



FocalSpec LabVIEW Example User Manual

TABLE OF CONTENTS

Document Control and Version History.....	3
Introduction	5
Overview	5
Preconditions.....	6
FocalSpec LabVIEW Example Application	6
Connect Camera	7
Auto ROI settings	7
External Triggering	7
Surface Selection	7
Profile Data Buffer Settings	7
Peak Detection	8
Start Grabbing	8
Imaging Settings	8
Advanced Settings	9
Dynamic Sensor Parameters	9
X-Filter Parameters	9
Noise Removal	9
Layer Specific Parameters	10
FocalSpec LabVIEW Example Project.....	10
LabVIEW Example Project Structure	10
VI Front panel block diagrams	11

Document Control and Version History

Document Control

Document ID	FocalSpec LabVIEW SDK
Status	Approved
Version	2.1.0
Prepared by:	Jukka Kontio
Approved by:	Masa Mäkäräinen
Archived by:	

Version History

Version	Date	Author	Description
2.1.0	5.12.2019	Jukka Kontio	Support for Layer Specific Parameters. Support for Peak Detection Parameters. Encoder Location included to point cloud data. Replaces interleaving. New Profile Data Buffer settings on main view to adjust point cloud data buffer format. Selections 'Compact buffer size', 'Fixed buffer size' and 'No Measurement point included'.
2.0.0	12.9.2019	Jukka Kontio	Multiple LCI Sensor usage improved. Point data received from all grabbing cameras not only selected one.
1.51.0	30.5.2019	Jukka Kontio	LabVIEW Example included to FSSDK release content. Support for LCI1220 and LCI1620 sensors. New layout and design for example application.
1.50.1	9.4.2019	Jukka Kontio	Support for Controlling Multiple LCI Sensor. Support to Read X and Z Calibration Files from the Camera. Support for parameters X-Filter, Noise removal Algorithm, Image Height Zero Adjustment.

			FSSDK version updated to 1.50.1. Version numbering aligned with FS SDK version.
1.5	21.12.2018	Jukka Kontio	Support for Dynamic Sensor Control Parameters. 'Apply settings' button added to 'Settings'. FSSDK version updated to 1.31.0.
1.4	20.9.2018	Jukka Kontio	Surface selection updated, new options are Top, Bottom, Brightest and All. Additional selection for number of layers up to 10. Option to select 'No Measurement' points be included to line profile data.
1.3	19.9.2018	Jukka Kontio	OS platform, LabVIEW and installer updated to 64bit version.
1.1	8.2.2018	Jukka Kontio	'Top + Bottom' surface selection callback replaced by 'Two Topmost'. Additional 'Two Bottommost' selection added.
1.0	1.3.2018	Jukka Kontio	FSSDK version updated to 1.16.0.
0.9	25.10.2017	Jukka Kontio	Rebuild and saved with the Base LabVIEW Development System. Project files moved to same location with build exe
0.8	25.09.2017	Jukka Kontio	LayerId included to the Point Cloud array.
0.5	21.09.2017	Jukka Kontio	Support for line profile exporting to csv file format added. Support for Top and Bottom surface selection at the same time added.
0.4	15.09.2017	Jukka Kontio	Calibration file selection simplified
0.3	05.09.2017	Jukka Kontio	Surface Selection option added to the Settings page.
0.2	29.08.2017	Jukka Kontio	Image height and Y offset parameters added to the Settings page.
0.1	25.08.2017	Jukka Kontio	Initial version of FocalSpec LabVIEW client example software manual.

Introduction

FocalSpec LabVIEW Example is API interface driver allowing end user to develop their own measurement solutions for FocalSpec LCI sensors by using National Instrument LabVIEW development platform. LabVIEW example project and needed source components are part of FocalSpec Software Development Kit (FSSDK). It is compatible with 32- and 64-bit Windows 7 SP1 or later and Windows 10 operating systems.

Overview

Folder *"FocalSpec Software Development Kit\FsLabViewExample"* contains files for FocalSpec LabVIEW example project. The project has been made up by using NI LabVIEW 2019 Base Development System. Project is included also in LabVIEW 2017 format.

Figure 1 below shows FocalSpec LabVIEW API software stack from sensor to LabVIEW application.

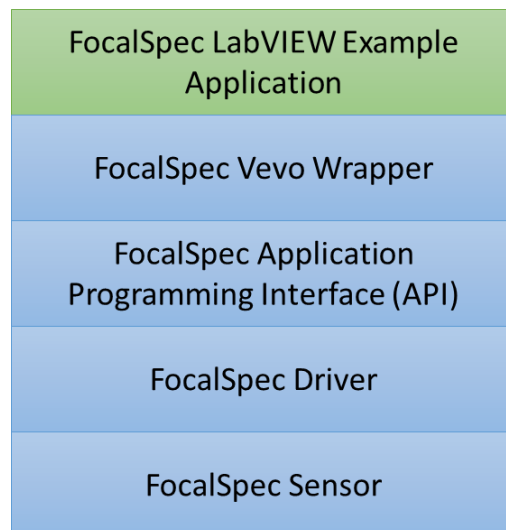


Figure 1. FocalSpec LabVIEW example software stack

FsLabViewExample content:

FsLabViewExample

- FocalSpec client example LabVIEW project and configuration files
- **data**
 - LabVIEW runtime library and copy of FocalSpec icon
- **DLLs**
 - FocalSpec API and LabVIEW wrapper dynamic-link library files
- **FsLabViewApi**
 - FocalSpec LabVIEW API class virtual instrument and control files accessing sensor
- **VI**
 - Virtual Instrument files for the application

Preconditions

Check list for preconditions fulfilled before start working with the project.

- ✓ FocalSpec Software Development Kit installed.
- ✓ FocalSpec Vevo filter driver – Windows Driver for FocalSpec Sensor.
- ✓ National Instrument LabVIEW 2017 or later (32-bit / 64-bit) base development system software.
- ✓ Ensure FS LabVIEW example application rule has been added to the Windows firewall allowed applications list.

Saving project for previous LabVIEW version format is possible if 2018 version is not available.

FocalSpec LabVIEW Example Application

Parent Virtual Instrument for project: 'FsLabViewExample.vi' Initializes API on startup. Cameras are discovered automatically on startup. Available camera(s) list box on panel left side shows camera ids from detected FocalSpec LCI sensors. Highlighted camera is selected, and any actions are applied for it.

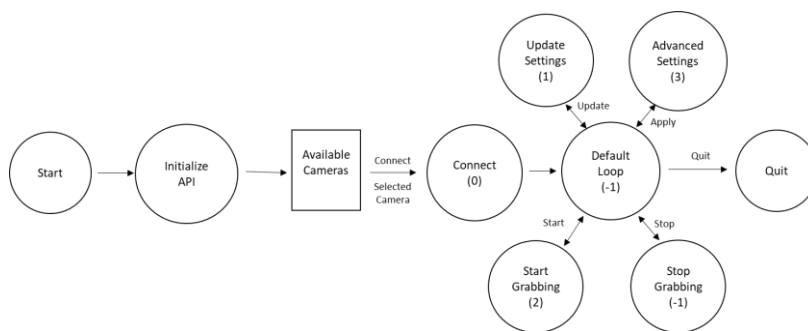


Figure 2: Program state transition diagram

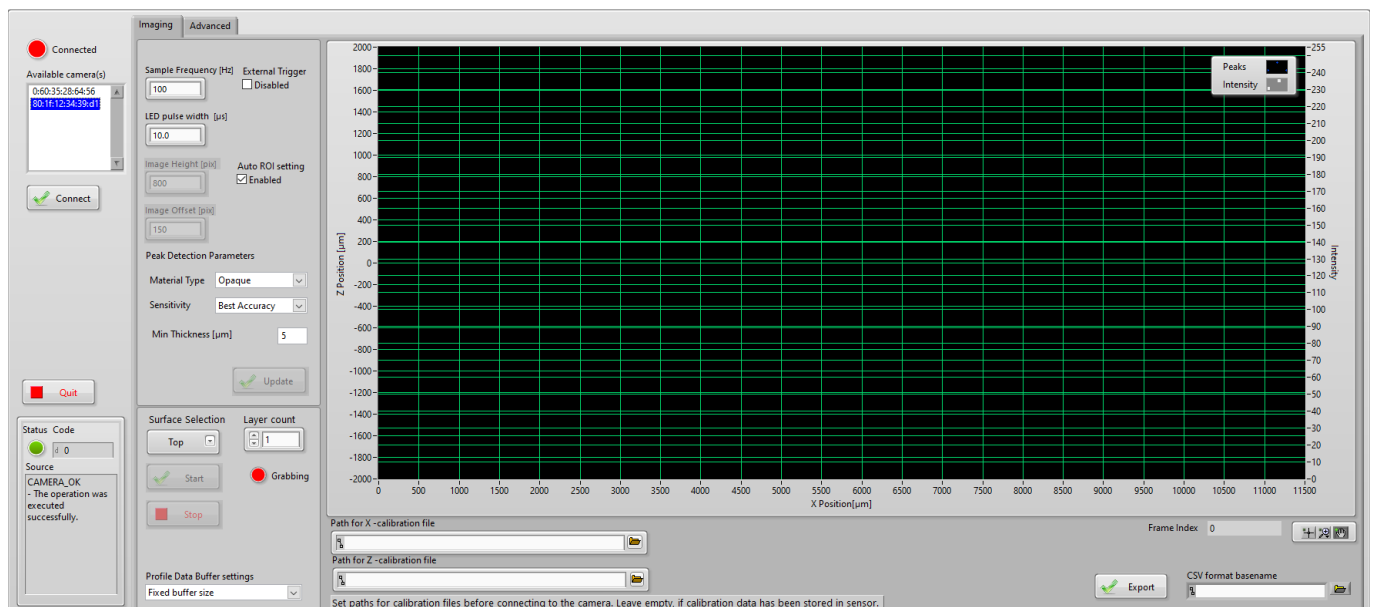


Figure 3: Front panel cameras discovered but not yet connected

Connect Camera

To continue select desired camera on list box, define X and Z calibration files for selected camera. If X and Z calibration files reading from sensor is supported, leave paths empty. Select 'Connect' when ready to continue.

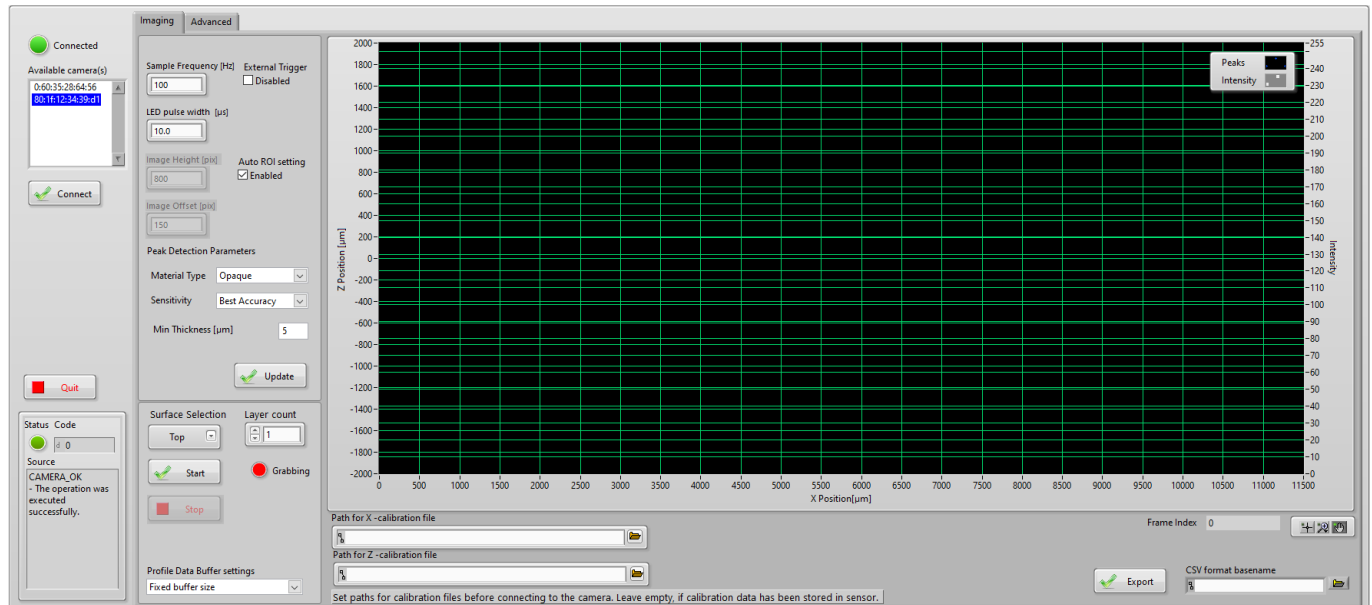


Figure 4: Calibration files defined camera on connected state

Camera is connected when status LED turns green. If multiple cameras are needed to take on use, pick another camera and select 'Connect' again.

Auto ROI settings

Enable Auto ROI settings to get image height and offset adjusted automatically based on sample frequency. When External triggering is enabled and auto ROI is used, set expected maximum value for sample frequency to allow suitable auto ROI settings. If Auto ROI is disabled, image height and offset values should be given by user.

External Triggering

If external triggering is used for imaging, select 'External Triggering' check box.

Surface Selection

Surface selection has four options, 'Top', 'Bottom', 'Brightest' and 'All'. Beside surface selection is number of layers. It is effective with 'Top', 'Bottom' and 'Brightest' surface sorting order.

Profile Data Buffer Settings

Allows adjust point cloud data buffer format. Options are:

Compact Buffer size

- Filling '0' fields not added, only points that have measured values included for each layer.

Fixed Buffer size

- Each layer buffer size is equal, filled with '0' values if less points detected compared to full layer length

No Measurement points included

- When selected point data for all pixels and layers is always delivered. If point location does not contain measured data, intensity and z-coordinate is set to '9999999'.

Peak Detection

Peak detection enables an easy selection from pre-selected sensor attributes by changing "*Material Type*" and light "*Sensitivity*". For transparent materials one must set minimum thickness of the layer (μm). For more detailed info see FocalSpec Sensor API manual.

Start Grabbing

Select 'Start' to set image grabbing on. Start grabbing is applies to the camera selected from Available camera(s) list. Results shall appear to grid when conditions are fine. Blue line shows 3D profile, white line presents intensity level. Imaging is stopped by selecting 'Stop'.

'Export' allows saving line profile data to csv file format. Select 'Quit' to close all camera connections and exit from application.

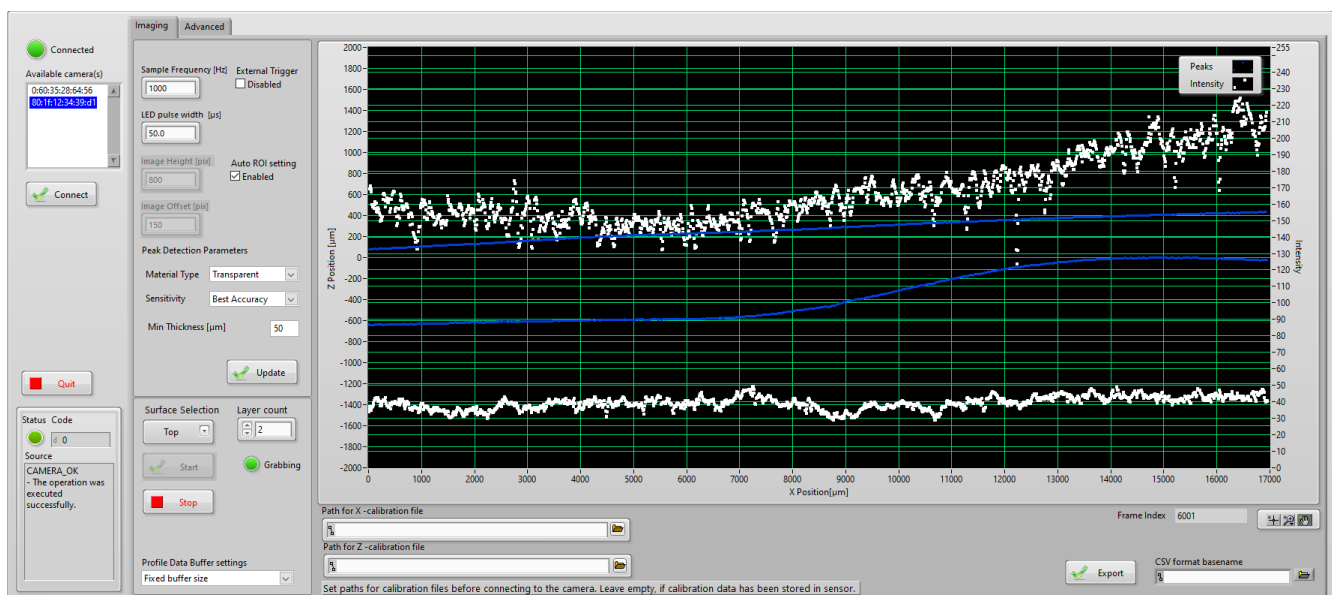


Figure 5: Grabbing ongoing 3D profile and intensity level shown in graph window

Imaging Settings

By using Available camera(s) list box it is possible to switch between cameras to control start and stop grabbing and from which results viewed on graph. If multiple sensors have been set grabbing simultaneously, graph shows sampling from selected camera while others are running background.

Modify imaging settings like frequency or LED pulse width by adjusting values and selecting update.

Advanced Settings

Select Advanced tab to adjust dynamic sensor control parameters or activate filtering.

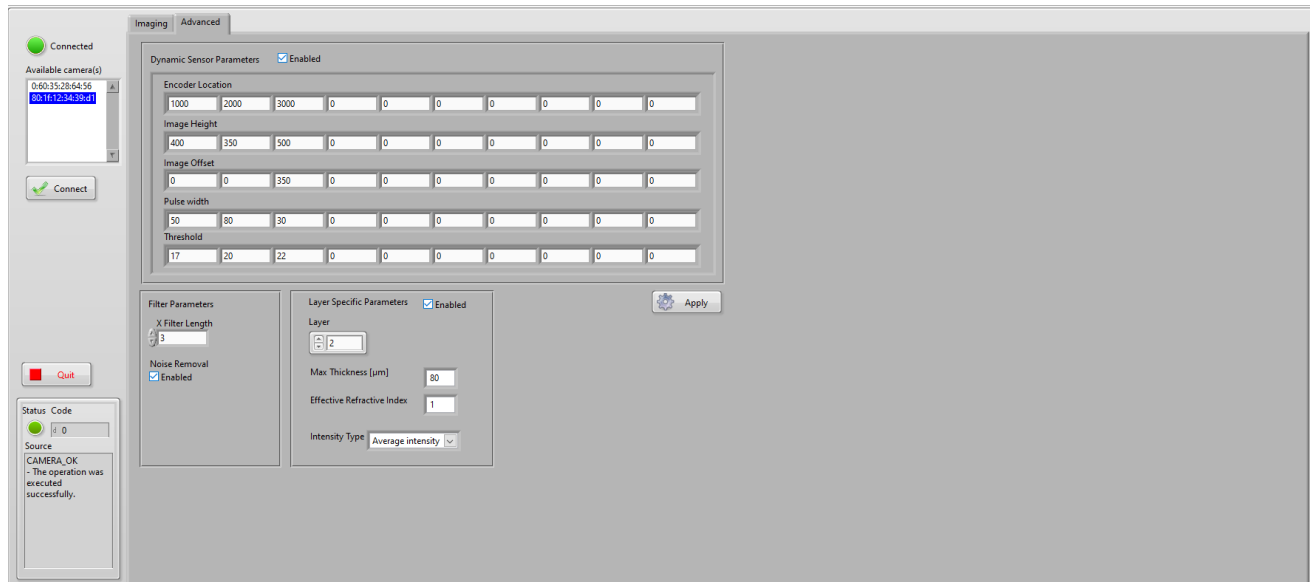


Figure 6: Advanced camera parameters that are usually needed to adjust less frequently

Dynamic Sensor Parameters

Dynamic Sensor Parameters section values are passed to the sensor if 'Enabled' is checked. Settings are stored to the sensor before imaging is started. Parameter settings are taken on use when triggering encoder location is reached. Add incrementing encoder location position values as many as parameter sets are needed. Remaining left to '0' are not applied. Image height is also mandatory in current version. When 'offset' is set to '0' image is centered around the middle of sensor height area. 'Pulse width' equals to Led duration. 'Threshold' is supported only by High speed sensors. It defines threshold intensity level.

X-Filter Parameters

X-Filter functionality can be used to smooth image in X direction before the peak detection. Filtering reduces noise and gives possibility to use lower threshold value for the peak detection. Valid values are 0 (disabled), 3, 5 or 7 pixels. Noise removal filter removes points which are not connected to any neighboring points.

Noise Removal

Noise removal algorithm suppresses the noise and allows to use lower threshold which improves the data acquisition. Noise filter removes single data points which do not have adjacent data points.

Layer Specific Parameters

These parameters are defined for each layer separately. Applicable when surface selection 'Top', 'Bottom' or 'Brightest' is used.

Effective refractive index specifies the effective refractive index of a material.

- **Parameter type:** float
- **Layer:** layer id (0=first layer)
- **Values:** The effective refractive index (1.0 by default)

Layer intensity type specifies which filter is used for intensity.

- **Parameter type:** int
- **Layer:** layer id (0=first layer)
- **Values:** 0 = Average intensity filter, 1 = Signal detection filter

Layer Max thickness specifies maximum thickness for the layer. Used for missing surface detection.

- **Parameter type:** float
- **Layer:** layer id (0=first layer)
- **Values:** Thickness in um (0, if not used)

Layer Min Thickness specifies minimum thickness for the layer.

- **Parameter type:** float
- **Layer:** layer id (0=first layer)
- **Values:** Thickness in um (0, if not used)

On example application Layer Min Thickness parameter setting is on Peak Detection parameters group because has most effect when Material Type 'Transparent' is selected.

For more information see FocalSpec Sensor API manual. Press 'Apply setting' button when all configurations has been done for the selected camera. When multiple cameras available, each camera shall be configured separately. Select another from the list and adjust any settings if needed, then press 'Apply setting' again.

FocalSpec LabVIEW Example Project

LabVIEW Example Project Structure

Project file: 'LabViewExampleProject.lvproj'

Main VI: 'FsLabViewExample\VI\FsLabViewExample.vi'

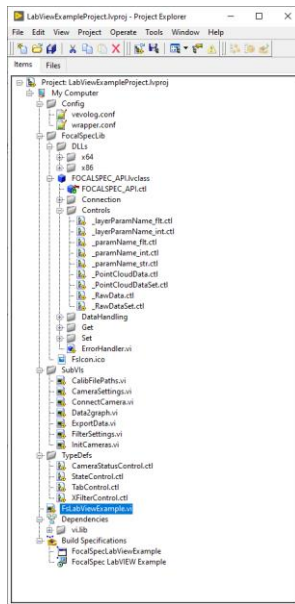


Figure 7. FocalSpec LabVIEW example project item structure

VI Front panel block diagrams

This chapter contains overview of block diagrams for major stages.

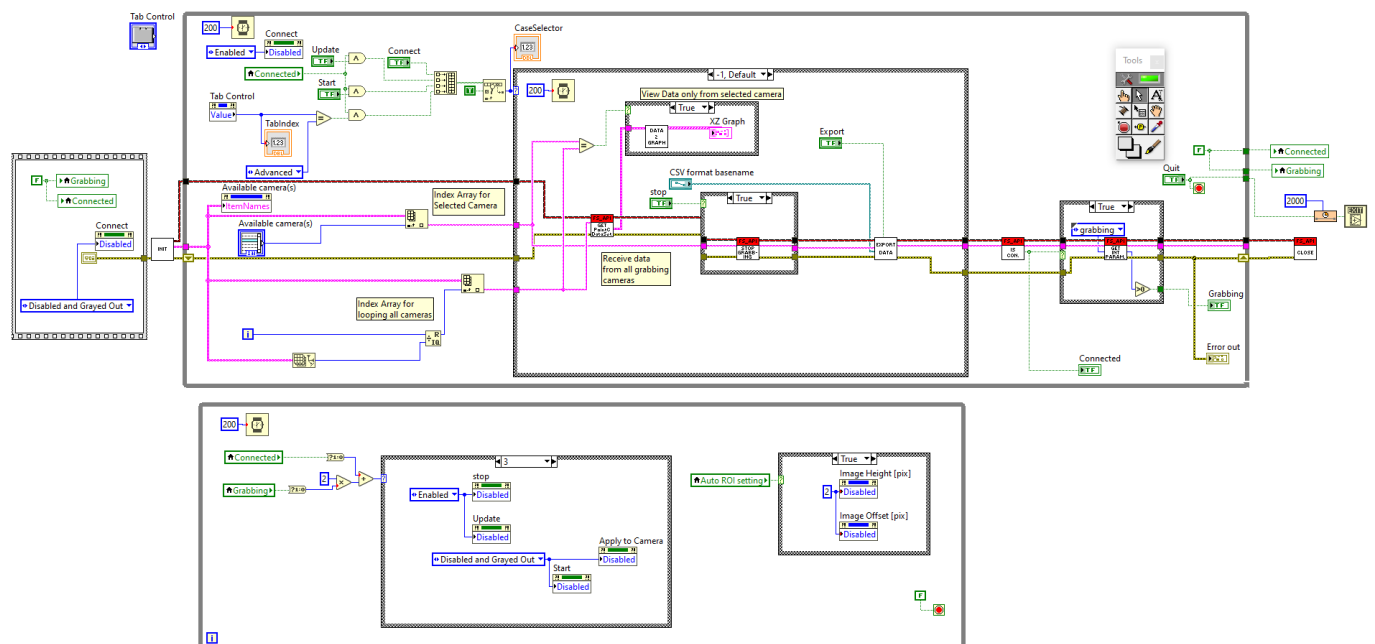


Figure 8. Parent VI structures

- On startup 'INIT' discovers available cameras.
- Boolean buttons 'Connect', 'Start', 'Update' and 'Advanced' tab controls state structure on middle.
- On right side Connection and Grabbing stage for selected camera are updated.
- Lower while loop manages Boolean button enabling/disabling based on program stages.
- Possible to 'Stop' grabbing if grabbing has been started.
- 'Quit closes cameras and unloads API, after a delay also application is closed.

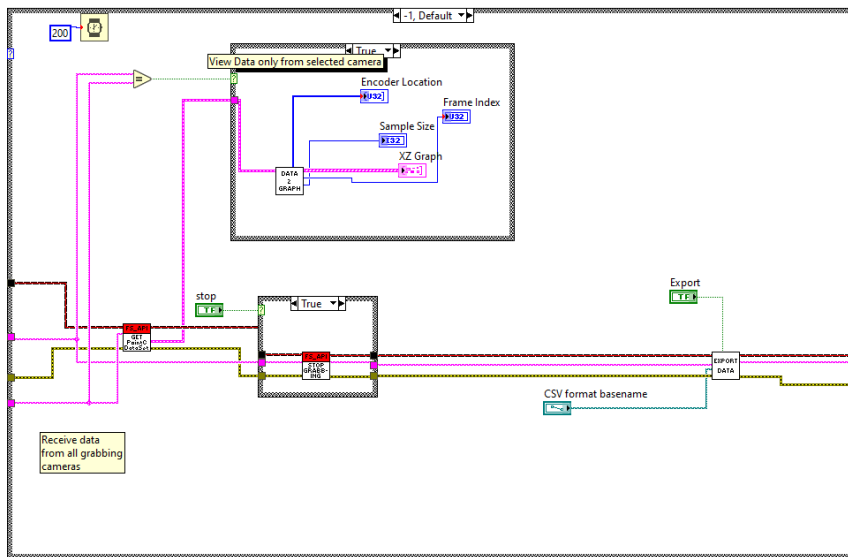


Figure 9. Default stage

- 'Default' stage contains VIs for start grabbing.
- Imaging data receive and presenting on graph.
- Control for exporting profile data to csv file.

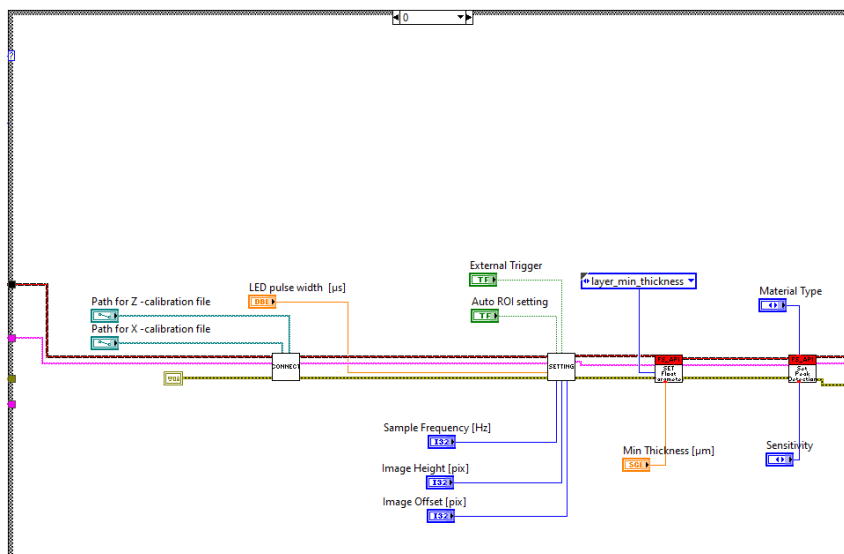


Figure 10. Connect stage

- 'CONNECT' VI establishes connection to camera.
- Pass calibration file paths.
- Initializes camera for peak data receiving.
- Enable / disable external trigger or Auto ROI.
- 'SETTING' controls imaging parameters given in front panel.

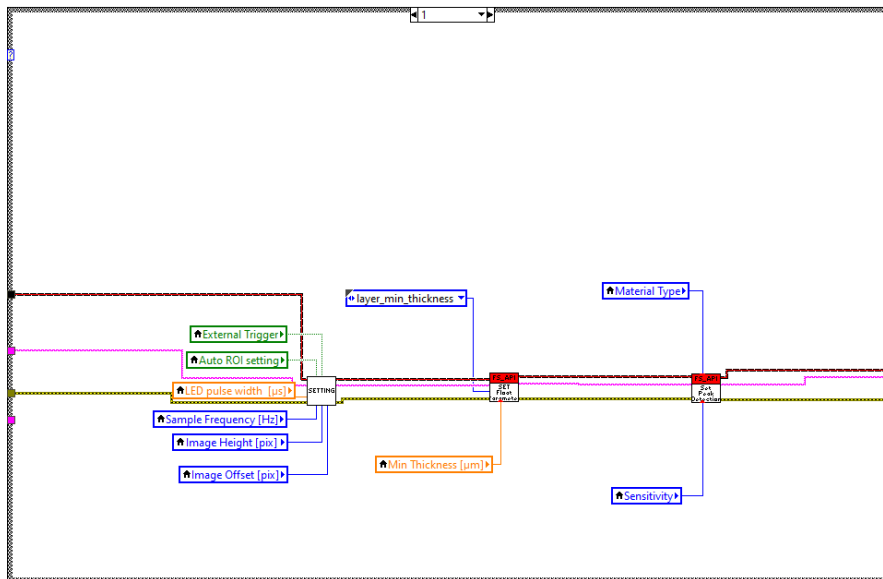


Figure 11. Update stage

- Updated 'SETTING' passed to camera.

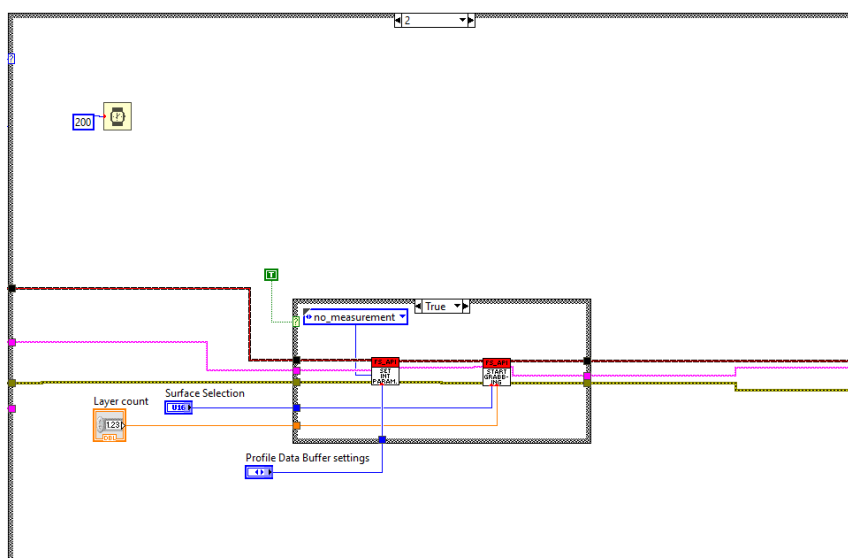


Figure 12. Start stage

- Start Grabbing for any connected camera.
- Define surface sorting order.
- Adjust number of layers received for Top, Bottom or Brightest surfaces.

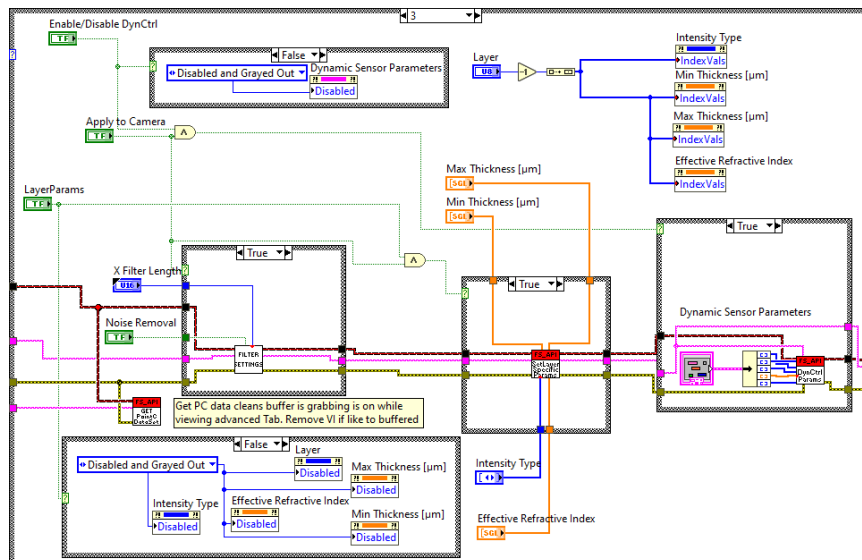


Figure 13. Advanced stage

- Set and enable dynamic sensor control parameters.
- Adjust filtering.
- Include or exclude no measurement points on peak profile data