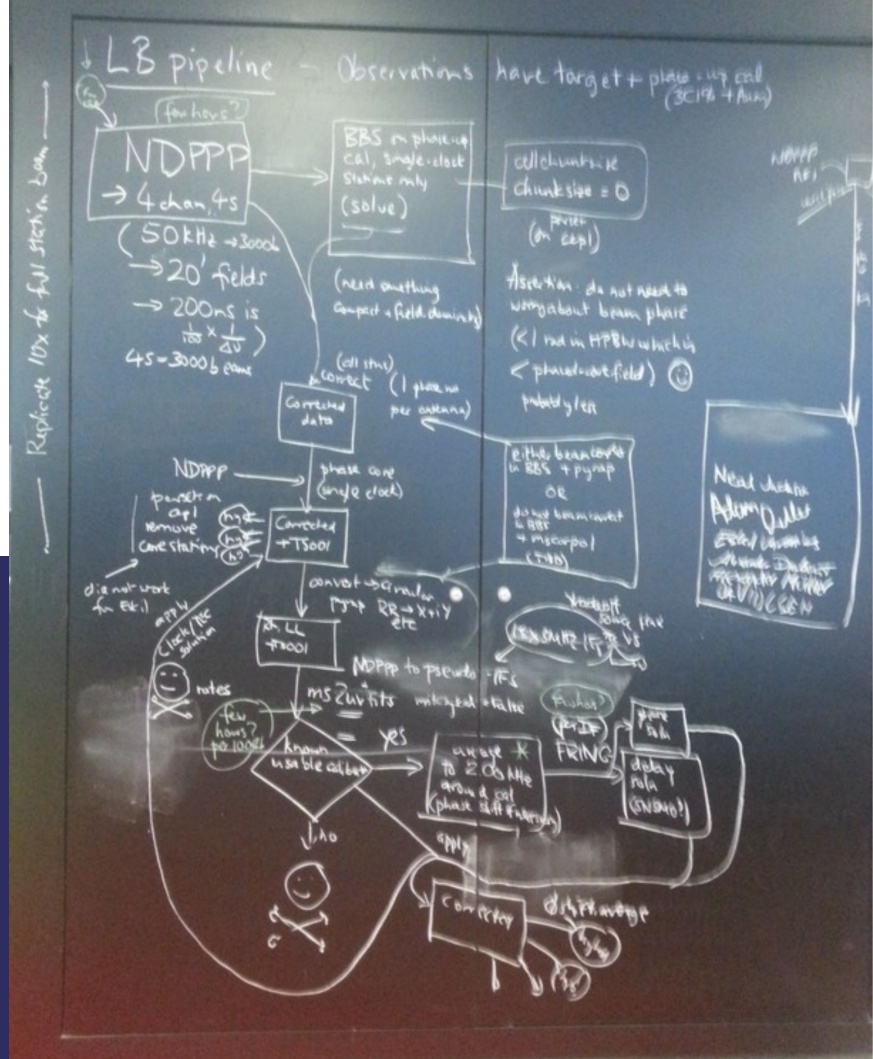


LOFAR-VLBI

pipelines and challenges

LOFAR Family Meeting, 3 June 2024

Dr. Leah Morabito
 UKRI Future Leaders Fellow & Assoc Prof



Overview

Go to: <https://github.com/LOFAR-VLBI/lofar-vlbi-pipeline/wiki>

- Pipeline philosophy / overview
- Documentation & help getting started
- Long Baseline Working Group documentation
 - Telecon minutes
 - Busy week reports
 - LB memo series



Overview

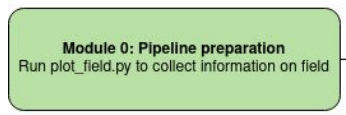
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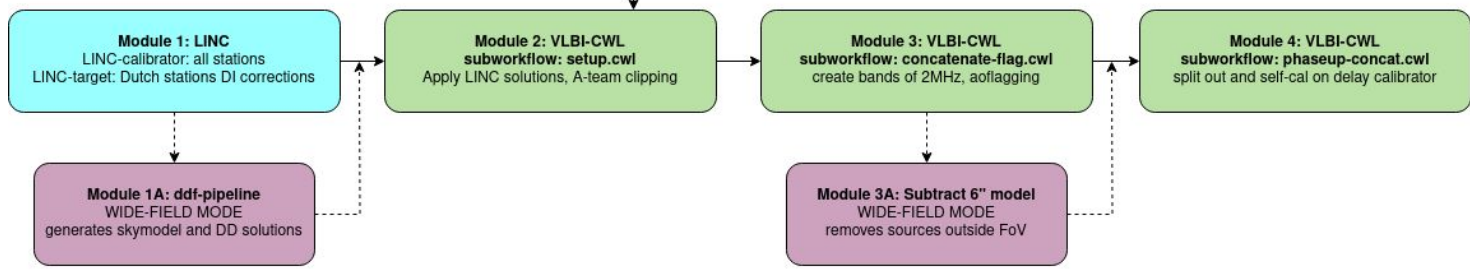
- Pipeline philosophy / overview
 - Documentation & help getting started
 - Long Baseline Working Group
 - Telecon minutes
 - Busy week reports
 - LB memo series
- Slack workspace
 - Telecons every 3 weeks
 - Busy weeks 2 x per year
 - one virtual, one in person
 - Join us! email me at:
leah.k.morabito@durham.ac.uk



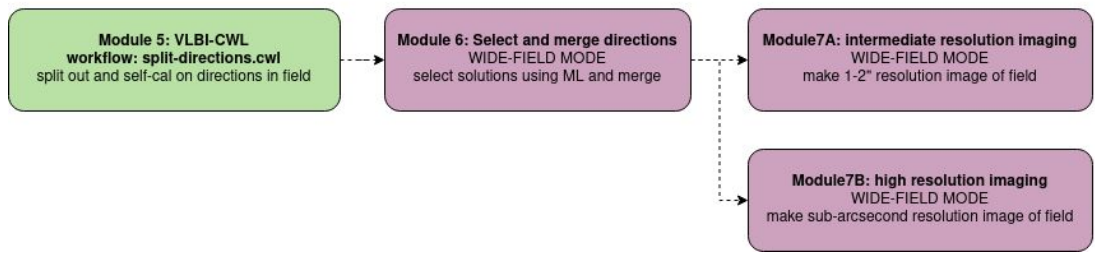
Preparation



Direction Independent (DI) calibration



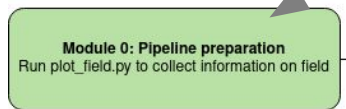
Direction Dependent (DD) calibration



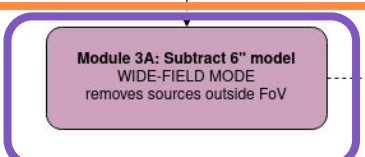
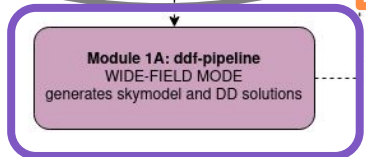
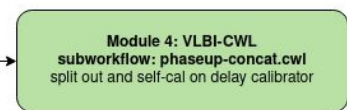
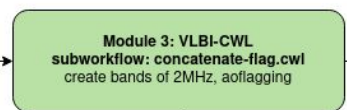
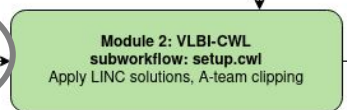
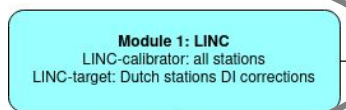


Preparation

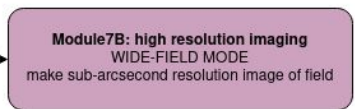
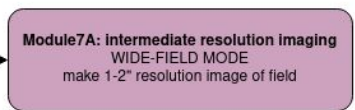
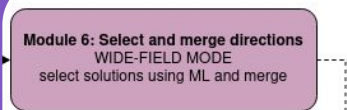
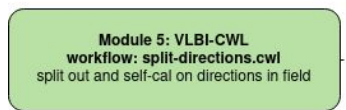
standalone python script



Direction Independent (DI) calibration



Direction Dependent (DD) calibration



postage stamp
imaging

widefield
imaging



Preparation

standalone python script



Module 0: Pipeline preparation
Run plot_field.py to collect information on field



Direction Independent (DI) calibration



Module 1: LINC
LINC-calibrator: all stations
LINC-target: Dutch stations DI corrections

Module 2: VLBI-CWL
subworkflow: setup.cwl
Apply LINC solutions, A-team clipping

Module 3: VLBI-CWL
subworkflow: concatenate-flag.cwl
create bands of 2MHz, aoflagging

Module 4: VLBI-CWL
subworkflow: phaseup-concat.cwl
split out and self-cal on delay calibrator



Module 1A: ddf-pipeline
WIDE-FIELD MODE
generates skymodel and DD solutions



Module 3A: Subtract 6" model
WIDE-FIELD MODE
removes sources outside FoV

Direction Dependent (DD) calibration

Module 5: VLBI-CWL
workflow: split-directions.cwl
split out and self-cal on directions in field



Module 6: Select and merge directions
WIDE-FIELD MODE
select solutions using ML and merge



postage stamp imaging

Module 7: Resolution imaging
WIDE-FIELD MODE
make sub-arcsecond resolution image of field

Module 7B: high resolution imaging
WIDE-FIELD MODE
make sub-arcsecond resolution image of field

widefield imaging



Current status & future challenges

- ✓ Workflows all in CWL
 - Updated A-team clipper step
 - Working on integrating “setup” steps into LINC
- ✓ Tested end-to-end on tens (postage stamp) or a handful (widefield) of observations
- 🕒 In-field calibration often needs to be tweaked by hand
- 🕒 Computational requirements
 - Requires running using a queuing system on a cluster (often the barrier for beginners)
 - Imaging steps (largest portion) are still expensive
 - Downloading data from the LTA can be prohibitive
- ⚠️ Polarisation still in progress ...
- ⚠️ LBA still in progress ...

Where are we in terms of LOFAR2.0?

HBA: Data processing rate

- **data transport:** compressed datasets will be 5.5TB per observation
- **Data processing:** still need optimisation / exploring other options
- **18 month data availability:** data transport and processing will drive our required ***data processing rate***. Open questions are: What will the compute resources be? How much data will we need to process? At what cadence will it be observed?
Difficult to answer these questions until we know what will happen with the large programmes.

LBA: theoretically transferring solutions from HBA to LBA will allow us to calibrate around more than just bright sources, but we need test data to know how far we can go

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we need to know what our achievable data processing rate will be before we can know if we have optimised data processing enough

LBA: theoretically transferring solutions from HBA to LBA will allow us to calibrate around more than just bright sources, but we need test data to know how far we can go

LOFAR VLBI Working Group

