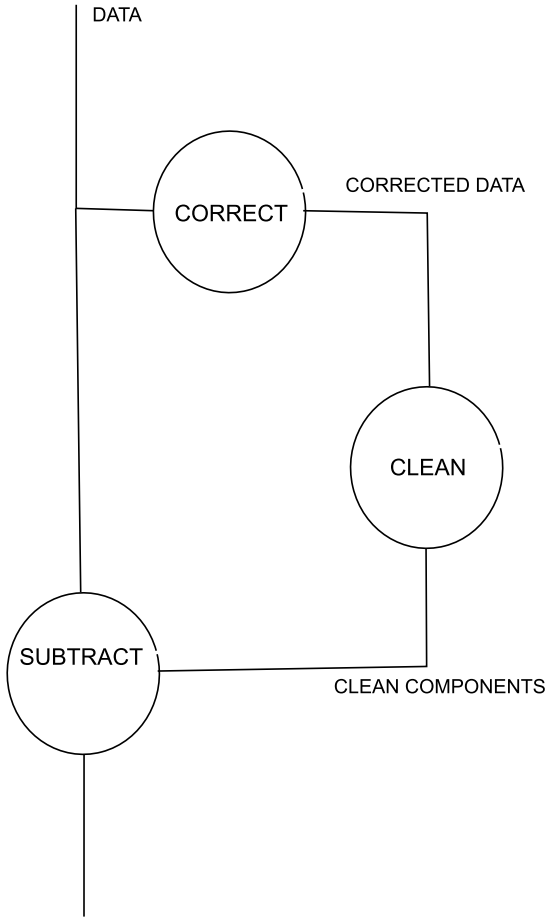


MWImager Facets

Based on Ger van Diepens implementation for facets.
Additional steps:

- Keep track of facet peak flux
- Multiple visits of facet
- Extract clean components in BBS format
- Subtract clean components using BBS

MWImager Dataflow



Number of facets

The number of facets that MWImager needs is lower than what SPAM needs because

- Imager support W-projection
- Each clean component is subtracted by BBS with it's own gain

Preparation

The imager needs features of BBS that are not yet part of the standard LofIm package. Initialize the environment with either one of

- source /home/vdtol/lofar/lofarinit.csh
- source /home/vdtol/lofar/lofarinit.sh

Important: do NOT do "use Casa", even not implicitely through .mypackages

Invocation

- mwimager mwimager.parset clusterdesc workdir

Use an absolute path for workdir, (not "." for example)

Parset

```
dataset = /data/scratch/vdtol/SB010.gds
key = mykey
Imager = casa
dde=True
datacolumn = CORRECTED_DATA
residualcolumn = RESIDUAL_DATA
correctedcolumn = CORRECTED_DATA
padding = 1.25
restore = True

threshold = 0.001     # Jansky
SNR_threshold = 6.5
```

Parset

```
Images.stokes = [I]
Images.shape = [2000, 2000]
Images.cellSize = [15, 15]
Images.ra = 08:13:36.062300
Images.dec = +48.13.02.24900
Images.directionType = J2000
Images.nfacets =  5

Correct.Model.Beam.Enable=True
Correct.Model.Beam.Element.Type = HAMAKER_LBA
Correct.Model.Beam.StationConfig.Name = LBA_OUT
Correct.Model.Ionosphere.Enable = False
```

Parset

```
Solver.type = Dirty
Solver.verbose = True
Gridder.type = WProject
Gridder.wmax = 15000
Gridder.nwplanes = 64
Gridder.oversample = 1
Gridder.maxsupport = 400
Gridder.limitsupport = 0
Gridder.cutoff = 0.001
Gridder.padding = 1.25

Weighting.type = briggs
Weighting.robust = -0.75
```

Important

- Facet based correction is slow. First fix all other problems and make sure you get a reasonable good image without DD correction..
- Enable the beam in the Solve step of BBS, do NOT enable the beam in the Correct step
- The CORRECTED_DATA column will be overwritten. Make a backup and restore the backup before restarting the imager.
- Do not undersample; use at least 5 pixels per beam.
- NO "use Casa".

Things not implemented

- Multi Frequency Synthesis : there is no distributed imager that can do this
- Multi Scale Clean : do not know how to extract clean components in BBS format