IMAGER Cheat Sheet – Quick Reference Guide

INSTALLING & STARTING

IMAGER program is available:

1. As a LINUX standalone version, please follow instructions here *https://imager.oasu.u-bordeaux.fr/repository-and-installation/*
2. Using MacPorts for MacOsX*:*
   ```
   $ sudo port install imager
   $ sudo port -f activate imager
   ```

Just type `$ imager` to start.
(commands in IMAGER are *not case-sensitive)*

RUNNING DEMOS

`IMAGER>@gag_demo:demo` get an up-to-date list of demos

CREATING UV TABLES

NOEMA:

- Create a UV table with CLIC (see CLIC manual)
- Create a set of UV tables for all spectral windows and all sources from a set of .hpb files
  ```
  $ clic ; CLIC> @ all-tables ; CLIC> EXIT
  $ imager ; IMAGER> SIC FIND *.uvt
  IMAGER> READ UV 'dir%file[1]' ! For the first one...
  ```

ALMA:

- Create a list of UVFITS files from a Measurement Set and convert
  ```
  $ casa ; CASA <2>: vis='MyMeasurementSet.ms'
  CASA <3>: casagildas("Do") ; CASA <4>: exit()
  $ imager
  IMAGER> sic find *.uvfits
  IMAGER> for string /in dir%file
  IMAGER> @ fits_to_uvt 'string'
  IMAGER> next
  ```

Or (both cases): automatic data organization using the PIPELINE command

```
IMAGER> PIPELINE ORGANIZE
```

USING HELP

`HELP APPLY`	provides a description of the command `APPLY`, its arguments and options. Arguments within [] are optional, the language is coded as `LANGUAGE\`, command options as `/OPTIONS`
`HELP UV_MAP Variables`	displays the list of control variables for the command `UV_MAP`
`HELP UV_MAP MAP_item`	describes the `MAP_item` variable controlling the `UV_MAP` parameter(s) (e.g., `MAP_CENTER`)
`Command ?`	short help on the command and its current parameters
`Command ??`	displays its second level parameters (advanced users)
`Command ???`	displays all parameters of *command*

Lost? Try typing "How do I do something"

SINGLE FIELD IMAGING AND DECONVOLUTION

Typical basic command sequence:

`READ UV myTable`	read your UV table in an internal buffer
`UV_STAT`	get recommendations for imaging
`UV_MAP`	make an image with current weights
`SHOW BEAM`	display the dirty beam
`VIEW DIRTY`	display the dirty image
`CLEAN`	deconvolve with default clean parameters
`VIEW CLEAN`	display the deconvolution results
`PRIMARY`	primary beam correction to a Clean image
`VIEW SKY`	display the primary-beam corrected data
`WRITE * myResult`	save all buffers in myResult files

Useful parameters: `MAP_FIELD`, `MAP_ROBUST`, `MAP_UVTAPER`

GENERIC DATA INSPECTION AND HANDLING UV TABLES

`HEADER table.uvt`	display all the information of a Gildas Data File header in a human readable way
`READ UV /RANGE`	read the UV table present in the current UV buffer in a restricted range of channels
`WRITE UV`	write the current UV buffer in a uv table
`SHOW COVERAGE`	display the UV coverage
`UV_PREVIEW`	quick view of visibilities vs. frequencies
`UV_SELECT`	select UV data to be displayed/imaged/written
`UV_COMPRESS`	simple spectral smoothing, providing only channel averaging by integer number of channels
`UV_RESAMPLE`	provides a more flexible spectral smoothing and resampling facility
`UV_TIME`	perform time-averaging of the UV data set
`PROPER_MOTION`	apply specified PM to a UV table

DISPLAYING DATA

`SHOW`	per plane display (`MOMENTS`, `PV`, `NOISE`, …)
`VIEW`	synthetic view of maps and cubes
`INSPECT`	display 3D cuts along all 3 axes
`EXPLORE`	interactive display
`COMPARE`	compare 2 maps or data cubes

CONTINUUM PROCESSING

`UV_BASELINE`	remove the continuum baseline
`UV_FILTER`	filter the spectral line range to leave only the channels with continuum emission
`UV_MAP /CONT`	compute a continuum image from all channels using multi-frequency synthesis
`MAP_CONTINUUM`	compute a continuum image from 3D Clean or dirty data
`UV_MERGE /FILE`	merge UV tables with a specified spectral index

IMAGE PREPARATION

`UV_CHECK`	inspect the UV data to figure out how many different synthesized beams are needed
`UV_SHORT`	add the short- (or zero-)spacing information provided by an additional single dish data
`UV_STAT`	evaluate the impact of robust weighting and tapering on the synthesized beam, and provide recommendations for the image and pixel sizes
`UV_TRUNCATE`	restrict the UV baseline length range
`UV_MAP`	compute the dirty image
`UV_RESTORE`	compute the Clean image from a Clean component list by removal of the Clean components in the UV plane, and image the residuals

DECONVOLUTION

IMAGER offers the following deconvolution algorithms:

HOGBOM	iterative search for point-source clean components (CC)
CLARK	faster variant of HOGBOM with minor/major cycles
MX	Cotton-Schwab algorithm, variant of CLARK
SDI	variant of CLARK including search for extended structures
MRC	Multi-Resolution CLEAN on 2 intermediate maps
MULTI	Multi-Scale CLEAN algorithm for extended sources
SPECTRAL	CLEAN with multi-resolution in frequency

Useful parameters: METHOD, CLEAN_STOP, MASK

MOSAIC IMAGING AND SHORT SPACINGS

Image and deconvolve like single-field data (except for self-calibration)

READ SINGLE single_dish.tab	optionally read short-spacing data
UV_SHORT	optionally merge short spacings with UV data set
SHOW SKY	if UV data set is a mosaic, the results appear as a sky brightness distribution (i.e, corrected for primary beams)

SELF-CALIBRATION

SELFCAL CHECK	check if self-calibration is useful and feasible
SELFCAL PHASE	self-calibrate the phase
SELFCAL SUMMARY	presents a summary of the result
SELFCAL SHOW	phase correction between the last 2 iterations
SELFCAL APPLY	apply the self-calibration solution
[SELFCAL AMPLI	optionally self-calibrate the amplitude (SELF_TIMES parameter should be adjusted first)]
WRITE CGAINS	save the gains table
READ CGAINS; READ UV; APPLY	apply saved self-calibration results to a different UV table

Useful parameters: SELF_SNR, SELF_TIMES, SELF_FLAG

POLARIZATION

Complete polarization handling only for continuum data so far

STOKES	derive or extract a single-polarization state UV table from a multi-polarization UV table/file. IMAGER can then process the individual Stokes parameters separately.
MAP_POLAR	compute the polarization fraction and polarization angle images from the (I, Q, U) Stokes images or display polarization vectors on a background image

Note: when importing data, full polarization information is preserved only if the /STOKES option is added to the @fits_to_uvt command.

SPECTRAL LINE IDENTIFICATION

CATALOG	define or list the current catalog(s) for spectral line identification (GILDAS or LINEDB format)
UV_PREVIEW	get a quick look at spectral information, attempts line identification and automatic continuum estimate
VIEW	display the integrated area, the current channel, the integrated spectrum and the current spectrum

Useful parameter: REDSHIFT

UV PLANE ANALYSIS

SHOW UV	display UV data
UV_FIT	fit simple source models to the visibilities
SHOW UV_FIT	display the fit results, usually as a function of frequency
UV_SHIFT	change the phase centre
UV_DEPROJECT	de-project the (U, V) coordinates given a specified phase centre, orientation and inclination
UV_CIRCLE and UV_RADIAL	azimuthal averaging of visibilities
UV_REWEIGHT	change the visibility weights
UV_RESIDUAL	compute the residuals by subtraction of the Clean components or the residuals of UV_FIT

PIPELINE

The pipeline contains all processing steps for high fidelity imaging
(Self-calibration, continuum extraction, line identification, etc.)

`PIPELINE ?` check the Pipeline parameters. The control parameters are available in the `ALL%` global structure.

`PIPELINE` start the imaging Pipeline

`PIPELINE /MODE ALL|CONTINUUM|SPLIT|SURVEY`

Specify in which mode the pipeline will run:

- `ALL`: produce data cubes of line and continuum emission together, around lines identified from the `CATALOG`
- `CONTINUUM`: only produce continuum images
- `SPLIT` (default): similar to ALL, but produces separate line data cubes and continuum maps
- `SURVEY`: image the full bandwidth at user-controlled spectral resolution

`PIPELINE /WIDGET` launch the Pipeline interactive control panel.

The Widget allows the user to launch a step-by-step imaging process:

- `ORGANIZE` moves the initial files in a sub-directory structure
- `FIND` identifies *wide band UV tables* suitable for self-calibration
- `SELECT` restricts the work to a defined subset of files
- `CHECK` verifies if self-calibration is needed and possible
- `SELF` computes the self-calibration solution for the selected data
- `SHOW` displays the phase and amplitude correction
- `COLLECT` merges all self-calibration solutions from several bands
- `APPLY` applies the `SELF` (and optionally `COLLECT`) solutions to all UV tables
- `TIME` averages the self-calibrated UV Tables before imaging
- `IMAGING` produces continuum and/or spectral line images from identified spectral windows
- `SKY` performs primary beam correction to deconvolved data

SIMULATOR

`SIMULATE` activates the array Simulator

MAPS & CUBES HANDLING

`COMBINE`	combine data cubes with auto resampling
`MAP_CONVOLVE`	spatial convolution
`MAP_REPROJECT`	spatial re-projection (coordinates system, rotation, interpolation)
`MAP_INTEGRATE`	integrate on spectral range
`MAP_RESAMPLE`	spectral resampling
`MAP_SMOOTH`	spectral smoothing
`MOMENTS`	compute cube moments
`EXTRACT`	extract sub-cubes
`SPECTRUM`	extract a spectrum from a cube

BOOKKEEPING

`BUFFERS`	list status of internal buffers
`DISCARD`	forget (destroy) a buffer
`SPECIFY`	add or change header information
`UV_TRIM`	remove flagged data from a UV data set

`HARDCOPY filename /DEV EPDF` create a hardcopy of the current plot

ADVANCED TOOLS

`UV_DETECT`	apply a matched filter defined by the Clean image to the current UV data (for weak lines detection)
`KEPLER`	re-align spectra of a Keplerian rotating thin disk according to the projected rotation velocity at any point in the disk, and compute the combined integrated spectrum and brightness radial distribution (PV image)
`FEATHER`	Combine a data cube containing high-resolution data with one containing the short-spacing data (hybridization in the UV plane). See variable `FEATHER_RADIUS`

`UV_MERGE /MODE STACK` create a stacked UV table