Interface

The source modeler parameters will be passed through TelCal via the ParameterTuning interface. Two parameters have currently been defined and are evaluated by TelCal:

- sourceModelAux_BB_X   arbitrary string that contains the source model for the given baseband
- sourceModelEnable_BB_X   enables/disables application of source model phases for the given baseband

The exact content of the sourceModelAux_BB_X parameter depends on the choosen source model format (see next section).

Q: In order to select the source model format we can either encode it into the sourceModelAux parameter or introduce a new parameter e.g. sourceModelFormat

Source model format

AIPS CLEAN components

AIPS CLEAN components are described by X,Y coordinates and flux (amplitude). The units of the x/y coordinates must be passed to TelCal. The flux units are not strictly required but might be useful.

Q: What is the reference point for the map coordinates?

Proposed encoding of the information into the sourceModelAux_BB_X string:

format=AIPSCC;units=1:1:1;0.0:-2.0:0.0202189;0.0:-1.0:0.0131107;....

units: 1:1:1 would indicate x-resolution=1 arcsec, y-resolution=1 arcsec, flux=1Jy

Excerpt from AIPS CC table:

Comp #	Delta X asec	Delta Y asec	Flux Jy	Total Jy
1	0.00	-2.00	0.0202189	0.0202189
2	0.00	–1.00	0.0131107	0.0333296
3	1.00	–1.00	0.0106496	0.0439792
4	4.00	0.00	0.0060412	0.0500203
5	6.00	0.00	0.0041927	0.0542130
6	-1.00	-2.00	0.0040595	0.0582725
7	3.00	0.00	0.0037264	0.0619989
8	-3.00	-3.00	0.0034779	0.0654768

CASA source model

To be defined

Calculation of structure phases

Procedure described below is for AIPS CLEAN components format and might require to be modified for other formats.

Prepare FFT of model brightness distribution

1. Select CLEAN components based on flux. **A cut-off criterion must be defined to discard CLEAN componets below a certain flux level**
2. Calculate largest and smallest separation in x and y direction of selected CLEAN components. The largest separation defines the size of the source map. Size of the source map should be somewhat larger than this separation (factor 2 ?) in order to avoid aliasing effects and provide enough UV resolution for interpolation after appying the FFT (see below).
3. Transfer the selected CLEAN components to the source map (brightness distribution)
4. FFT the brightness distribution.

The above steps must be performed only once per baseband whenever the source model changes (a new sourceModelAux_BB_X gets passed through the Parameter Tuning interface). The Fourier transformations of the brightness distributions will be stored in the persistent TelCal Datamanager component. This will reduce the computational overheads per subscan.

Obtain structure phases

Currently the phase solver assumes structure phases to be 0 for all the baselines. The phase solver must now calculate the source structure phase with the following procedure:

For every baseline:

1. Calculate the UV coordinates. UV-coordinates are unfortunately not directly available in the ASDM/binary and must be approximated by evaluating the antenna positions and the source position. Something similar has been done already by Dominique in the *AmpliCal* code which can probably be largerly recycled. Note that the obtained UV-coordinates are lacking any other delay compensation normally applied by the delay server (e.g. atmospheric refraction etc.). This will introduce an additional phase error in the residuals.
2. Obtain the phase from the FFT of the brightness distribution at the given UV-coordinate. The UV-coordinate will typically not lie on the grid so the phase must be calculated by (linear) interpolation.
3. Feed the structure phase into the phase solver model
4. Solve normally

Q: How large is the phase error due to the approximation in the UV-coordinates?

Q: How large is the error due to the grid interpolation? Is the UV-resolution sufficient?

Q: frequency depends of source model. What is to be considered PER_AVERAGE phasing mode?

Q: What to do regarding time averaging? Calculate structure phases once e.g. for the mid-subscan time, or per integration and average?

Instead of the described procedure of calculating the FFT of the brightness distribution and then obtaining the structure phases by interpolation one could do the following:

1) calculate the UV coordinates for each baseline (identical to the above)

2) Do a direct Fourier transform to the UV-coordinate and obtain the phase directly and with high accuracy (no interpolation).

Pros: high accuracy

Cons: Requires to do an FFT for each baseline for every subscan and baseband => Probably too much computational overhead.