



Imaging and Calibration Algorithms for EVLA, e-MERLIN and ALMA



Calibration and wide-field imaging



- **Issues are inextricably linked**
- **Primary beams (all Stokes)**
 - **Use a proper physical model**
 - **Need to do simulations (EM and FE) and measurements**
 - **Variations (El, T, ...) are not understood**
 - **Beam squint corrections understood**
- **Ionosphere**
 - **What is the most economical description?**
 - **MIM**
 - **Field-based calibration. Zernike basis or something else?**
 - **GPS data**
 - **Ionospheric physics**



Approaches to ionospheric correction



- **Field-based calibration**
- **Peeling (various approaches)**
- **Global (expectation maximization)**
- **Empirical approaches (differential gain)**

Understanding the physics will lead to models with fewer parameters to be measured

Apply corrections to the model and subtract

- **More use of smoothness in time or direction**
- **What are the errors?**

The “nicest” image is not necessarily the most faithful description of the sky.



Wide-field imaging approaches

- **Correcting for the w term**
 - **Facets (AIPS/Obit) with auto-boxing extensions**
 - **w -projection**

- **Correction for direction-dependent effects**
 - **Peeling + squint**
 - **AW projection**
 - **Pointing self-calibration**



Deconvolution

- **Multi-scale clean approaches look promising:**
 - AIPS, CASA implementations
 - ASP clean
- **MEM**
 - Discussion on convergence; different algorithms
 - Bayesian approach to point-source fitting, RM, etc.

Spectral-line issues

- Calibration transfer between sub-bands
- Very wide bandpasses
- Multi-channel questions



Wide-band imaging



- Sault-Wieringa to higher order. Can handle variable sources in similar ways
- MF MSC approach is a promising generalization
- Fitting cleaned narrow-band images is an alternative
- We do not have the equivalent for linear polarization

Need to integrate with wide-field imaging



What should we do next?

■ Document

- What problems do we need to solve? Comprehensive description using ME framework.
- What software is available?
- What is missing?

SOC will write a framework and ask for input

■ Wiki

- Talks from this and other meetings
- Papers, memos
- Software documentation
- Forum for interchange of ideas



Test problems



- **Standard test problems**
 - Simulated data without noise
 - Simulated data with realistic noise
 - Real data
- **Peeling and related algorithms**
 - Flavours of peel
 - Expectation maximization
- **Wide-band imaging**
 - Sault-Wieringa to various orders
 - Hybrid
 - MS-MS
 - Fitting deconvolved narrow-band images



Test problems (2)



- **Wide-field imaging**
 - w-projection
 - facets
- **Deconvolution**
 - standard clean
 - multiscale clean variants
 - MEM variants





Promoting collaboration

- **Essential to document algorithms in detail**
 - Publish, but also
 - provide code/detailed description
- **Funding for visits**
- **More meetings**
 - how often?
 - who?
- **Proposals for additional funding?**
 - Observatories – how to approach?
 - PhD projects
 - National/International funding agencies



How do we put the pieces together?



- We have many of the algorithms we need, but not all
- Terabyte data problem
- We have made progress on interoperability at the scripting level (Parseltongue, python interfaces to Obit and CASA)
- It is very inefficient to exchange data between CASA and AIPS/Obit data: we cannot afford to do this more than once or twice in the data-reduction process.
- AIPS/Obit and CASA calibration models are very different, so need to apply calibrations to data before interchanging.

How do we proceed?