Calibrating LOFAR data

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Overview

1. Derive gain solutions from a calibrator scan.
2. Apply the solutions to the target field.
3. Perform phase calibration using a global sky model.

Setting up your environment

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  - ssh -XY lhd002

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  - Initialize your reservation with
  - srun -A lofar_school2018 −−reservation=lofar_school2018_114 -N 1 -w “your node” -u bash -i
  - Detach from the screen with Ctrl-a d

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  - ssh -XY lhd002
  - Initialize your reservation with
  - srun -A lofar_school2018 --reservation=lofar_school2018_114 -N 1 -w "your node" -u bash -i
  - Detach from the screen with Ctrl-a d
  - SSH -XY lof0XX
  - Initialize your environment with **module load lofar**
  - Verify with **which NDPPP**

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- mkdir T2
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- Copy calibrator MS to your working directory
- `cp -r /data/scratch/DATASCHOOL2018_T2/L456102_SB000_uv.dppp.MS.flg .`

Setting up your workspace

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- cd T2

- Copy calibrator MS to your working directory
- `cp -r /data/scratch/DATASCHOOL2018_T2/L456102_SB000_uv.dppp.MS.flg .`
- **Can you find the name of our calibrator?**

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Predict the calibrator model

- We assume we have a good model for the calibrator source
- The file **A-Team_lowres.skymodel** contains the model for our calibrator (CygA)
- This is just a text file. Convert to **sourcedb** format.
- `makesourcedb in=A-Team_lowres.skymodel out=skymodel.sourcedb format="<"`
- Copy over the parset for NDPPP
- `cp -r /data/scratch/DATASCHOOL2018_T2/predict_model.parset .`

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Predict the calibrator model

- Make sure the following files are in your CWD
  - *.MS
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Predict the calibrator model

- Make sure the following files are in your CWD
  - *.MS
  - A-Team_lowres.skymodel
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- Run the command:
- `NDPPP predict_model.parset msin=L456102_SB000_uv.dppp.MS.flg`

Visualizing the predicted model

- You can use casaplotms to see what is in the MODEL_DATA column.
  - `module clear`
  - `module load casa`
  - `casaplotms`

Deriving the calibrator solutions

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- `cp -r /data/scratch/DATASCHOOL2018_T2/gaincal.parset .`
- `NDPPP gaincal.parset msin=L456102_SB000_uv.dppp.MS.flg gaincal.parmdb=instrument`

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Deriving the calibrator solutions

- As Tim mentioned in the talk, we derive $\mathbf{G}_{pq}$ by minimising $||\mathbf{V}_{pq} - \mathbf{G}_{pq}\mathbf{M}_{pq}\mathbf{G}_{pq}^{H}||$
- `cp -r /data/scratch/DATASCHOOL2018_T2/gaincal.parset .`
- `NDPPP gaincal.parset msin=L456102_SB000_uv.dppp.MS.flg gaincal.parmdb=instrument`
- Inspect the calibrator solutions using **parmdpplot.py**

Applying the calibration solutions

- Calibrator and target were observed at different times.
- We must first get the time-independent version of the solutions in the **instrument** table.
- `parmexportcal in=instrument out=instrument_tind zerophase=True`

Applying the calibration solutions

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- Correct the target field using **instrument_tind**.
- Copy over the target MS
- `cp -r /data/scratch/DATASCHOOL2018_T2/L456106_SB000_uv.dppp.MS.flg .`

Applying the calibration solutions

- Correct the target field using **instrument_tind**.
- Copy over the target MS
- `cp -r /data/scratch/DATASCHOOL2018_T2/L456106_SB000_uv.dppp.MS.flg .`
- `cp -r /data/scratch/DATASCHOOL2018_T2/applycal.parset .`

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- Correct the target field using **instrument_tind**.
- Copy over the target MS
- `cp -r /data/scratch/DATASCHOOL2018_T2/L456106_SB000_uv.dppp.MS.flg .`
- `cp -r /data/scratch/DATASCHOOL2018_T2/applycal.parset .`
- Run the command `NDPPP applycal.parset applycal.parmdb=instrument_tind msin=L456106_SB000_uv.dppp.MS.flg`

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- `cp -r /data/scratch/DATASCHOOL2018_T2/phaseonly.parset .`
- `cp -r /data/scratch/DATASCHOOL2018_T2/P1.sky .`
- `makesourcedb in=P1.sky out=P1.sourcedb format="<"`

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- `cp -r /data/scratch/DATASCHOOL2018_T2/phaseonly.parset .`
- `cp -r /data/scratch/DATASCHOOL2018_T2/P1.sky .`
- `makesourcedb in=P1.sky out=P1.sourcedb format="<"`
- `NDPPP phaseonly.parset msin=L456106_SB000_uv.dppp.MS.flg msout=. gaincal.parmdb=instrument.phase`

What's next?

- The calibration strategy we have used is too simplistic.
- The core and the remote stations are not connected on the same clock.
- CS and RS look through different parts of the ionosphere
- LOFAR has large field of view
  - A single correction is not valid for the entire field of view.
- Better calibration strategy is needed
  - **prefactor** – Direction-independent corrections.
  - **factor** – Direction-dependent corrections.