# Prefactor - The LOFAR pre-facet calibration pipeline

#### **Overview**

The official repository of prefactor is now on GitHub: https://github.com/lofar-astron/prefactor

It consists of parsets for the genericpipeline that do the first calibration of LOFAR data. Originally in order to prepare said data for the Factor facet calibration (https://github.com/lofar-astron/factor), but also useful if you don't plan to run Factor.

#### It includes:

- clock-TEC separation with transfer of clock from the calibrator to the target
- · some flagging and averaging of amplitude solutions
- diagnostic plots
- · at least some documentation

There are several pipeline parsets in this repository:

- **Pre-Facet-Cal.parset**: The "standard" pre-facet calibration pipeline, works on pre-NDPPP'ed data
- Pre-Facet-Cal-RawData-Single.parset : A pre-facet pipeline to work on raw (non NDPPP'ed) data
- **Pre-Facet-Cal-RawData-PreAvg.parset**: A pre-facet pipeline to work on raw (non NDPPP'ed) data that does the subband concatenating in the first NDPPP step. (To reduce the number of files on systems where this is a problem, e.g. JURECA)
- **Initial-Subtract.parset**: A pipeline that generates full FoV images and subtracts the sky-models from the visibilities. (Needed for facet-calibration, this could also be done as the first step of Factor.)

# **Software requirements**

- the full "offline" LOFAR software installation version >= 2.15
   (With small modifications the Pre-Facet-Cal pipelines can be run with older versions, but that is not supported by the authors anymore.)
- LoSoTo
- LSMTool (see https://github.com/darafferty/LSMTool)
- Python-PP (see http://www.parallelpython.com/ or https://pypi.python.org/pypi/pp )
- Python matplotlib
- WSClean (for Initial-Subtract, version >=1.9)
- Aplpy (see https://aplpy.github.io)

#### **Documentation**

Installation and setup is explained in the preliminary version of a cookbook chapter at:

https://github.com/lofar-astron/prefactor/blob/pdf-doc/docs/cookbook\_prefacet.pdf

#### Please read that first!

#### **Usage Notes**

- Don't edit the original parset files directly. Make a copy with a descriptive name (e.g. Pre-Facet-Cal-calibrator-3c295.parset) and edit that copy.
  - There is also no need to change the runtime\_directory and working\_directory entries in the pipeline.cfg for different pipeline runs. The pipeline framework will generate sub-directories with the job-name in there.
- calibrator and target data have to match:
  - observed with the same selection of stations (If calibrator and target observations have the same number of stations but different stations, then the pipeline will not fail but produce wrong results.)
  - observed close enough in time that calibration values can be transferred
- For each observation you should process all the calibrator data at once together. (Clock/TEC separation and flagging of bad amplitudes work better with the full bandwidth.)
  - Calibrator and target data are typically processed separately.
  - The target data can be processed one time- or frequency- block at a time, e.g. when you have limited disk space. (The processed data is a lot smaller than the input data.)



- Yes, updating the LOFAR software can be annoying. But it is worth ist! Trust me.
- Get someone to write a better documentation for the genericpipeline.
- Don't forget to update the recipe\_directories entry in the pipeline.cfg to include the pre-factor plugins, for example:

```
recipe_directories =
[%(pythonpath)s/lofarpipe/recipes,/home/rvweeren/software/prefactor]
```

# **FAQ**

**BLAS Core affinity:** Your pipeline runs slow. All NDPPP-/BBS-/whatever- processes use only little CPU time and only one core of the node is busy.

On clusters like CEP-3 the OpenBLAS library is built with threading affinity. This means that by default the different processes all try to use the same core(s). The use LofIm and use Lofar scripts set an environment variable that disables this threading affinity, but if the pipeline.cfg file does not have the [remote] section included, then this environment variable is not forwarded to the processes that are started by the pipeline.

So please set the [remote] section in your pipeline.cfg.

**KeyError 'mapfile':** Your pipeline run fails like that:

That happens when one step didn't generate a mapfile. Usually that means that the pipeline was looking for its input data, but couldn't find any files that match. Please check your \*\_input\_path and \*\_input\_pattern in the parset file! (Note: ls -d \*\_input\_path/\*\_input\_pattern should find your data.)

## **PipelineStep\_\* missing :** Your pipeline run fails like that:

```
2016-02-04 13:33:56 ERROR
                         genericpipeline:
************
2016-02-04 13:33:56 ERROR
                         genericpipeline: Failed pipeline run: Pre-Facet-
Cal
2016-02-04 13:33:56 ERROR
                         genericpipeline: Detailed exception information:
2016-02-04 13:33:56 ERROR
                         genericpipeline: <type 'exceptions.ImportError'>
2016-02-04 13:33:56 ERROR
                         genericpipeline: No module named
PipelineStep createMapfile
2016-02-04 13:33:56 ERROR
                         genericpipeline:
************
```

(The exact name of the missing module varies.) You are probably missing one of the entries in the recipe\_directories setting in your pipeline.cfg, or one of those entries doesn't work. Make sure both entries point to the correct directories, and that the missing module can be found in the plugins subdirectory of one of those two entries.

**Missing "h5imp\_cal\_losoto.h5":** Your pipeline run fails with an "executable\_args failed" error and in the logfile you can find something like:

```
"/usr/local/lofar/losoto/current/lib/python2.7/site-packages/losoto-1.0.0-
py2.7.egg/losoto/h5parm.py",
line 40, in __init__
    raise Exception('Missing file '+h5parmFile+'.')
Exception: Missing file ./h5imp_cal_losoto.h5.
```

That was caused by a bug in an old version of the genericpipeline. Update the software, make sure you use the new version of the software when starting the pipeline, and check the pathes in pipeline.cfg that they use the new version!

### invalid value for ExecField executable: Your pipeline run fails like that:

09:12

The given path points to a file that either doesn't exist or that does not have the execute flag set on the file system ("chmod +x"). Usually this affects executables that are defined in the pipeline parset. So make sure that the variables in the pipeline parset point to the right files, and check if the execute flag is set.

#### To do list

For prefactor please use the ToDo list on the GitHub wiki:

https://github.com/lofar-astron/prefactor/wiki

Or set up an issue in the GitHub issue List: https://github.com/lofar-astron/prefactor/issues

#### **FACTOR**

- Time correlation settings given by user.
- Aplpy plots (Tammo has script on his github but change noise to 1mJy (current 5mJy))
- All WSclean (any aliasing issues?)
- pybdsm boxes from restoring beam size.
- outer uvrange option (maybe good for help create models for selfcalbration when working at full resolution)
- Check that amplitudes are properly normalised
- Second major iteration
- High dynamic range option
- optimize number of IO-intesive (NDPPP) processes

From:

https://www.astron.nl/lofarwiki/ - LOFAR Wiki

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https://www.astron.nl/lofarwiki/doku.php?id=public:user\_software:prefactor&rev=1488986863

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