

Report on the sub-group discussion
on image-plane effects

or rather:
direction-dependent effects (DDE)

SKA CALIM 2009, Socorro
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Participants

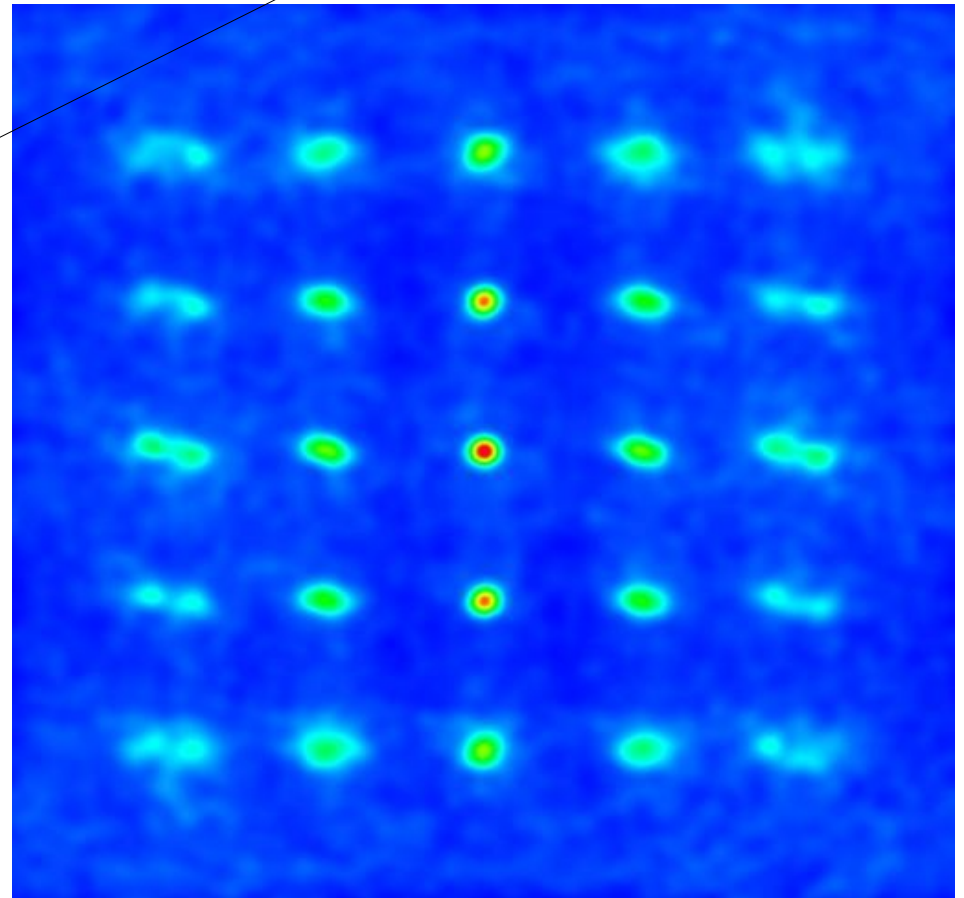
- James Anderson (LOFAR)
- Gerry Harp (ATA)
- George Moellenbrock (EVLA)
- Rob Reid (EVLA)
- Anita Richards (eMERLIN)
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- Walter Brisken (EVLA)
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Definition

(after all, this is cat country)

- direction-independent effects (i,f,t)
 - e.g. G,D,T,C,PJones
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- DDE: direction-dependent effects (i,f,t,l,m)
 - e.g. E,Z,F,R,KJones
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- **The BIG one is EJones**

NB: i is antenna index



Inventory of DDE's (incomplete)

- Atmospheric complex gain
 - Z_{jones} (ionosphere)
 - T_{jones} (troposphere)
 - R_{jones} (differential refraction)
 - scalar matrix (commutes with everything)
- F_{jones} : Ionospheric Faraday rotation
- P_{jones} : Parallax angle (orientation of “dipole” on the sky)
- E_{jones} : Primary beam shape(s!), i.e. voltage patterns
- other?
 - e.g. doppler-correction (Jones matrix?)

Calim generations

- 1st generation (<1980)
 - rely on instrument stability
- 2nd generation (>1980)
 - selfcal, direction-independent effects
- 3rd generation (>2000)
 - direction-dependent effects (DDE)
- 4th generation (>2010?)
 - residual statistics
 - requires 3rd gen to create suitable conditions

The two-stage procedure

- 1: Subtract the brightest sources from the uv-data
 - Cat I sources: used to solve for instrumental parameters
 - Cat II sources: subtracted in patches
 - choose a cutoff level (e.g. 1 Jy)
 - this stage determines the dynamic range
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- 2: Image the residuals (Cat III sources + remnants + noise)
 - correct the uv residuals for direction-independent effects
 - apply direction-dependent effects (DDE) while gridding
 - deconvolve the residual image
 - this stage determines the noise/science

DDE issues

- Modelling (a mixture of the following)
 - a priori (measurements or e.m. simulations)
 - physical (based on internal structure)
 - heuristic (minimum nr of parameters (f,t))
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- Application
 - forward (while imaging)
 - reverse (calculating model visibilities)
 - point sources
 - patches of sky

Inventory of EJones modeling

- [This workshop:](#)
- Wijnholds (LOFAR)
- van Diepen (LOFAR)
- Kuniyoshi (LWA)
- Harp (ATA)
- Ord (MWA)
- Willis (SKA)
- Moellenbrock (EVLA)
- Parsons (PAPER)
- Voronkov (ASKAP)
- [Elsewhere \(incomplete\):](#)
- VLA (Brisken)
- Embrace (with WSRT)
- Apertif (with WSRT)
- 2PAD
- LOFAR (Yatawatta, Hamaker)
-

Ejones modeling (II)

- e.m. simulations
 - ..
- analytical
 - ..
- holography and mapping
 - ATA, VLA

Inventory of Zjones modeling

- This workshop:
- Nijboer (LOFAR)
- Anderson (LOFAR)
- van Diepen (LOFAR)
- Ord (MWA)
- Lonsdale (MWA)
- Parsons (PAPER)
- Elsewhere (incomplete):
-

Zjones modeling (II)

- Field-based calibration
 - ..
- SPAM
 - ..
- MIM
 - ..

Inventory of DDE application

- [This workshop:](#)
- Wijnholds
- Ord
- Bhatnagar
- Rau
- Lonsdale
- Parsons
- Cornwell, Voronkov
- Cotton
- Willis, Reid
- [Elsewhere \(incomplete\):](#)
- Abdalla (UVBrick)

DDE application (II)

- reverse (on model visibilities)
 - to point sources (trivial)
 - to patches of sky (UVBrick)
- forward (while gridding/imaging)
 - ..
 - ..
 - ..
 - ..

Relevance to SKA

All roads lead to Rome....

Conclusions

- Direction-dependent effects (DDE) represent a major shift in software
 - many more parameters (enough information?)
 - processing power (do we have enough)
- Some specialization is emerging
 - above and below the (arbitrary) cutoff level (e.g. 1 Jy)
- There has been lots of progress
 - modeling of DDE's
 - application of DDE's
- But (much) more work is needed
 - rather urgently, in fact

SKA CALIM 2009 Socorro

group discussion on
image-plane effects

Finally....

- I did not say that there was no progress
 - ..
 - ..
- I just said that little had reached the user
 - to be properly tested
- I also emphasized that the rate of evolution is too low