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## **FrameSmooth**

User guide

Version 1.2

2016

## **1. Common information**

Frame Smooth - cross-platform module for brightness equalization of CoLiTec software. It allows processing images with any formats, including astronomical frames. Module is based on using of filter for brightness equalization, inverse median and nonlinear high-frequency filters. Also it supports using of additional astronomical master-frames (Bias, Dark, DarkFlat and Flat).

## **2. Minimal system requirements:**

- **Windows** system from 2000 version or **UNIX** system;
- **Processor** frequency no less 1 Hz;
- **RAM** no less 1GB;
- **Free space** on the hard drive (taking into account the space for temporary files) no less 500 Mb.

### 3. Main window:

Access to the program features can be provided through the main window of GUI (fig. 1).

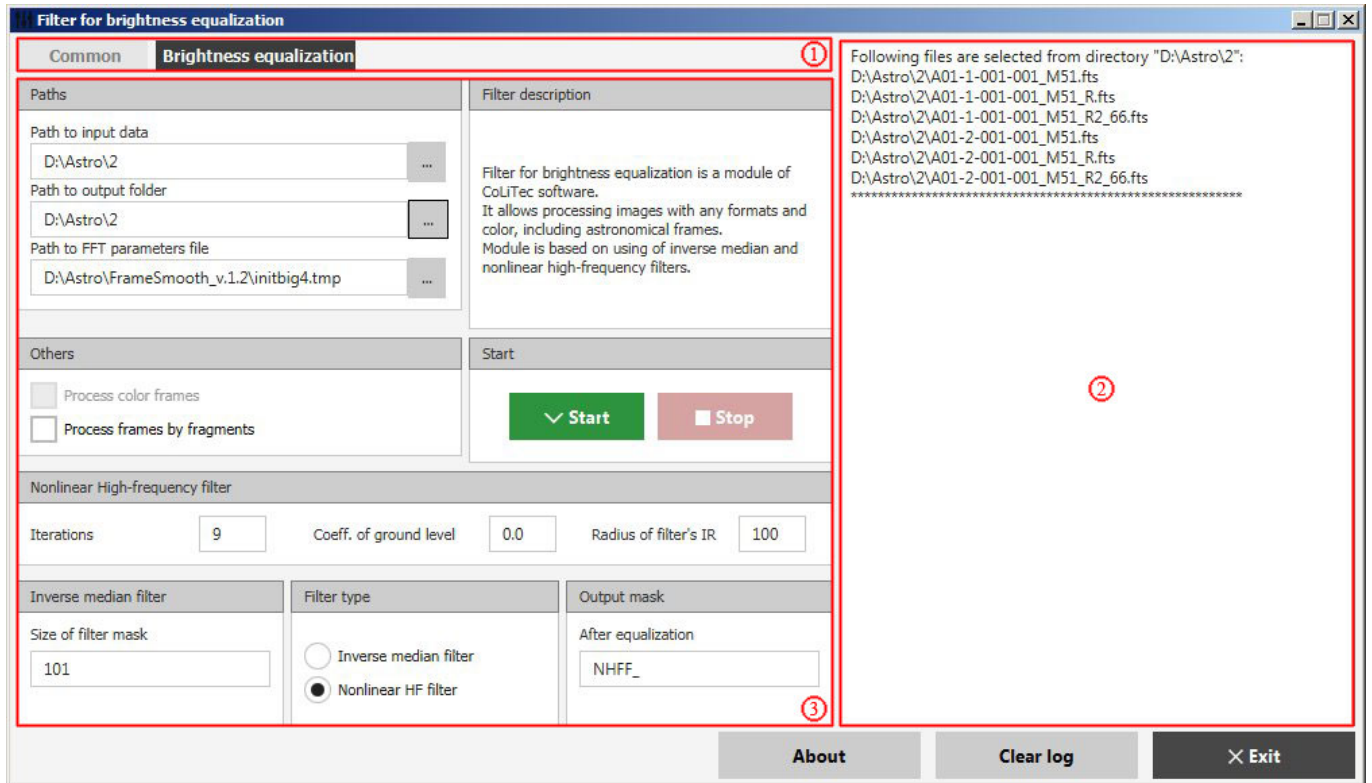


Fig. 1. Main window: 1 – tabs; 2 – Output window with text information (processing log); 3 – tab area to set parameters.

#### 4. “Common” tab

- “**Modules paths**” field to specify a path to the image processing executable files (set automatically);
- “**Language choice**” selection field of the language interface;
- In field “**Others**” optionally set:
  - “**Delete temporary files**” – removing of temporary files;
  - “**Use additional Master-Frames**” – usinf of additional tabs to process with master-frames (6 section).

Common	Brightness alignment
<b>Modules paths</b>	
Path to module for brightness equalization	
<input type="text" value="D:\Astro\Manual FHF\FHFv.2.2\FHF5\FHF5.2.exe"/> ...	
Path to CosmCLT	
<input type="text" value="D:\Astro\Manual FHF\FHFv.2.2\CosmCLT.exe"/> ...	
<b>Language choice</b>	<b>Others</b>
<input type="radio"/> Russian	<input type="checkbox"/> Delete temporary files
<input checked="" type="radio"/> English	<input type="checkbox"/> Use additional Master-Frames

## 5. “Brightness equalization” tab

Settings for the image filtration.

The screenshot shows the 'Brightness equalization' tab in the FrameSmooth software. The interface is organized into several sections:

- Paths:** Three input fields with browse buttons (three dots) for:
  - Path to input data: D:\Astro\2
  - Path to output folder: D:\Astro\2
  - Path to FFT parameters file: D:\Astro\FramSmooth\_v.1.2\initbig4.tmp
- Filter description:** A text box containing: "Filter for brightness equalization is a module of CoLiTec software. It allows processing images with any formats and color, including astronomical frames. Module is based on using of inverse median and nonlinear high-frequency filters."
- Others:** Two checkboxes:
  - Process color frames
  - Process frames by fragments
- Start:** A green button with a downward arrow and the text 'Start', and a red button with a square and the text 'Stop'.
- Nonlinear High-frequency filter:** Three input fields:
  - Iterations: 9
  - Coeff. of ground level: 0.0
  - Radius of filter's IR: 100
- Inverse median filter:** One input field:
  - Size of filter mask: 101
- Filter type:** Two radio buttons:
  - Inverse median filter
  - Nonlinear HF filter
- Output mask:** One text field:
  - After equalization: NHFF\_

In “**Paths**” field following paths can be set:

- “*Path to input data*” – path to the raw files;
- “*Path to output folder*” – the path to the output folder of processed files;
- “*Path to FFT parameters file*” – path to the optimal settings file of the Fast Fourier Transform. (*initbig4.tmp*).

*initbig4.tmp file is used in the nonlinear high-frequency filter. It includes settings parameters of Fast Fourier Transform and optimally adapted to the system (CPU + RAM), in which it was created. To create a parameter files that are configured on your system, you must remove (stored separately) delivered initbig4.tmp file and run the program. This file will be created automatically during the image processing by the Nonlinear High-Frequency filter. Time for creation of setting file can be from 5 to 20 minutes.*

Parameters of Nonlinear High-Frequency filter can be set in “***Nonlinear High-Pass filter***” field:

- “*Number of iterations*” – number of iterations from 1 to 50;
- “*Coefficient of background level*” – parameter changes from -3 to 3, recommended value equal zero;
- “*Radius of filter's IR*” – the radius of the filter's impulse characteristic from 30 to 500;

Parameter of the inverse median filter – mask size “*Size of filter mask*” – can be set in “***Inverse median filter***” field.

*The recommended value of the inverse median filter mask size is determined by the expression:*

$$d \geq \sqrt{2N + 1},$$

where  $d$  - window size of inverse median filter;

$N$  - number of pixels (area), which occupies by the bright object on the image.

Filter type can be selected in “***Filter type***” section.

The mask for filename of the processed images can be set in “***Output mask***” field.

In field “***Others***” selected “*Process frames by fragments*” to trigger filtering algorithm large images (10000x10000 pixels).

## 6. The creation and use of astronomical master-frames.

### Creating of master frames

1. Section "Path to the master-frames" - paths to master frames (Bias, Dark, DarkFlat, Flat) can be set in these fields. Frames prescribed in this section, will be used in «MF using» tab (using of master-frames).
2. Names for created master-frames. You can specify only the file name, a name with extension or the full path.
3. Creating a master frame – choose the appropriate button to create the necessary master frame.

### Using of created master-frames

1. Specify names of the output directories to store processed frames, according to the selected task. If the folder path is not specified, the processed images will be created in the same folder as the raw frames.
2. Set mask of the frames names that will be added during processing. Also the level of pixels rejection can be set during the creation of a master-frames.
3. Select raw frames and process it (subtract the Bias, Dark, Dark Flat, or divide the Flat). The results will be stored into the corresponding output location. Master-frame which is used may be set in "Master Frame" tab.

### The complex processing

1. Select corresponding additional frames (raw or already formed master-frames). Checkbox «Use» confirms usinf of this type of additional frames during processing of raw frames. When "Use FHF" checkbox is selected the raw frames will be processed with inverse median filter after subtraction of the Dark master-frame.
2. Set folder path to store the processing result.
3. «START» - specify a list of raw frames, masks and to start processing.

Common	FHF	Master-Frames	MF using	Processing
<p><b>Paths to Raw additional frames</b></p> <p>Use Path to Raw-Bias or Master-Bias <input type="checkbox"/> <input type="text"/> ...</p> <p>Path to Raw-Dark or Master-Dark <input type="checkbox"/> <input type="text"/> ...</p> <p>Path to Raw-DarkFlat or Master-DarkFlat <input type="checkbox"/> <input type="text"/> ...</p> <p>Path to Raw-Flat or Master-Flat <input type="checkbox"/> <input type="text"/> ...</p> <p><input type="checkbox"/> Use FHF (select filter type in FHF tab)</p>				
<p><b>Path to output folder</b></p> <p>Path to processing output folder after script execution <input type="text"/> ...</p>				
<p><b>Script description</b></p> <p>Process flow:                      1. Master-Bias, -Dark, -DarkFlat, -Flat creation;                      2. Master-Bias, -Dark, -DarkFlat rejection;                      3. Median filter processing;                      4. Master-Flat division.</p>		<p><b>Start</b></p> <p>Output mask after script execution <input type="text"/></p> <p>Script_</p> <p><input type="button" value="Start"/> <input type="button" value="Stop"/></p>		