User manual: openSIM software

Contents

1. Introduction to openSIM software

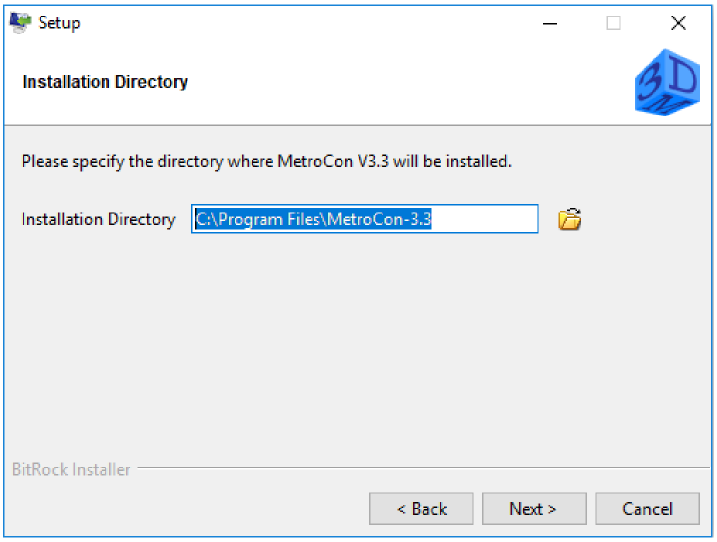
The openSIM software is written with LabView. It controls the openSIM device itself and interfaces additional components such as the camera, microscope, and piezo focus positioner if available. It includes a user interface to enter the necessary parameters and to display currently executed commands and error messages. The part of the software operating the openSIM device controls the LEDs, provides the projected pattern for the spatial light modulator (SLM), and actuates the fan. The projected patterns can be selected either manually from a list of patterns or automatically based on parameter inputs from the user. The software handles the image mode selection, saving and formatting of the acquired data and the corresponding metadata. In addition, the software controls the camera for the image acquisition. If a device necessary for z-stacking, such as a piezo focus positioner or a motorized focus controller, is available, the software can be used to perform z-stacking. The z-stacking function automatically changes the focus of the objective by providing an analog output to the focus adjusting device.

The software is written in a modular structure to enable a customization and adaption to different peripheral components such as different camera models or focus adjustment. The current version of the software includes an integration for an Andor Zyla sCMOS, an Andor iXonUltra EMCCD camera (information specifically relevant for these two camera types are marked in grey in the following text) and Piezosystem Jena Mipos 100 piezo focus positioner.

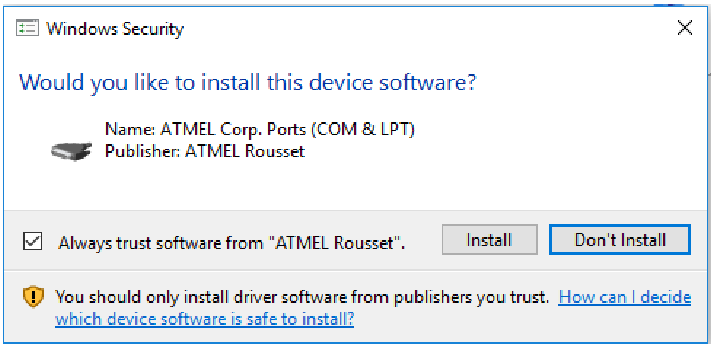
See the documentation of openSIM software (provided within the distributed openSIM documentation folder) for more detailed information on the LabView code.

2. Installation

1. Install Labview > 2015 including the vision development module and DAQmx module
   Download: https://www.ni.com/en-us/support/downloads/software-products/download.labview.html#329059
   - ➔ Vision development module: https://www.ni.com/en-us/support/downloads/software-products/download.vision-development-module.html#329460
   - ➔ DAQmx module: https://www.ni.com/en-us/support/downloads/drivers/download.ni-daqmx.html#333268
2. Run the MetroCon 3.3 application from …\drivers\ForthDD_QXGA\MetroCon within the distributed openSIM folder
   Check that MetroCon is installed in C:\Program Files\MetroCon-3.3
   (or C:\Program Files (x86) \MetroCon-3.3 for the 36-bit version or the corresponding path to the program folder for other operating systems than windows)



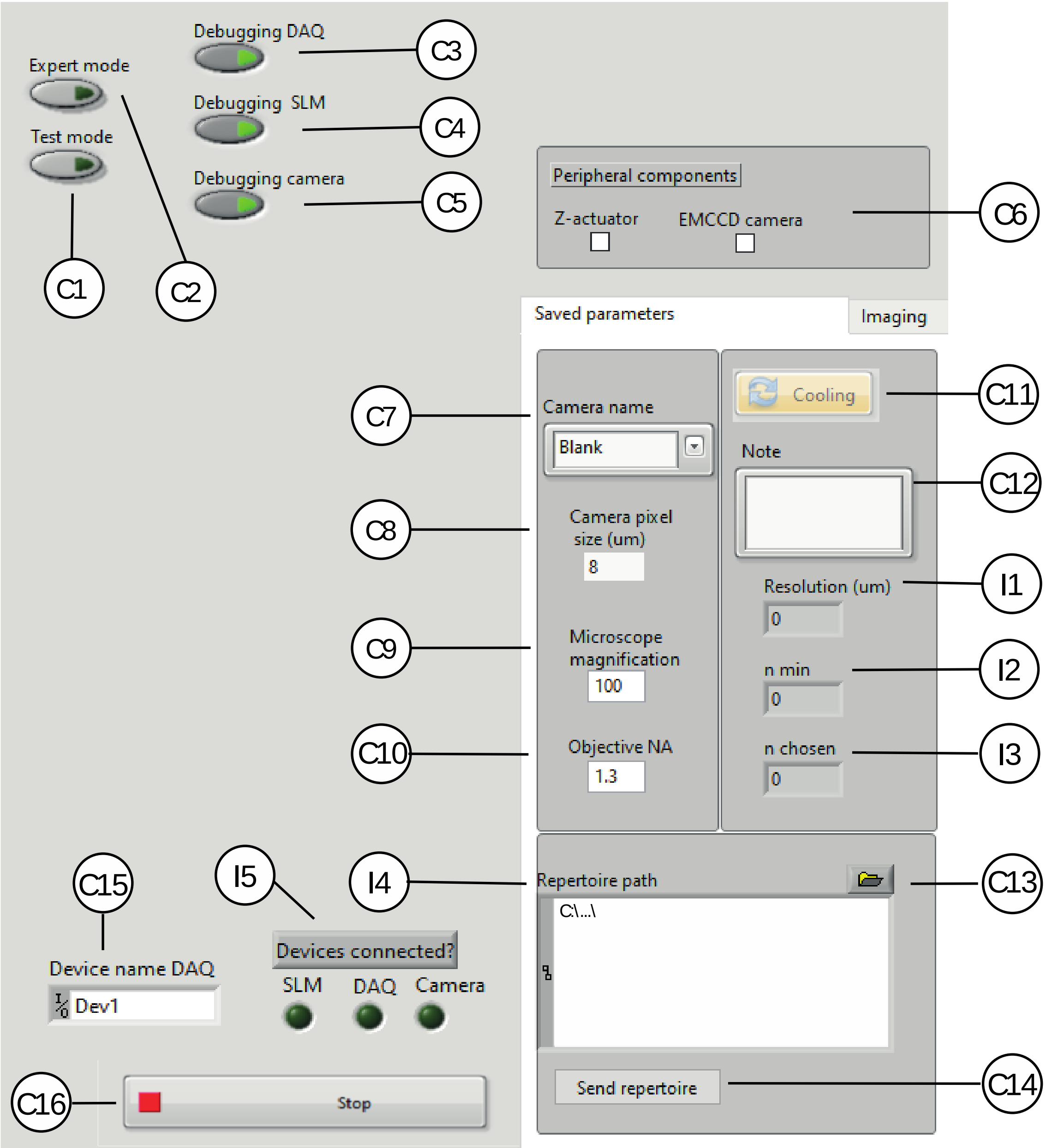
Install ATMEL Corps. Ports (COM & LPT)



3. Install visual studio 2013. It is important to download the 2013 version and not another version
   Download: https://visualstudio.microsoft.com/vs/older-downloads/
4. Restart the computer one more time
5. Copy the openSIM Labview folder to a local directory

3. Control of openSIM software

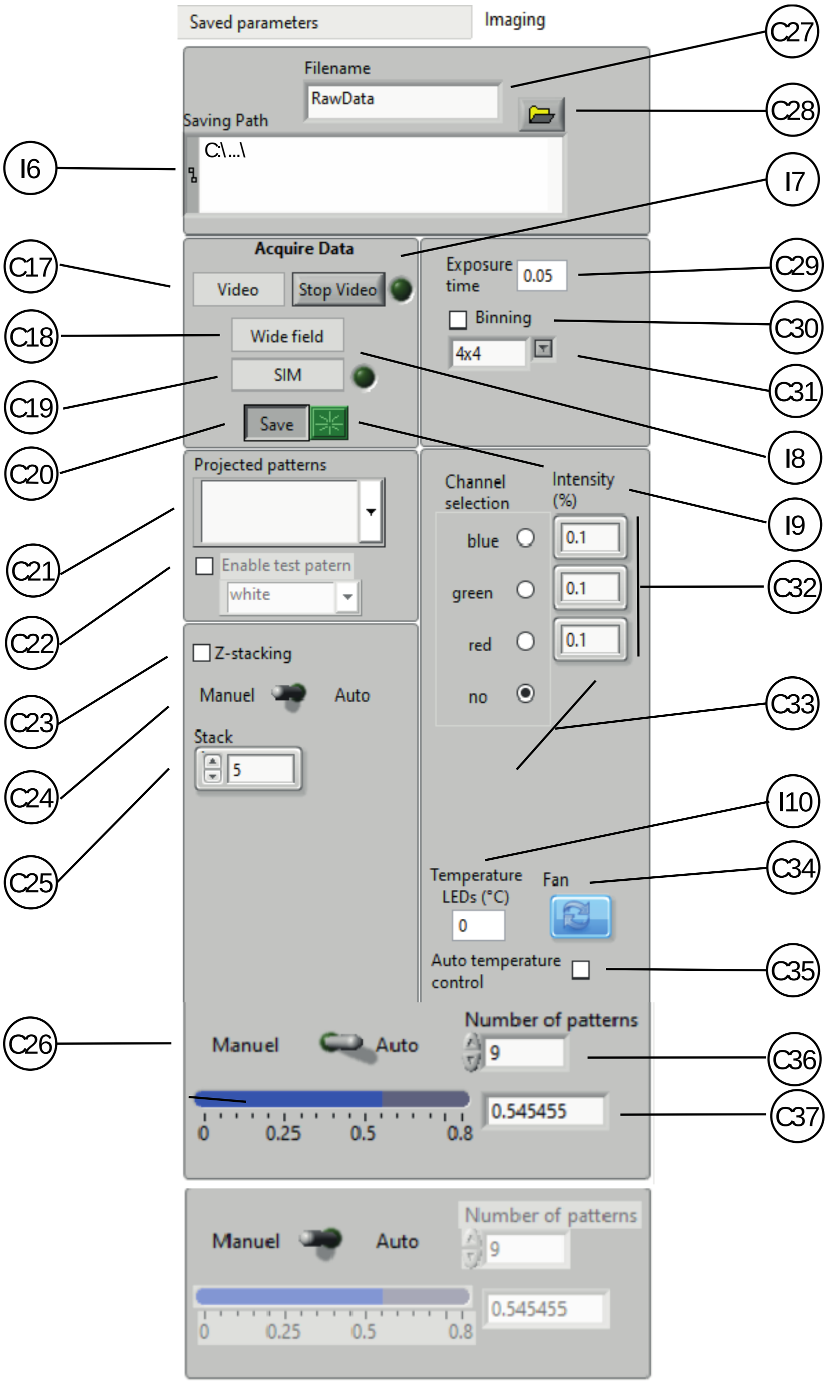
3.1. User interface in normal mode



C1: Enabling test mode
C2: Enabling expert mode
C3: Enabling DAQ debugging mode
C4: Enabling SLM debugging mode
C5: Enabling camera debugging mode
C6: Selection of available peripheral components
C7: Selection of camera
C8: Pixel size of selected camera
C9: Magni cation of microscope objective
C10: Numerical Aperture (NA) of microscope objective
C11: Enabling camera cooling system
C12: Note added to meta data
C13: Browse directory to select repertoire path
C14: Load repertoire to SLM
C15: Selection of device name of DAQ
C16: Stop program execution

I1: Calculated resolution
I2: Minimal possible period of grating
I3: Selected numer of patterns
I4: Path to SLM repertoire
I5: Indication if devices are connected

Figure 1: User interface in normal mode (part 1)



C17: Selection of acquisition mode (video)
C18: Selection of acquisition mode (Wide eld)
C19: Selection of acquisition mode (SIM)
C20: Enabling data saving (default: enabled)
C21: Selection of projected patterns
C22: Enabling test pattern
When enabled: selection of test pattern below
C23: Enabling z-stacking
C24: Selection of manual/automatic z-stacking mode
C25: Number of images within the stack
C26: Selection repertoire selection mode
C27: File name for the saved data
C28: Browse directory to select saving path
C29: Setting camera exposure time
C30: Enabling binning of camera
C31: Setting binning size of camera
C32: Selection LED channel
C33: Selection LED intensity
C34: Turn on/o openSIM fan
C35: Enabling automatic temperature control
If auto repertoire selection mode is selected:
C36: Number of desired patterns
C37: Slider to select period of grating

I6: Selected path for saving the data
I7: Indicator video aquistion on
I8: Indicator SIM aquistion on
I9: Measured temperature LEDs

Figure 2: User interface in normal mode (part 2)

3.2. Input parameters

Indicators:

I1: Calculated resolution in µm
→ based on wavelength of selected channel and NA of objective *(C33, C10)*

I2: Calculated minimal period
→ based on calculated resolution *(I1)*, camera pixel size *(C8)* and magnification of objective *(C9)*

I4: Selected number of patterns, automatically chosen in auto mode
Path to repertoire (.repz file)
→ the repertoire defines the sequence and the display duration of the patterns, these repertoires are saves as a .repz file
(default: path to the .repz file which is included in the distributed openSIM software folder)

I5: Indicator showing if devices (SLM, DAQ, Camera) are connected

I6: Display showing the selected folder where the data is saved in

I7: Indicator showing if video acquisition is currently running

I8: Indicator showing if SIM acquisition is currently running

I9: Temperature measured by thermistor at illumination block holding the PT54 LEDs
→ temperature is used as input for the temperature control system
→ if the temperature is too high, the two fans at the aluminum heat sink extender are turned on

Controls:

C1: Enabling/Disabling expert mode (normal mode is default)
→ expert mode includes additional indicators which support debugging (in the expert mode indicator *I10-I17* are visible)
→ see appendix for more information about the expert mode

C2: Enabling/Disabling test mode
→ if test mode is enabled, only the fan is controlled

C3: DAQ debugging mode
→ if enabled, the software does not try to connect to the DAQ device, which facilitates the testing of functions independent of the DAQ devise

C4: SLM debugging mode
→ if enabled, the software does not try to connect to the SLM, which facilitates the testing of functions independent of the SLM

C5: Camera debugging mode
→ if enabled, the software does not try to connect to the camera, which facilitates the testing of functions independent of the camera

C6: Selecting the available peripheral components
→ specific controls are visible/invisible depending on the availability of the corresponding peripheral component
→ <u>Z-actuator:</u> should be selected if an actuator for changing the z-position of the microscope such as a piezo focus positioner, stepper motor or automated microscope is available and implemented. If enabled, the controls *C38-42* are visible
(see section 5 for more information how to implement a z-actuator and see appendix for more information about the user interface for automated z-positioning)

→ EMCCD camera: should be selected if a EMCCD camera, where the EM gain can be changed, is implemented and used. If enabled, the controls *C43-C44* are visible
(see section 5 for more information how to implement a camera and see appendix for more information about the additional control for a EMCCD camera)

C7: Selection of camera from list of implemented camera interfaces
→ see appendix for information how to include an interface for a different camera
→ select *Andor iXon* for Andor iXonUltra EMCCD camera
→ select *Andor Zyla* for Andor Zyla sCMOS camera

C8: Pixel size of selected camera in µm
→ see the specification sheet of your camera for information about the pixel size
→ sCMOS camera Andor Zyla 4.2: pixel size is 6.5µm
→ EMCCD camera Andor iXonUltra 897: pixel size is 16µm

C9: Magnification of microscope objective

C10: Numerical aperture (NA) of microscope objective

C11: Enabling/Disabling cooler (relevant if the camera includes a cooling system)
→ see the specification sheet of your camera to see whether it includes a cooling system
→ see appendix for information about the control of a camera cooling system when including a different camera
→ EMCCD camera Andor iXonUltra has a deep vacuum cooling
→ sCMOS camera Andor Zyla 4.2 has no cooling option

C12: saved note in SIM mode
→ when acquiring SIM images, a text file containing meta data such as the imaging parameter settings are saved
→ the inserted note is added to the saved text file in SIM mode

C13: Browse directory to select file path to the repertoires (.repz file)
→ selected .repz file which is loaded to the SLM
(default: path to the file 'patterns_openSIM_all_20180802.repz' in the directory containing the application)

C14: Loading repertoires to SLM (selected with *C13* and displayed at *I4)*
→ repertoires (.repz file) have to be loaded only once to the SLM

C15: Device name of connected data acquisition (DAQ) device
→ device name is shown when USB cable of DAQ device is connected to the PC
(see operation instructions for more information)

C16: Stop button to close the program

C17: Selection of acquisition mode → video: for test purpose, continuous acquisition of widefield images without a saving option

C18: Selection of acquisition mode → widefield: acquisition of widefield images (if z-stacking is enabled: number of total images equals number of stacks *(C25)*

C19: Selection of acquisition mode → *SIM*: acquisition of SIM images, number of total images depends on number of patterns and number of stacks *(C25)* if z-stacking is enabled

C20: Enabling/Disabling data saving
→ acquired data is saved as .tiff file
→ in the SIM mode, the metadata (number of SIM datasets, number of pixels (x,y), camera pixel size, exposure time, EM gain, microscope magnification, channel selection) is saved as .txt file located at the file path specified by saving path *(I6),* saving is enabled by default

C21: Selection of the projected patterns (repertoire)
→ manual repertoire selection mode: the user manually selects the projected patterns from the list of available repertoires in the dropdown menu
→ auto repertoire selection mode: the control serves as an display which shows the automatically chosen repertoire (see *C21* for more information about the repertoire selection mode)

C22: Enabling/Disabling test pattern
→ if test pattern is enabled, different projected test patterns can be selected
→ possible test pattern: black, white, vertical bars

C23: Enabling/Disabling z-stacking
→ widefield mode: the z-position of the microscope objective is changed in steps and one image is acquired per step, the number of images in the stack is defined by *C…*
→ SIM mode: the z-position of the microscope objective is changed in steps and for every step several SIM images are acquired, the number of images in the stack in defined by *C…* and *C…*
(default: z-stacking disabled)

C24: Selecting manual or automatic z-stacking mode
→ manual mode: the user has to select the starting z-position of the microscope objective and has to manually change the z-position by using the focus adjustment knob of the microscope before acquiring the next image of the z-stack
→ automatic mode: the focus is automatically changed by an actuator according to the z-stacking input parameter during the image acquisitions
(see appendix for more information about the automatic stacking mode)

C25: Number of images in the stack

C26: Repertoire selection mode
→ manual mode: the user has to select the desired repertoire from the list of repertoires *(C21)* within the selected .repz file *(I4)*, the number of projected patterns is defined by the selected repertoire
→ auto mode: the repertoire is automatically selected based on the selected period *(I3)* and the desired number of projected patterns *(C36)*

C27: File/folder name of saved data
→ The file name is automatically appended with an XXX-digit number for consecutive images
→ widefield acquisition mode: inserted name defines the name of the image (.tiff file) which is saved at the location defined by *C24* and showed in *I6*
→ SIM acquisition mode: inserted name defines the name of an automatically created folder where the image (.tiff file), the metadata (.txt file) and the projected pattern (.repz file) are saved in

C28: Browse directory to select path to folder where the data is saved in (default: path to folder 'openSIMdata' the directory containing the application)

C29: Exposure time of camera in seconds

C30: Enabling/Disabling binning
→ only implemented for Andor Zyla sCMOS camera
→ sCMOS camera Andor Zyla: if binning is disabled the area of interest (AOI) is set back to 1048 pixel, if binning is enabled the pixel binning is set to the binning size defined by *C…*

C31: Binning size of camera
→ possible options are *2x2, 3x3, 4x4, 8x8*

C32: LED excitation intensity in %

C33: Selection of channel
→ indicates color of excitation light (*blue, green, red LED*)
(default setting is no LED selected)

C34: Manually turning the two fans which are mounted to the SIM device on/off
→ are also controlled by an automatic temperature control
→ fans are at the aluminum heat sink extender

C35: Enabling automatic temperature control

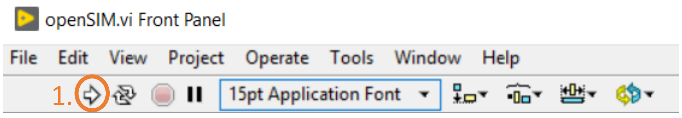
C36: Number of projected patterns (relevant for auto repertoire selection mode)

C37: Slider in % (maximum 80% possible)
→ determines how close the period of the grating is to the minimal possible value *(I2),* selected value is displayed on the right (relevant for auto repertoire selection mode)

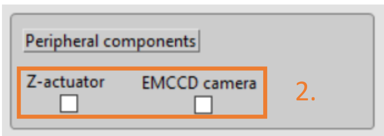
3.3. Operating instructions

Running the software with default settings

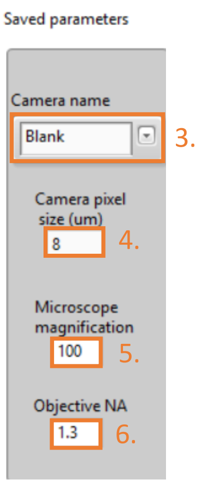
1. Run the Labview VI 'openSIM'



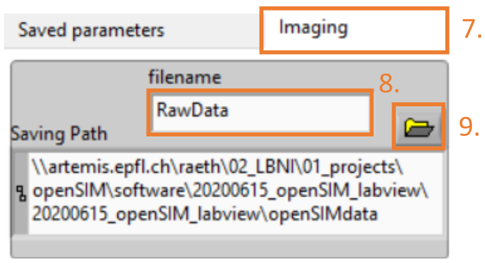
2. Select the available peripheral components
→ see appendix for information about possible peripheral components and corresponding differences in the user interface and operational instructions
→ do only select Z-actuator and EMCCD camera if you are sure that the appropriate components are connected



3. Select camera from the list of implemented cameras by clicking on the drop-down menu *(C7)*
→ select *Andor iXon* for Andor iXonUltra EMCCD camera
→ select *Andor Zyla* for Andor Zyla sCMOS camera
→ select *Blank* for testing purposes if no camera is connected
→ see appendix for information how to include an interface for a different camera



4. Insert camera pixel size in µm *(C8)* of selected camera
5. Insert magnification of used microscope objective *(C9)*
6. Insert NA of used microscope objective *(C10)*
7. Select 'Imaging' tab
8. Insert file name *(C27)*

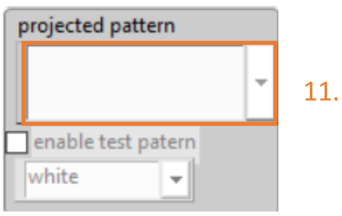


9. Select saving path *(C28)* (saving is enabled by default)

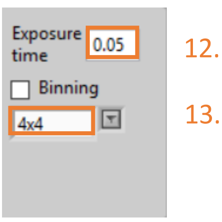
10. Select projected pattern from list of patterns *(C21)* by clicking on the drop-down menu

→ naming scheme: lines-p45-a4-N14

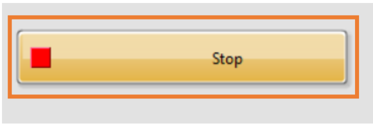
grating type period of grating number of angles number of patterns



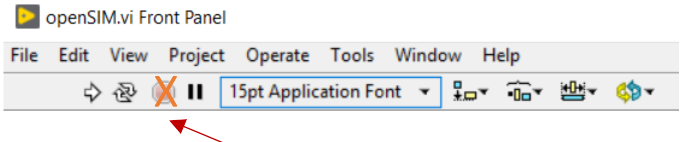
11. Set exposure time in seconds *(C29)*
12. (optional) Enable binning if desired *(C31)* and select binning



13. Set LED intensity in % *(C32)*
14. Select the LED channel *(C33)* to choose the color of the excitation light
15. Image acquisition (see instructions below)
16. Close the program by clicking stop button on front panel *(C16)*
    → Important to stop execution by stop button on front panel and not by 'Abort Execution' button in the LabView toolbar



17.



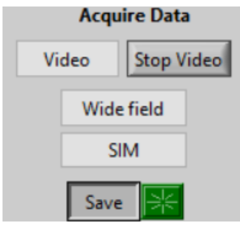
! Do not stop the program here !

Note:
Repertoires (.repz file) have to be loaded only once to the SLM
→ Selecting repertoire path *(C13)* and sending repertoire path *(C14)* should be performed only when using the software for the first time after assembling the openSIM or if the user wants to load additional repertoires to the SLM

Default settings
- Expert mode: disabled
- Test mode: disabled
- Repertoire path: to the file 'patterns_openSIM_all_20180802.repz' in the directory containing the application
- Saving path: to folder 'openSIMdata' in the directory containing the application
- Saving: enabled (data is saved with the file 'RawData' at the default saving path)
- Fan: turned on
- Repertoire selection mode: manual
- Test pattern: disabled
- EM gain: disabled

Acquire Data: widefield image

1. Adjust microscope focus to the desired imaging plane
2. Click on the 'Widefield' button *(C18)*



Acquire Data: SIM image

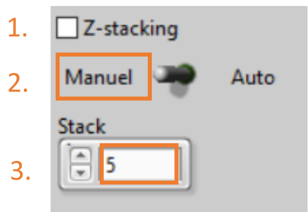
1. Adjust microscope focus (manually or via microscope interface) to the desired imaging plane
2. Click on the 'SIM' button *(C19)*

Manual z-stacking

→ stacking disabled: one single SIM/widefield image is acquired
→ stacking enabled: several SIM/widefield images are acquired

1. Enable z-stacking
2. Select manual z-stacking mode
3. Select the number of desired images within the stack

4. Manually select the starting z-position of the microscope objective
5. Click either the Widefield *(C18)* or the SIM button *(C19)* depending on the desired imaging mode in order to start the acquisition
6. After every acquired image, a dialog window pops up asking if the next image can be acquired. Before clicking on *acquire*, change manually the z-position of the objective by using the focus adjustment knob of the microscope. When clicking acquire, the next image will be acquired
7. Repeat step six until all images are acquired



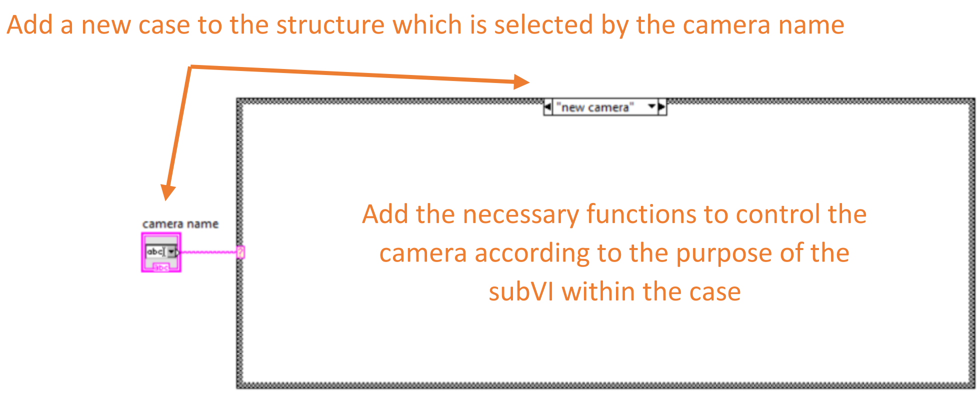
4. Troubleshooting

Problem	Possible reason	Possible Solution

5. Software adaptation

5.1. Integration of a different camera

In order to integrate another camera to the openSIM software the subVIs listed below have to be adapted. All of these VIs contain a main case structure to differentiate between the implemented cameras. An additional case has to be added to include the necessary code within the subVIs. The camera name has to be added to the Combo Box *Camera name* to select the corresponding case in the subVIs. Many scientific camera manufacturers provide Labview SDKs for their camera systems which are often structured as libraries containing several subVIs to control the camera. The exact integration of the camera highly depends on the camera type and the camera manufacturer. In the section below the general approach how to implement a different camera into the openSIM software is descripted. For more specific information about the camera-specific SDK please see the information provided by the manufacturer. They are often distributed together with the SDK installation program or accessible online.



subVi_Initialyse_Camera
- input: *Camera name, Em gain enable, Em gain, Exp Time, binning enable, binning size*
- output: *camera connected?, IMAQ Buffer, Handle, Xpixel, Ypixel*

→ in this subVI, the camera/camera specific library has to be initialized and all general and camera specific parameters have to be set in order to run the camera (for more specific information about the camera initialization and the necessary parameters please refer to the information about the corresponding SDK often provided by the camera manufacturer)
→ the indicator camera connected? has to be set true at the end of the subVI if everything was initialized and set correctly
→ EM gain only relevant for EMCCD cameras
→ handle, area of interest (AOI) width, AOI height, Auxiliary (AUX) output source (configures the signal which appears on the AUX output pin of the camera) is relevant when using SDK3 to control sCMOS cameras from Andor

Internal settings for Andor Zyla 4.2 sCMOS camera:
- Pre-amplification gain control: 12-bit (low noise)
- Auxiliary output source: Fire all
- AOI height: 1048px, AOI width: 1048px

Internal settings for Andor iXonUltra EMCCD camera:
- EM gain mode: 8-bit
- Acquisition mode: 1
- Read mode: 4
- Trigger mode: internal
- Acquisition timing: TTL high
- Shutter: auto

EM_gain_enable
- input: *EM gain, Handle, Camera name, EM gain enable*

→ only relevant when using a EMCCD camera
→ if EM gain is enabled the value for the EM gain has to be set to the value determined by *C44*

sub_vi_exp_time
- input: *Handle, Camera name, Exp time*

→ in this subVI the exposure time of camera in seconds has to be set to the value determined by *C29*

subVI_GetImage_Camera
- input: *Camera name, IMAQ buffer, Handle, Xpixel, Ypixel*
- output: *array, array 2D, Display 2*

→ in this subVI, the image acquisition has to be implemented including triggering start of image acquisition by the camera, readout data from camera, if necessary, caching in an additional buffer, conversion of byte data into pixel data according to the selected pixel encoding
→ Xpixel / Ypixel are used to create 2D array of pixel data to save the data afterwards (saving has not to be included in the subVI)
→ IMAQ buffer is used to display data

subVI_Close_CamerasubVI_Close_Camera
- input: *Camera name, Handle*

→ closes camera

→ within the subVI it has to be ensured that the camera is closed properly to ensure a bugless start at the next execution (for many cameras the data structures which are held internally by the SDK have to be not cleaned up)

5.2. Integration of a different focus positioning

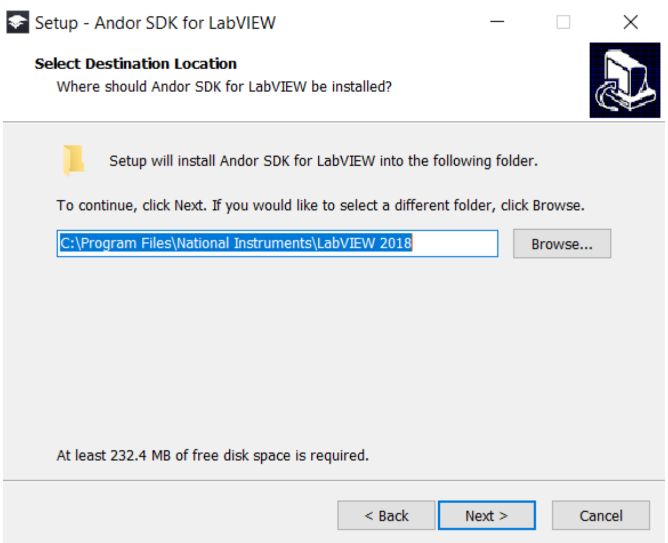
The implemented z-stacking/single z-movement uses an analog signal via the DAQ device to control a piezo focus positioner (piezo focus positioner Jena Mipos 100 from Piezosystem) mounted to the objective. In order to use a piezo focus positioner with a different motion range or voltage range but with the same operation principle (see figure 1), the initialization values for the motion and voltage range has to be changed in the initialization frame (first frame in Labview block diagram). If a different actuator type or a different operating principle should be implemented, the subVI *subVI_Zstacking_piezo* and the cases within the consumer loop have to be changed. Corresponding cases are *Z-auto, stacking_off, checking stacking input, single z-movement_on, single z-movement_off*.

Appendix

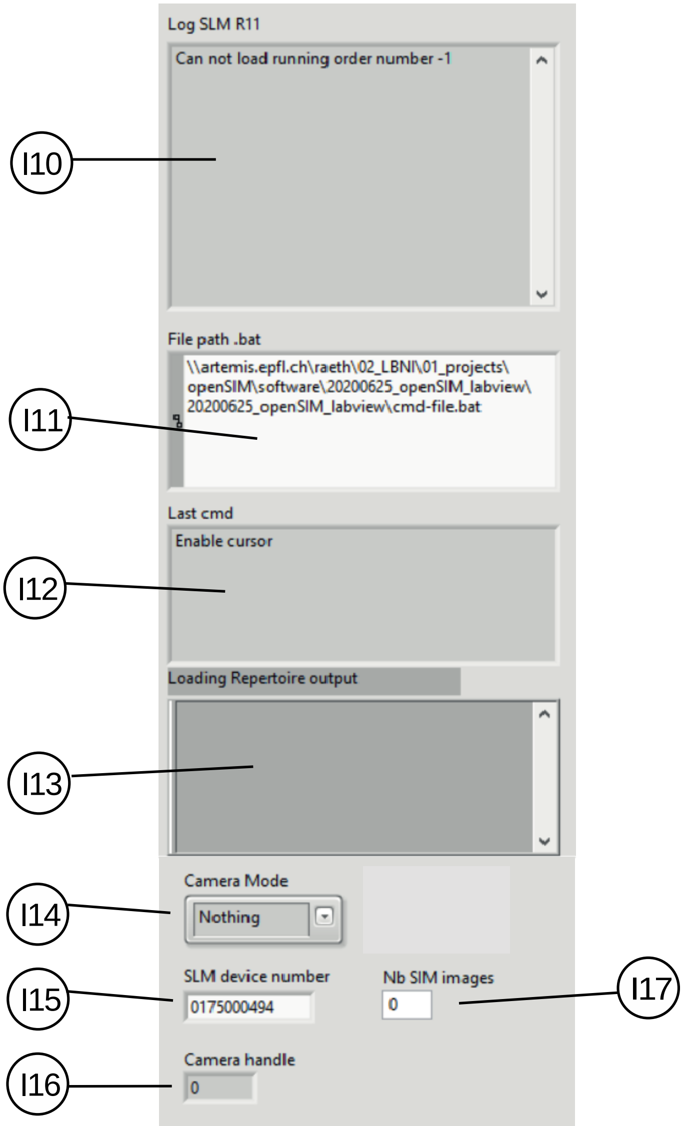
Installation of Andor SDK3 for LabView

→ LabView has to be installed before installing SDK3 for LabView

1. Run the Andor SDK3 for LabView installer (the SDK can be downloaded at https://andor.oxinst.com/products/software-development-kit/software-development-kit if it is not provided when purchasing the camera)
2. Choose the folder where LabView is installed as folder to install the SDK3 (program files → National Instruments → LabView XXXX) - if several LabView applications are installed (version, application bitness), make sure that the correct one is chosen
   → e.g. C:\Program Files\National Instruments\LabVIEW 20xx
   → e.g. C:\Program Files (x86)\National Instruments\LabVIEW 20xx
   → or corresponding path to the program folder for other operating systems than windows



Expert mode



I10: Dislaying current status of SLM
I11: Path to bat le
I12: Last executed command
I13: Text which is passed to command line
I14: Current acquistion mode
I15: Device number of SLM
I16: Handle of camera
I17: Number of projected patterns

Figure 3: User interface in expert mode

Additional Indicators:

I7: Display showing the current status of the SLM R11

→ e.g. bat file cleared/loaded, repertoire loaded, load running order number, cannot load running order number, pattern send, device closed

I8: Path to bat file

→ the SLM is controlled, the bat file contains commands for the SLM in order to load the repertoire

→ see *I4* for more information about the repertoire. The path should not be changed from the default value.

I9: Display showing the last executed command in the openSIM program

I**10:** Display showing the text which is passed to the command line to run a system command sent to the SLM (bat file to load repertoire)

I11: Current acquisition mode of the openSIM based on the selection of *C17, C18, C19*

→ video: for test purpose, continuous acquisition of widefield images without a saving option)

→ widefield: acquisition of widefield images, number of total images depends on number of stacks *(C25)* if z-stacking is enabled

→ SIM: acquisition of SIM images, number of total images depends on number of patterns *(I17)* and number of stacks *(C25)* if z-stacking is enabled

I12: Device number of connected SLM

I13: Handle to connected camera (relevant for sCMOS camera Andor Zyla)

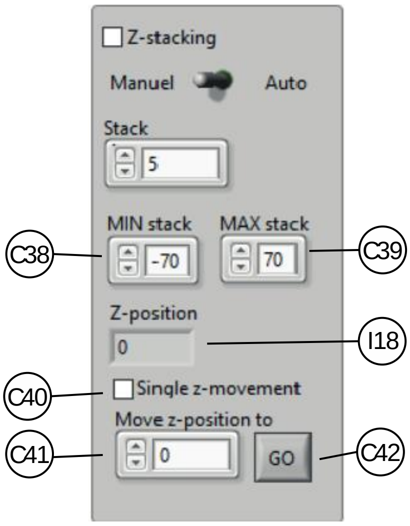
I14: Indicator showing if the selected camera is connected

I15: Number of SIM images/patterns

→ is automatically indicated based on the chosen projected pattern

Automatic z-positioning

This section applies only if the piezo focus positioner Jena Mipos 100 (Piezosystem) is used according to the operating principle depicted in figure 5. If a piezo positioner with a different motion and voltage range or a different actuator type is used, please refer to the section 5 for more information about the integration.



C38: Motion range of z-actuator (min)
C39: Motion range of z-actuator (max)
C40: Enabling single z-movement
C41: Desired z-position within motion range of z-actuator
C42: Start single z-movement

I18: current z-position of acutuator during z-stacking

C43: Enable EM gain for EMCCD camera
C44: Set EM gain for EMCCD camera

Figure 4: User interface for automatic z-stacking

ADDITIONAL INDICATOR AND CONTROLS

I16: Current position of z-actuator in µm during z-stacking if z-stacking is enabled

C33/C34: stack range in µm
→ min: z-position of first stack relative to mid-position
→ max: z-position of last stack relative to mid-position
(values have to be within motion range of z-actuator, for MIPOS 100 -70µm – 70µm)

C35: Enabling/disabling single adjustment of z-position by z-actuator
→ if enabled, piezo focus positioner is set to mid-position as initial position (half of its motion range)

C36: Desired z-position for single z-movement

→ focus positioner moves to inserted z-position in µm relative to mid-position by clicking the *GO* button (value has to be within motion range of piezo focus positioner, for MIPOS 100 -70µm – 70µm)

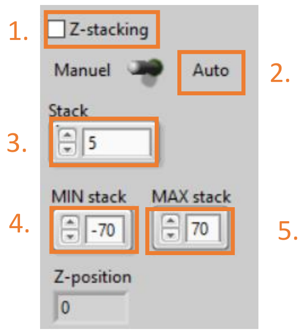
C37: Executing single z-movement

OPERATIONAL INSTRUCTIONS FOR AUTOMATIC Z-POSITIONING

Z-stacking:

→ relative to mid-position (half of the piezo motion range), mid-position is used as initial position

1. Enable z-stacking *(C23)* → piezo is set to mid-position (order important!)
2. Adjust microscope focus (manually or via microscope interface) to the object of interest
3. Set stack size *(C25)*
4. Set z-position of first stack in µm relative to mid-position (value has to be within motion range of piezo z-positioner) *(C38)*
5. Set z-position of last stack in µm relative to mid-position (value has to be within motion range of piezo z-positioner) *(C39)*
6. Acquire either widefield or SIM images

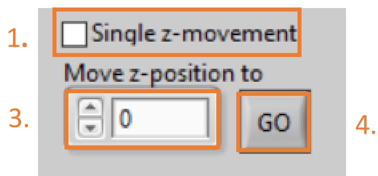


Single z-movement:

→ relative to mid-position (half of the piezo motion range), mid-position is used as initial position

→ independent of z-stacking: if z-stacking is enabled, the piezo focus positioner will be set back to its initial mid-position

1. Enable focus adjustment *(C40)* → piezo is set to mid-position (order important!)
2. Adjust microscope focus to the object of interest
3. Set desired z-position in µm relative to mid-position *(C41)*
4. Click the *GO* button *(C42)* to change z-position



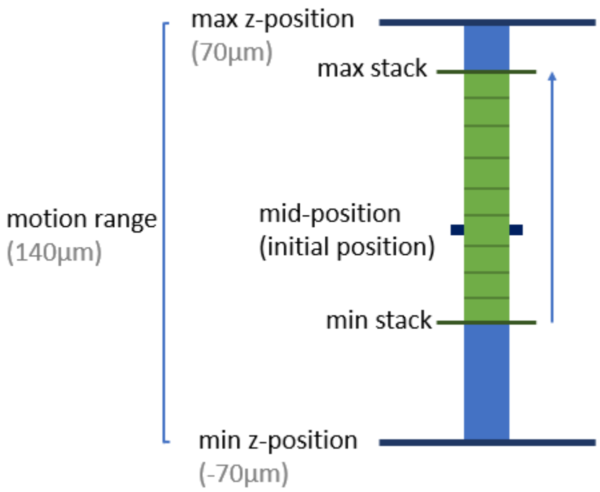


Figure 5: Schematic illustrating z-stacking via piezo focus positioner

EMCCD camera

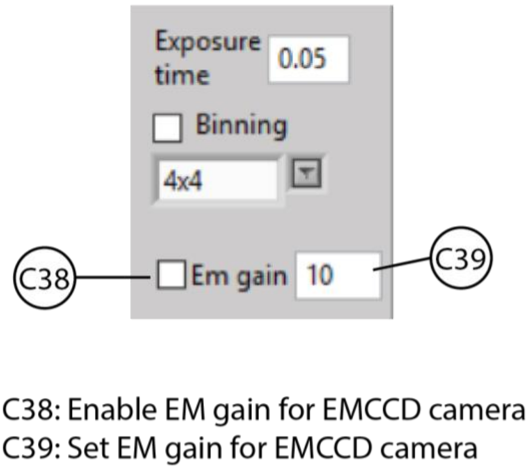


Figure 6: User interface for EMCCD cameras

Additional controls

C38: Enabling/Disabling electron multiplying (EM) gain of EMCCD

→ if EM gain is enabled, the gain is set according to the value specified with *C39*

→ if EM gain is disabled, the gain is set to zero

C39: EM gain

Troubleshooting Andor Zyla integration:

<table>
<tr><th>Problem</th><th>Possible reason</th><th>Possible Solution</th></tr>
<tr><td rowspan="2">Error message: ‘Error 5006 occurred at AT Open A.vi: OUT OF RANGE’</td><td>Camera is physically not connected to the PC</td><td>Connect the Andor Zyla camera to the PC via the USB cable</td></tr>
<tr><td>The openSIM software cannot connect to the camera. This problem can occur if the ‘Abort execution’ at the Labview toolbar is used for stopping the program execution instead of the stop button in the user interface (C16). If the camera is not closed properly, the data structures which are held internally by the SDK are not cleaned up which can lead to problems when reconnecting to the camera.</td><td>Disconnect and reconnect the USB cable from the camera to the PC. If this does not solve the problem restart the camera first and if the error message still occurs, then also restart the PC. One can also check if the camera can be accessed via via AndorSolis (Andor’s camera control system)</td></tr>
</table>