



STEVE-6D

User Manual

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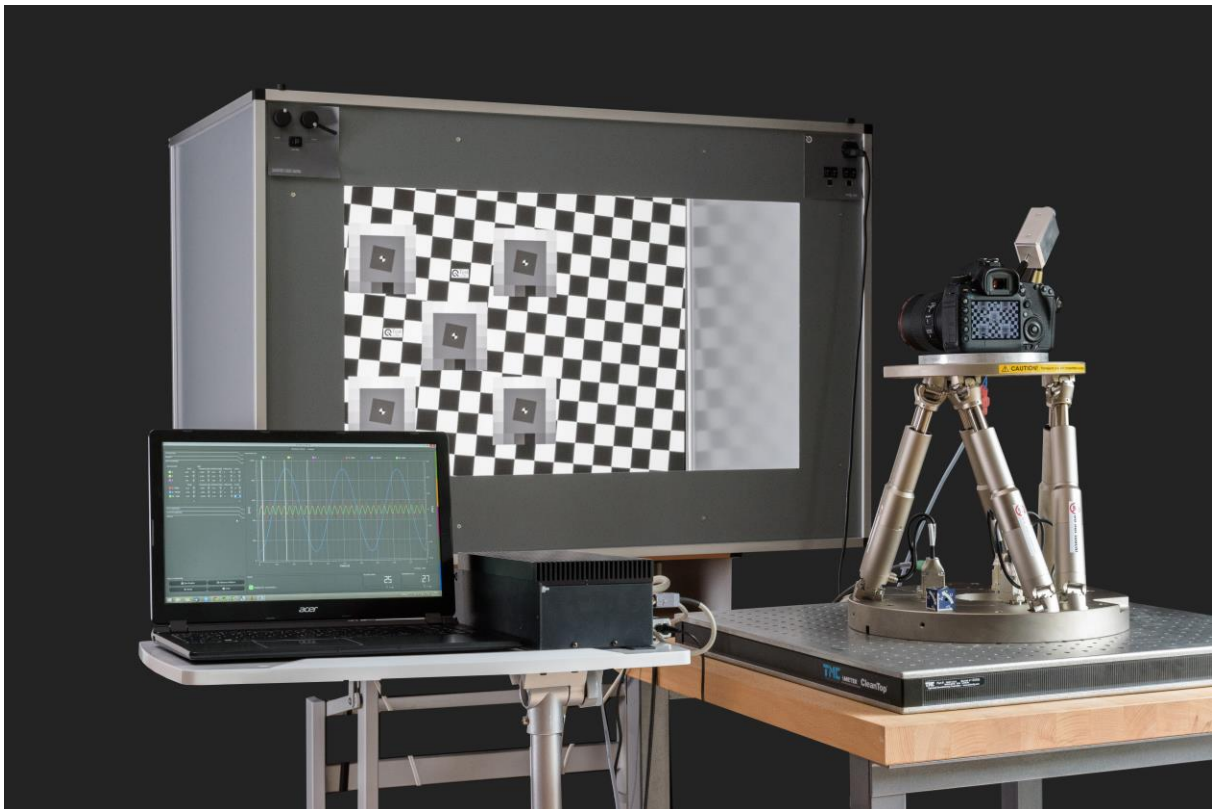
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1 INTRODUCTION

The STEVE-6D software evaluates the image stabilization performance of digital cameras. The following image illustrates an example setup for analyzing low-contrast slanted edges using the TE261 test chart. The camera is mounted to the STEVE-6D and is then vibrated while the image stabilization function of the camera is switched on and off to capture images at different exposure times. From here, the software analyzes the edge width of the blurred slanted edges and then calculates the stabilization performance in f-stops. This software can also control the iQ-Trigger and the STEVE-6D hardware with a sine wave generator, custom user waveforms, or the CIPA custom handshake.

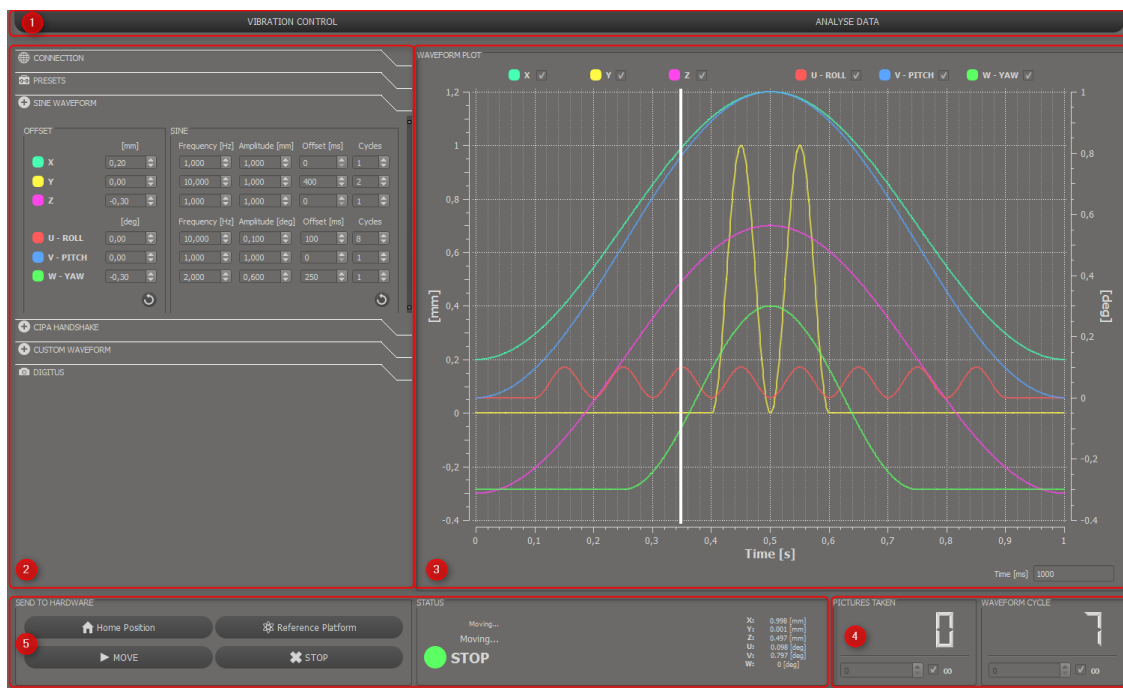


STEVE-6D - Turnkey solution



2 GRAPHICAL USER INTERFACE

The STEVE-6D software is divided into two major modules, one for communication to STEVE-6D hardware and the other for image stabilization performance calculation [1].



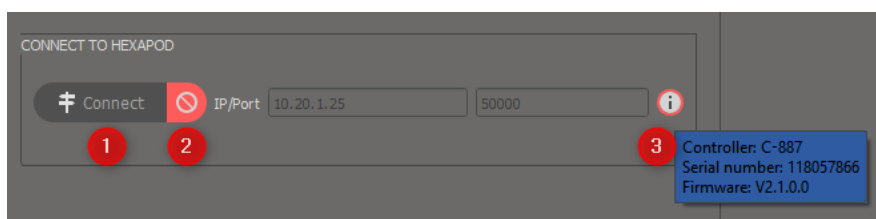
Module for vibration control of STEVE-6D

2.1 Vibration control module

The “VIBRATION CONTROL” module sets up waveform data and manages the interface between the STEVE-6D and the iQ-Trigger. The “VIBRATION CONTROL” is divided into four different parts, the first part [2] switches amongst the following tabs.

2.1.1 Connection tab

To get a connection with STEVE-6D, click the “Connect” button [1], and the STEVE-6D will automatically reference all six axes to position zero. For disconnecting, click the red button [2] to the right. Hovering the mouse cursor over the information item [3] will reveal information about the connected controller, such as serial number and firmware version in the tooltip.



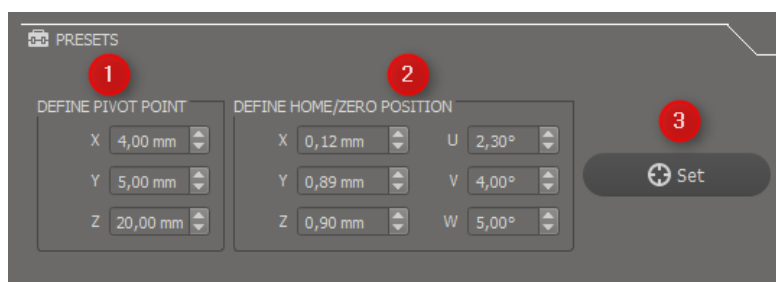
Connection tab



2.1.2 Presets tab

The camera system can be easily aligned by defining the rotation point, known as the pivot point [1], and the local home/zero position [2]. Every waveform data curve refers to this position.

The default pivot point ($x=y=z=0$) is located at the bottom center of the retaining plate. You can change its position to what is best for your application. For example, with a mobile phone, it makes sense to set the pivot point to the center of the phone as this is usually the center of rotation when a user holds it. However, an SLR camera probably has a different center of rotation due to its very different geometry.

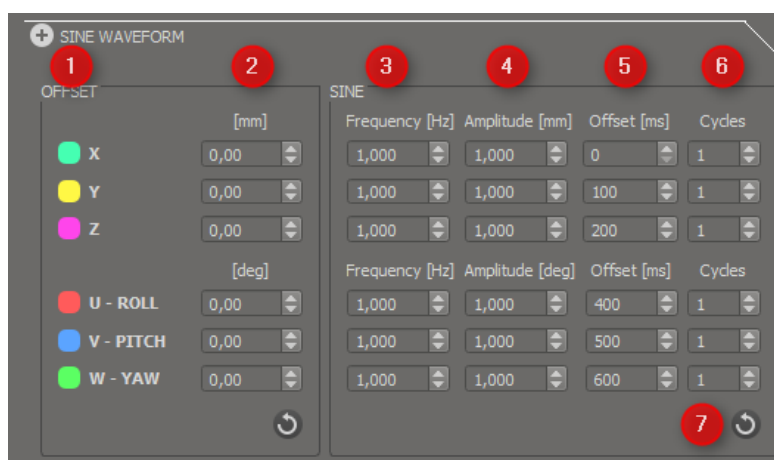


Presets tab

AFTER DEFINING A NEW PIVOT POINT, IT IS NECESSARY TO CLICK THE "SET" BUTTON [3].

2.1.3 Sine waveform tab

A sine wave generator for each axis creates a quick way to set up waveform data. To define a new waveform, change the values of the offset concerning position [2], frequency [3], amplitude [4], and time offset [5]. The "Cycles" [6] spin box defines how often the sine should repeat. To perform the waveform, click the "MOVE" button. Click the button in the lower right-hand corner [7].

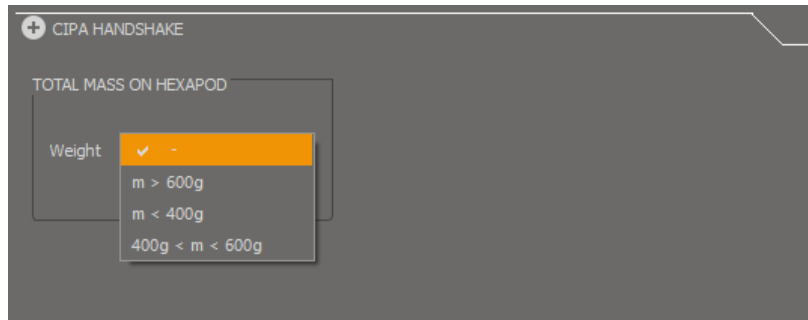


Sine waveform tab



2.1.4 CIPA handshake tab

To perform any of the three CIPA handshakes, first, select the weight of the optical system. From there, the waveform data is automatically uploaded to the STEVE-6D controller, and movement begins when the MOVE button is clicked. Due to the CIPA nondisclosure agreement, the “WAVEFORM PLOT” is just an example.



CIPA handshake tab

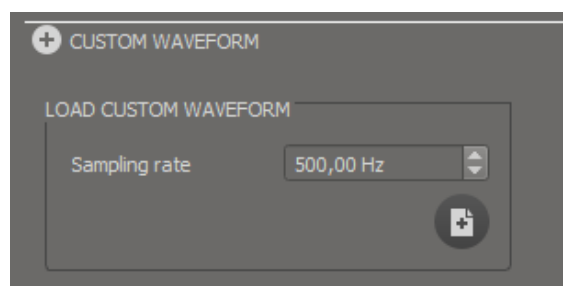
2.1.5 Custom waveform tab

2.1.5.1 By standard waveform

Upload a custom waveform to STEVE-6D by creating a simple .txt file with Cartesian coordinates. All values have to be separated with a tab stop. The axis sequence is X Y Z U V W. Set the sampling rate of the waveform in the STEVE-6D software and then load the .txt file to the software. All coordinates are irrespective of the pivot point and homing position. The waveform upload starts automatically after the .txt file is loaded into the STEVE-6D software.

File definition for standard waveform: (Use tab as separator)

X[mm]	Y[mm]	Z[mm]	U[deg]	V[deg]	W[deg]
-------	-------	-------	--------	--------	--------



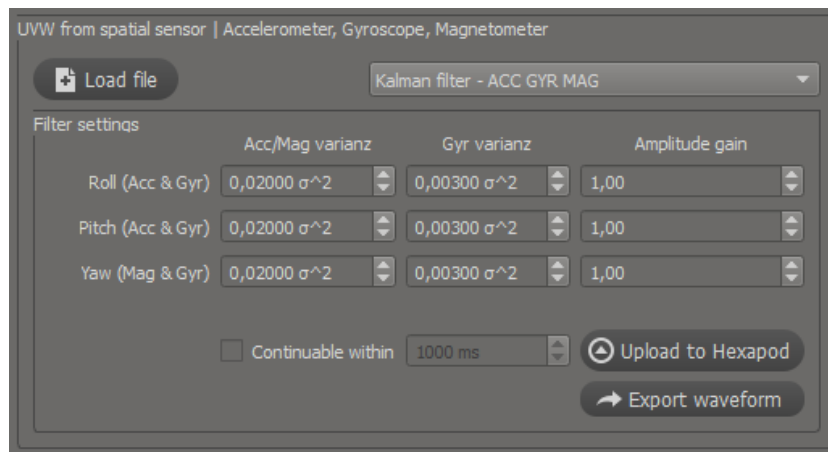
Load .txt file and set sampling rate



2.1.5.2 By spatial data

Use spatial sensor data when analyzing devices such as smartphones (accelerometer, gyroscope, magnetometer). To get more precise rotation values, set the parameter for Acc/Mag & Gyr variant. The amplitude gain is only for scaling the amplitude. After all parameters are set, click the upload to hexapod button to begin the movement. The continuable checkbox will allow the user to set a duration for the waveform to continue as long as the start position differs from the end position. There is also the option to use only the accelerometer or gyroscope data.

The export waveform button can be utilized to save the waveform and for the IS performance calculation. The data sampling rate is 1000Hz.



Spatial sensor settings

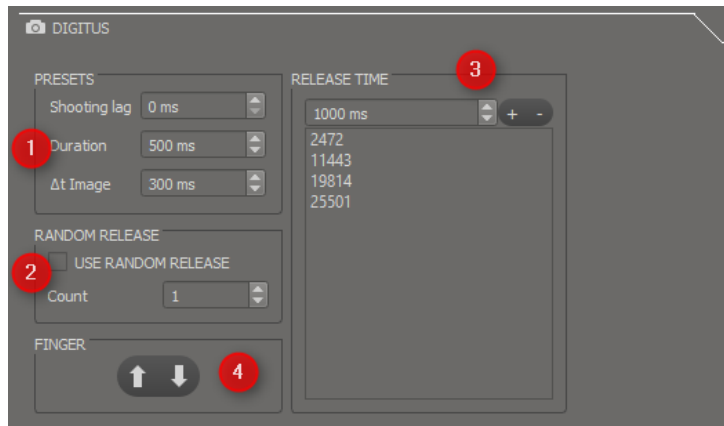
File definition for UVW from the spatial sensor:

HH:MM:SS.ZZZZ	AccX[g]	AccY[g]	AccZ[g]	GyrX[rad/s]	GyrY[rad/s]	GyrZ[rad/s]	Mag[μ t]	Mag[μ t]	Mag[μ t]

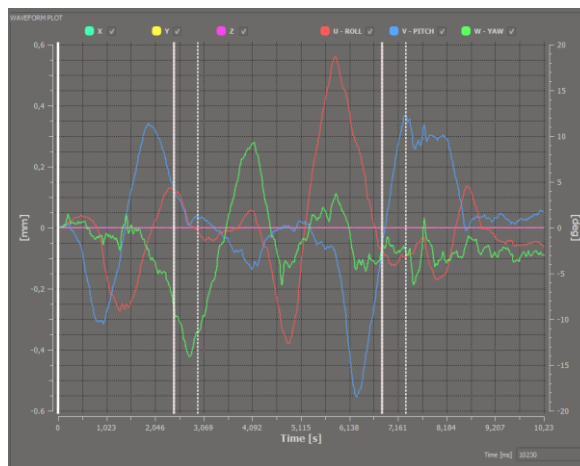
Use tab as the separator.

2.1.6 iQ-Trigger tab

Remote camera release can be performed with the iQ-Trigger. It is possible to define multiple release times by clicking the "WAVEFORM PLOT" or manually choosing the time in the iQ-Trigger tab [3]. If a random release time is needed, define the count of releases per waveform [2]. Every iQ-Trigger release is defined by the shooting lag, the release duration, and the delta time between two camera releases [1].



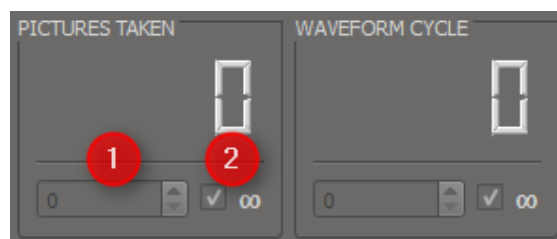
iQ-Trigger settings



Vertical lines indicate the Digitus release times

2.1.7 Send to hardware, status, and image/waveform count

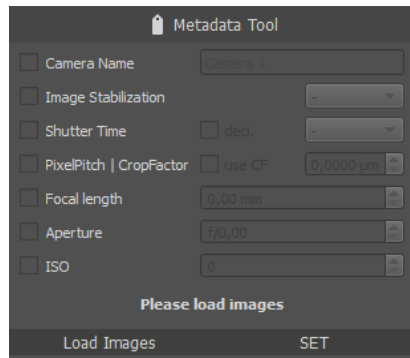
All information about the connection status or errors is displayed in the “STATUS” area. To start a movement, press the “MOVE” button. By clicking the “Home Position” button, the STEVE-6D moves directly to the homing position, which was set previously in the “PRESETS” tab. If it is necessary to recalibrate the STEVE-6D, click the “Reference Platform” button. When defining a value for “PICTURE TAKEN” or “WAVEFORM CYCLE,” it is possible to stop the motion of STEVE-6D automatically. Set the value to unlimited [2] or choose a value for the number of counts [1] the iQ-Trigger should trigger, or the waveform should execute.





2.2 Analyze Data

The “Analyze Data” module does the Image Stabilization calculation. This module has three significant parts. The first part is the “Metadata Tool” [1], which sets the camera metadata. The second part is the image batch processing for the IS-Performance calculation [2]. The final part displays the results of the captured images.



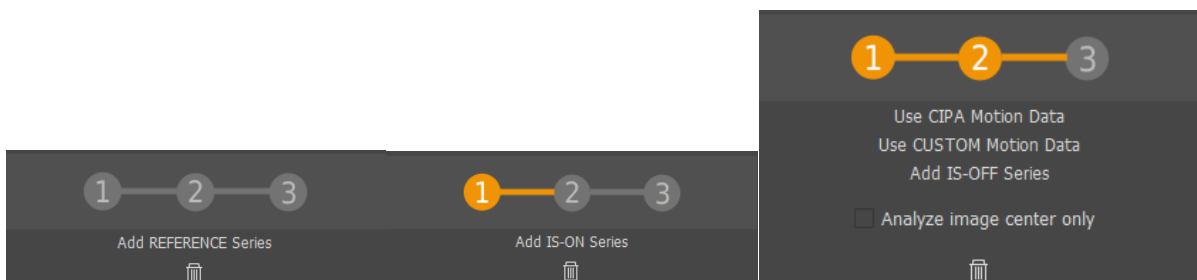
2.2.1 Metadata

It's essential to have camera metadata information for IS-Performance calculations such as pixel pitch and shutter time. If the camera doesn't record this information in the image file, load a batch of images and manually write it into the .jpg image. Load the images, set the parameters, and then hit the “SET” button.

ONLY FOR JPEG IMAGES

2.2.2 Load images for IS-Performance calculation

Once the reference series is loaded, choose a test series for IS-ON. At least one image series for IS-OFF is required. If the CIPA handshake waveform was used, the test series for IS-OFF is not needed. Instead, click the button for CIPA and then select the camera weight. Images from custom waveform measurements may be loaded by clicking the custom motion data button. The “analyze image center only” checkbox is available for quicker but less precise data. When choosing this option, only the middle edge box is used during the calculation.





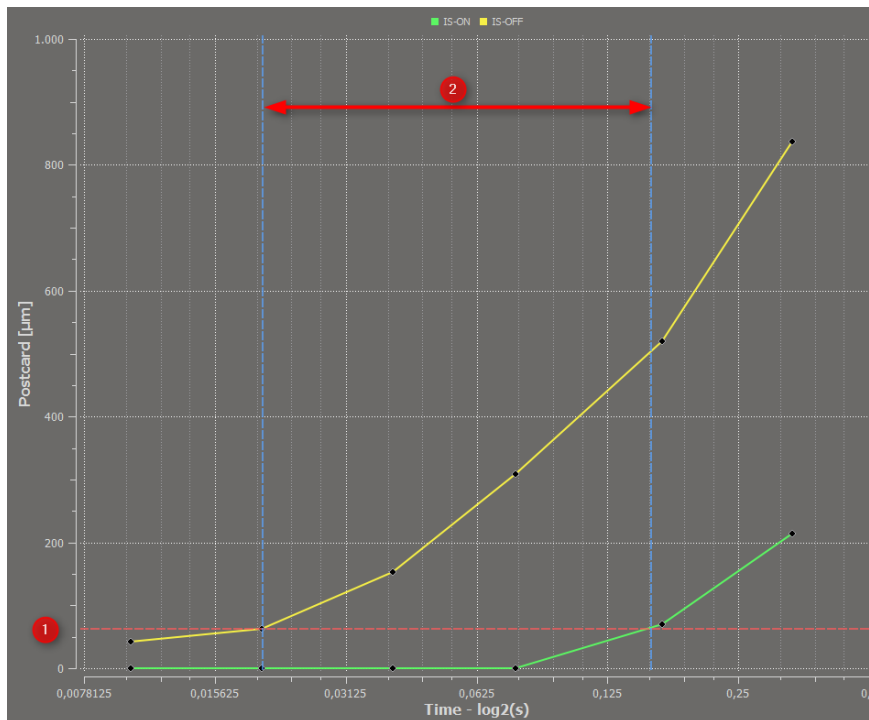
Once the options have been chosen, a tree view of the different series will appear, as seen below. If no image metadata is available, then use the “Metadata Tool,” which is indicated by an error message after the images are loaded to the STEVE-6D software.

Once complete, the image stabilization performance calculation can be started by clicking the “Process” button. A result file with single edge width calculations will be saved in the folder with the images.

	Exp.Time [s]	Pitch [pix]	Yaw [pix]	Sqrt(p ² +y ²)

2.2.3 IS-Performance

The edge width calculates the IS-Performance in μm vs. the exposure time. The edge widths of the IS-ON and IS-OFF (or motion data) series are converted to the size of a postcard with a viewing distance of 65-80 cm to accomplish this process. The image stabilization performance in f-stops [2] is located by the intersection points of the IS-ON and IS-OFF curve with a determination limit of $63\mu\text{m}$ [1]. The numerical value of the IS-Performance is displayed in f-stops.



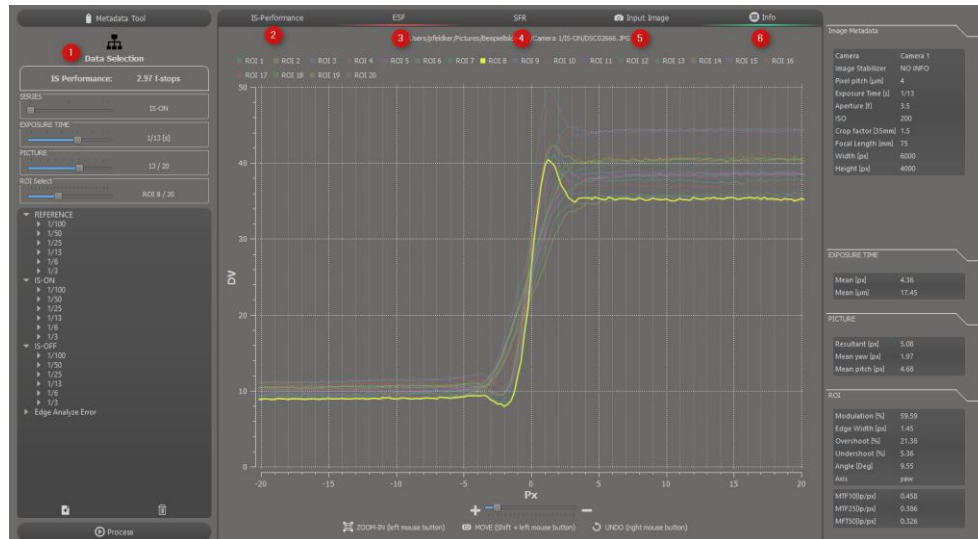
IS-Performance

2.2.4 Result data selection

To select single results of the IS-Performance calculation, move one of the sliders [1] for “SERIES,” “EXPOSURE TIME,” “PICTURE,” or “ROI” (region of interest). This move will change the displayed



results for the edge spread function (“ESF”) [3], spatial frequency response (“SFR”) [4], and the “INPUT IMAGE” [5] tab. Detailed information can be shown or hidden with the “INFO” button [6].



Data selection

2.2.5 Edge spread function (ESF)

The ESF calculates every edge width. Thus, an oversampled slanted edge of an image ROI is calculated from every image. Each image includes twenty slanted edges, including ten in the pitch and ten in the yaw direction.

2.2.6 Spatial frequency response (SFR)

The SFR is not used for IS-Performance calculation. Instead, it describes the modulation transfer function of every ROI.

2.2.7 Input image and ROI selection

It is possible to change or display the region of interest for every result. Click on the “Edit ROIs” button and change the location of the ROI. To set a new ROI, click the button, and use the “-“ button to delete an ROI. For a zooming effect, click the “Zoom +” button and draw a rectangle on the image.

2.2.8 Error handling

If the software does not detect all 20 ROIs on one of the images, then an error has occurred during the input image list view. If this happens, please select the image and manually define the missing ROIs for the image.



3 COPYRIGHT INFORMATION

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