

## aiCtfDetector

CTF-Detector estimates from the images' powerspectrum the CTF parameters defocus and astigmatism.

As input, CTF-Detector accepts a tilt-series or a single frame image, the metadata file is used to read initial values and to store the detected parameters. The search area is either the entire image frame or a cropped patch of user define size. The position of the patch is given by its 3D position in the volume that is then projected on each tilt in a tilt series. This allows to identify for example a piece of carbon in the tomogram and to track its position to obtain the CTF values for a well defined position in the tomogram.

aiCtfDetector can be used without a configuration file and all parameters can be provided by command line arguments. For convenience, parameters can also be given using a configuration file with the **-u** command line argument. Note: If a parameter is passed by file and by command line, the command line overrides the file.

Options are:

### CudaDeviceID

The deviceID of the GPU to use.

Argument for command line: **-d** or **--CudaDeviceID**

Type: **int**

Option is mandatory: **false**

Default value if not set: **0**

### Input

The file to process.

Argument for command line: **-i** or **--Input**

Type: **string**

Option is mandatory: **true**

### LP

Low pass filter value.

Argument for command line: **-lp** or **--LP**

Type: **float**

Option is mandatory: **true**

### LPS

Low pass filter sigma value.

Argument for command line: **-lps** or **--LPS**

Type: **float**

Option is mandatory: **true**

### HP

High pass filter value.

Argument for command line: **-hp** or **--HP**

Type: **float**

Option is mandatory: **false**

Default value if not set: **0**

### HPS

High pass filter sigma value.

Argument for command line: **-hps** or **--HPS**

Type: **float**  
Option is mandatory: **false**  
Default value if not set: **0**

## AverageMinTilts

Only valid for tilt series: if true, the power spectra of the three lowest tilts are averaged for initial CTF detection. If false, only the lowest tilt angle is used. This can help to detect astigmatism more precisely if dose is too low on one single tilt.

Argument for command line: **-avg** or **--AverageMinTilts**

Type: **bool**  
Option is mandatory: **false**  
Default value if not set: **false**

## Patch

If true, the CTF is detected on a cropped patch, if false on the entire frame.

Argument for command line: **-patch** or **--Patch**

Type: **bool**  
Option is mandatory: **false**  
Default value if not set: **false**

## PatchSize

The unbinned patch size on which CTF is detected.

Argument for command line: **-size** or **--PatchSize**

Type: **int**  
Option is mandatory: **true**  
Only applicable if **Patch** = true.

## PatchPosition

The (unbinned) position in 3D where the CTF is measured in global coordinates, e.g. a piece of carbon. The point is projected on the image for every frame, z is ignored if input is not a tilt series.

Argument for command line: **-patchPos** or **--PatchPosition**

Type: **float** or **float3**, one or three float values

Option is mandatory: **false**  
Default value if not set: **(0, 0, 0)**  
Only applicable if **Patch** = true.

## BackgroundRemoval

Defines the method for how to subtract the background noise from the power spectrum.

Argument for command line: **-bg** or **--BackgroundRemoval**

Type: one of [**LPCONCAVE**, **LPCONVEX**, **NONE**, **QUADRATURE**]

Option is mandatory: **true**

Possible notations:

- **LPCONCAVE**: LPConcave, LpConcave, lpconcave, LPCONCAVE
- **LPCONVEX**: LPConvex, LpConvex, lpconvex, LPCONVEX
- **NONE**: NONE, None, none
- **QUADRATURE**: QUADRATURE, QUAD, Quadrature, Quad, quadrature, quad

## Mask

Radius of the mask on the powerspectrum to crop out center of the CTF and limit the maximum frequency range where the CTF is detected. In relative values [0..0.5] or in absolute unbinned pixels [0..imDim/2] (image or patch if enabled).

Argument for command line: **-mask** or **--Mask**

Type: **float2**, two float values

Option is mandatory: **true**

## Binning

Binning factor to apply to the original image. This discards high frequencies that usually do not contain enough signal for CTF determination but speeds up the search.

Argument for command line: **-bin** or **--Binning**

Type: **int**

Option is mandatory: **false**

Default value if not set: **1**

## DefocusMin

Begin of search range in [nm] for each iteration. The value is added to the initial defocus value.

Argument for command line: **-defMin** or **--DefocusMin**

Type: **List<float>**, a list of floating point values

Option is mandatory: **true**

## DefocusMax

End of search range in [nm] for each iteration. The value is added to the initial defocus value.

Argument for command line: **-defMax** or **--DefocusMax**

Type: **List<float>**, a list of floating point values

Option is mandatory: **true**

## DefocusStep

Search step in [nm] for defocus in each iteration.

Argument for command line: **-defStep** or **--DefocusStep**

Type: **List<float>**, a list of floating point values

Option is mandatory: **true**

## Astigmatism

If true, the astigmatism parameters are included in the search.

Argument for command line: **-astig** or **--Astigmatism**

Type: **bool**

Option is mandatory: **false**

Default value if not set: **false**

## AstigmatismMin

Begin of search range for astigmatism in [nm] for each iteration. The value is added to the initial value.

Argument for command line: **-astigMin** or **--AstigmatismMin**

Type: **List<float>**, a list of floating point values

Option is mandatory: **true**

Only applicable if **Astigmatism** = true.

## AstigmatismMax

End of search range for astigmatism in [nm] for each iteration. The value is added to the initial value.

Argument for command line: **-astigMax** or **--AstigmatismMax**

Type: **List<float>**, a list of floating point values

Option is mandatory: **true**

Only applicable if **Astigmatism** = true.

## AstigmatismStep

Search step for astigmatism in each iteration.

Argument for command line: **-astigStep** or **--AstigmatismStep**

Type: **List<float>**, a list of floating point values

Option is mandatory: **true**

Only applicable if **Astigmatism** = true.

## AstigmatismAngleMin

Begin of search range for astigmatism angle in [degree] for each iteration. The value is added to the initial value.

Argument for command line: **-astigAngMin** or **--AstigmatismAngleMin**

Type: **List<float>**, a list of floating point values

Option is mandatory: **true**

Only applicable if **Astigmatism** = true.

## AstigmatismAngleMax

End of search range for astigmatism in [degree] for each iteration. The value is added to the initial value.

Argument for command line: **-astigAngMax** or **--AstigmatismAngleMax**

Type: **List<float>**, a list of floating point values

Option is mandatory: **true**

Only applicable if **Astigmatism** = true.

## AstigmatismAngleStep

Search step for astigmatism angle in each iteration.

Argument for command line: **-astigAngStep** or **--AstigmatismAngleStep**

Type: **List<float>**, a list of floating point values

Option is mandatory: **true**

Only applicable if **Astigmatism** = true.

## CropBorder

The numbers of pixels to crop from the image frame.

Argument for command line: **-crop** or **--CropBorder**

Type: **int**

Option is mandatory: **false**

Default value if not set: **0**

## DimBorder

The numbers of pixels to dim the image to zero at the image borders.

Argument for command line: **-dim** or **--DimBorder**

Type: **int**

Option is mandatory: **false**

Default value if not set: **0**

## FrameMetadata

Frame metadata for a tilt series can be stored inside the tilt series metadata file or in an additional file. Only used if input is a tilt series.

Argument for command line: **-meta** or **--FrameMetadata**

Type: **string**

Option is mandatory: **false**

Default value if not set: **"**

## SaveResultImages

Save an image of the powerspectrum and the matched CTF (for the lowest tilt in case of a tilt series).

Argument for command line: **-img** or **--SaveResultImages**

Type: **bool**

Option is mandatory: **false**

Default value if not set: **false**