LOFAR Self-Calibration using a Local Sky Model

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LOFAR Self Calibration

- Fitting parameters for adaptive models of the instrument, the ionosphere and the sky to the uv-data (see Poster 78) using a Measurement Equation (M.E., see Eq. 1)
- Subtract sources from the uv-data
- This results in an updated Sky Model and a Residual Image

- The MeqTree module implements a general M.E. (see Poster   )
- The LSM provides the sky model to the MeqTree system in Peeling or Predict Units (P-Units)
- P-Units are Points Sources or Patches (i.e. Images)
- Point Sources predict uv-data by means of a DFT, Patches do this by means of a FFT (see Fig. 1)

$$\vec{V}_{ij}(u,v) = \sum_{k} \int df \int dt \left(J_{ik} \otimes J_{jk}^{*} \right) S \ \vec{I}_{k}$$
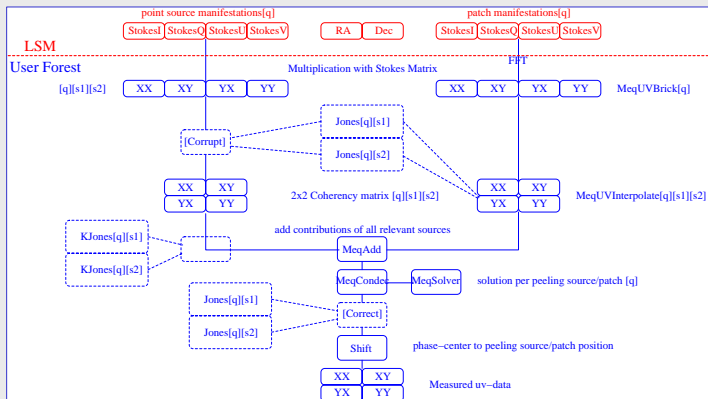
Eq. 1 The Measurement Equation

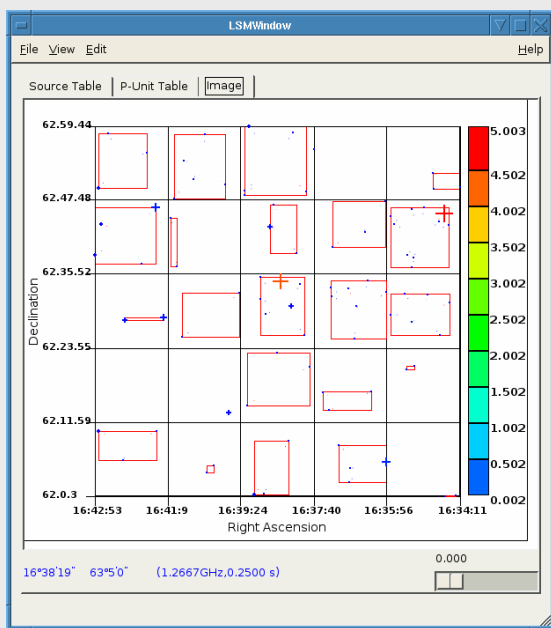Fig. 1 Implementing the M.E. and connecting it to P-Units in a parameter fitting mode

Fig. 3 A LSM window showing a field of Point Sources being combined into Patches

Local Sky Model (LSM)

The LSM is an object to be used with a uv-dataset (MS) and it has three interfaces (see Fig. 2)

- The MeqTree User Forest: the heart of the Self-Calibration data processing. The LSM calculates the 4 Stokes manifestations (I,Q,U,V) of a given point source or patch. The manifestations are used for parameter fitting or subtraction
- Residual Images: images of uv-data from which known sources are subtracted. The LSM is able to update source parameters from such images or find new sources from them.
- Global Sky Model (GSM): an all-sky database of eventually some 100 million objects. The LSM gets an initial subset from the GSM and eventually updates the GSM.

The LSM contains
- A GSM subset: Source Table, MeqParm Table, GSM Images, Tree Templates.
- A P-Unit list: controlling object for the data processing. Every Peeling / Predict – Unit is treated as a single unity.
- The Observational Window (ObsWin): the average station power beam. The ObsWin is the first order between intrinsic mode and apparent mode.
- The Observational Resolution (ObsRes): the spatial and spectral resolution of the observation. It is used for CLEANing Residual Images.
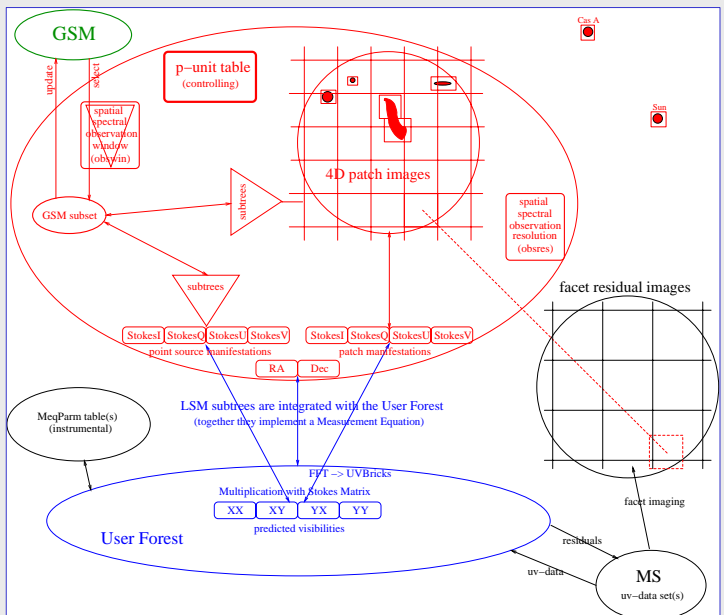

Fig.2 Schematic overview of the LSM and its interfaces

LSM User Interface

- The LSM User Interface can be used to save to and load from disk
- The interface can be used to visualize the LSM
- The interface can be used to prepare the processing. E.g., it can be used to combine Point Sources into Patch Images (see Fig. 3)

Related Posters

- P78 - MeqParm: parameter handling within the MeqTree selfcalibration module, M. Mevius, O.M. Smirnov, J.E. Noordam
- P   - Implementing arbitrary Measurement Equations with the MeqTree module, O.M. Smirnov, J.E. Noordam