IMPRS

DATA REDUCTION WITH MEQTREES

Outlines of my talk:

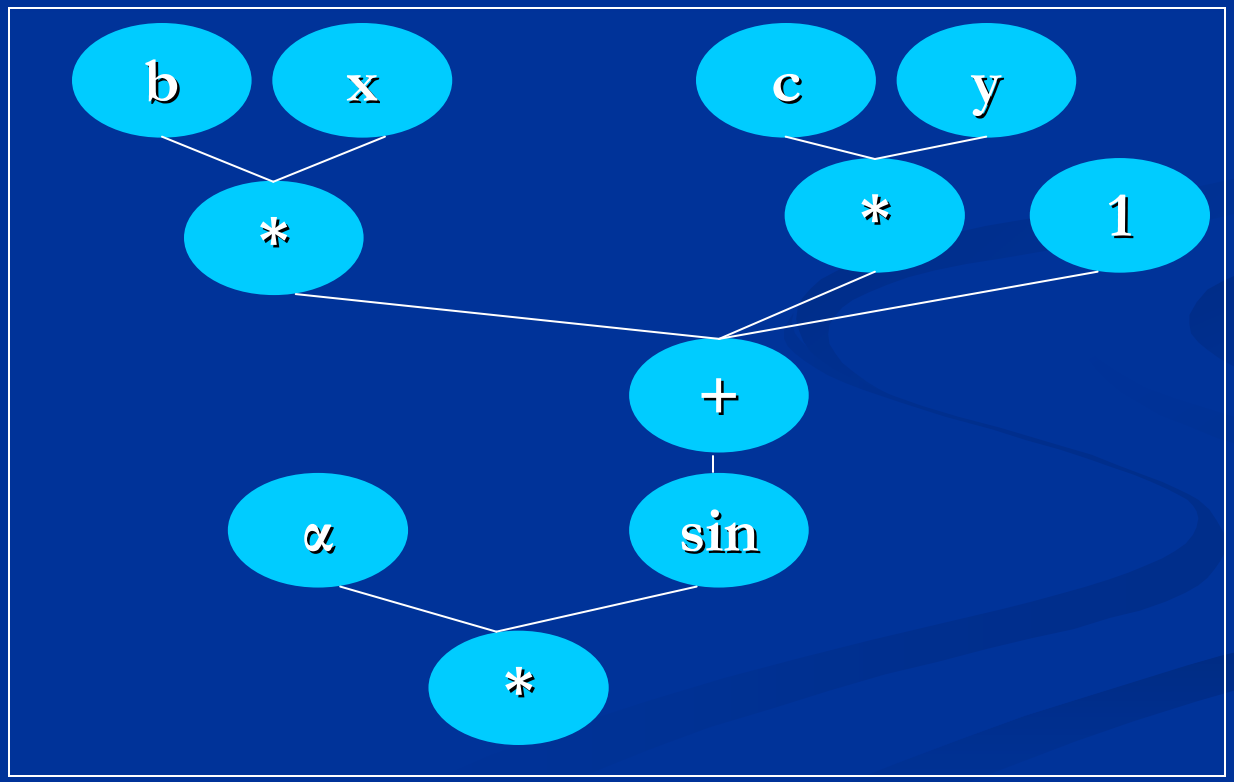
- Why MeqTrees
- What can be done and how
- Bandwidth smearing
- Conclusions

Why *MeqTrees:*

Trees because…

- Every mathematical function can be represented by a tree

$$f = \alpha * \sin(b * x + c * y + 1)$$



Why *MeqTrees:*

Meq because…

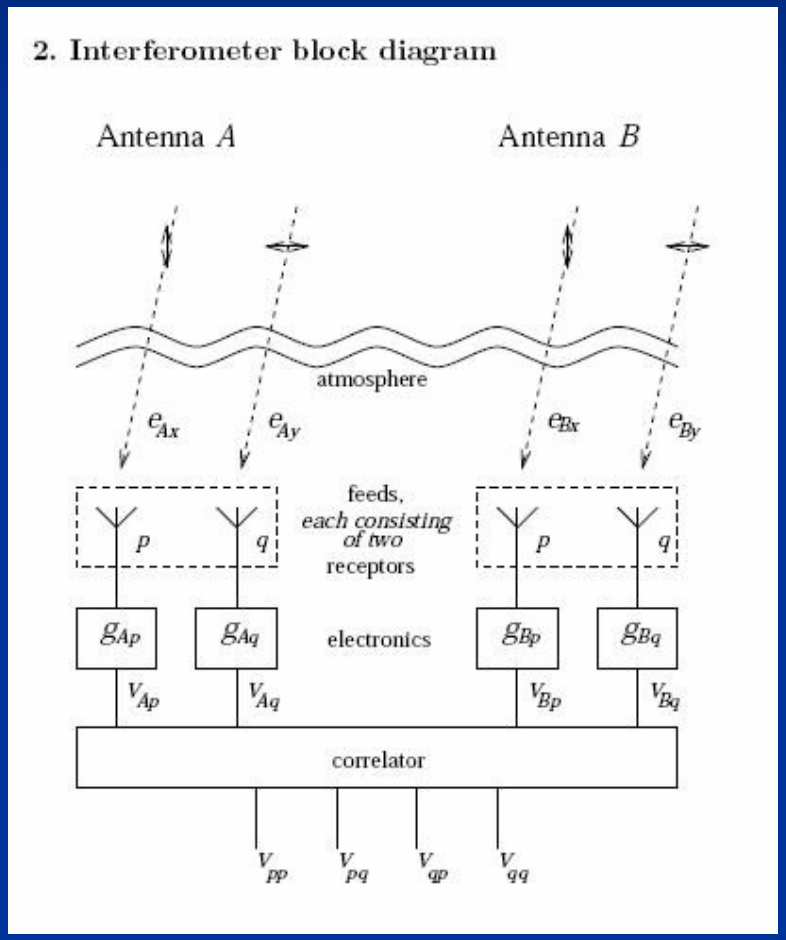
- **The function that is implemented in MeqTrees is the Measurement Equation (ME)!!**

What is a ME?

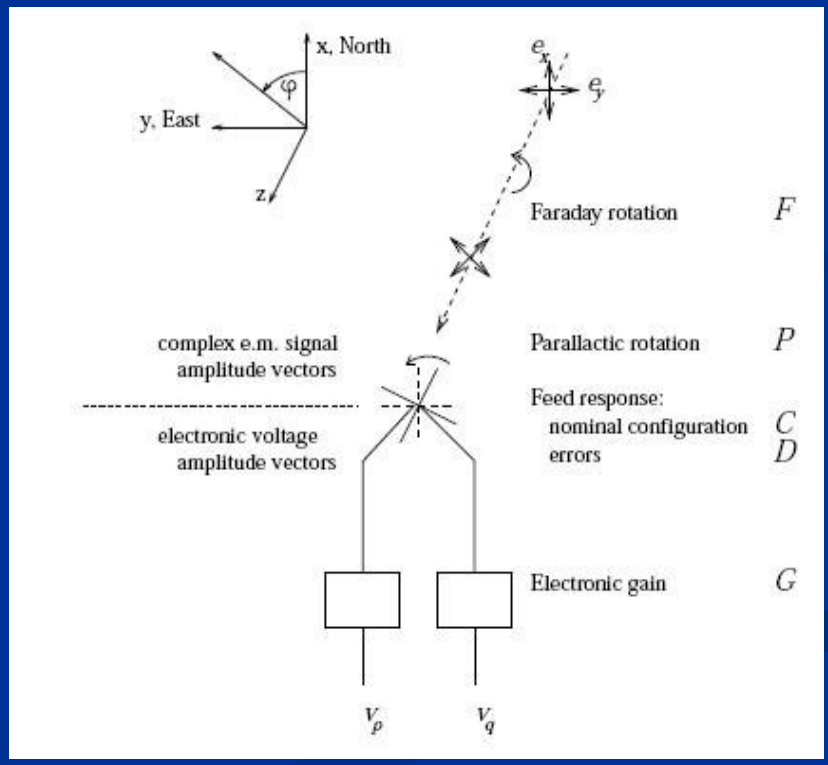
- ***It describes what can be observed with an instrument given a sky***
- ***It is composed by 2x2 antenna-based response matrices, which describe what affects the e.m. signal in its path.***

$$V_{pq} = \left\langle J_p B J_q^t \right\rangle$$

3 layers of intuition:



$$V_{pq} = \left\langle J_p B J_q^t \right\rangle$$



3 layers of intuition:

- **Physical**
  - Faraday Rotation, parallactic rotation…
- **Geometrical**
  - Rotation, stretching..
- **Mathematical**
  - Matrices properties

What can be done:

➢Simulation

- instrument or observations

➢Calibration (self-cal)

- build a ME to model your observation
- evaluate it on a time/frequency grid
- compare to observed visibilities and adjust for best fit
- subtract sky model

What can be done:

- Self-calibration for uv-plane effects and image-plane effects (depending on *l,m*)
- Ionosphere in ME (F,Z) $V_{pq} = \left\langle J_p B J_q^t \right\rangle$
- Field of view self-calibration, using 2nd order Zernike polynomials

How:

- According to commands from TDL scripts trees are designed into the "*MeqServer" (kernel)*
- The MeqServer talks to the *"MeqBrowser"* (graphical interface)
- The astronomer interacts with MeqTrees through the MeqBrowser!!!
- Scripts are loaded into the MeqBrowser.

How:

- We want evaluate functions *(visibility function, Fourier Transform..)* on a grid (frequency/time) taking 2 vectors children *uvw's* and *lmn's*

- Where do we get the *uvw's??*

-MeqTrees interface with AIPS++ Measurements Sets (MS)

-A MS is a container of data that are processed in chunks of time called 'tile'

Attach the server…

What is left:

- **Bandwidth smearing**

-Radial smearing for sources far from the phase centre.

-Very difficult subtract these sources

What is left:

- **O. Wucknitz (2006). Iterative method to fit the voltage bandpass for each station *j***
  - Visibilty on baseline j1, j2 $I_{j1,j2} = \langle V_{j1} \overline{V}_{j2} \rangle$
  - Voltage bandpass $BP_{j1,j2} = bp_{j1}(f)\overline{bp}_{j2}(f)$
  - Model visibilities $M_j = \sum_f BP_{j1,j2}(f) M(fu_j)$
  - With a known model: minimize χ^2

$$\chi^2 = \sum_j w_j \left| I_j - M_j \right|^2$$

Conclusions:

➢Why MeqTrees:

- **FOUNDAMENTAL IN ORDER TO REDUCE RADIO DATA FROM THE NEW RADIO TELESCOPES**
- **MEASUREMENT EQUATION** $V_{pq} = \left\langle J_p B J_q^t \right\rangle$

  (Polarization leakages, ionosphere, wild field imaging)
- **PERSONAL PARAMETRIZATION (PHYTON)**
- **SIMULATIONS**

THANKS!!!

What can be done:

- **Ionosphere in ME**

  F: Faraday rotation

  Z: phase change (refarction)

  P: Parallactic Rotation

  C: Ideal feed response

  R: Instrumental gains

$$V_{pq} = \left\langle J_p B J_q^t \right\rangle$$