

LCI sensor Z-compensation

Introduction

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November 16 2020



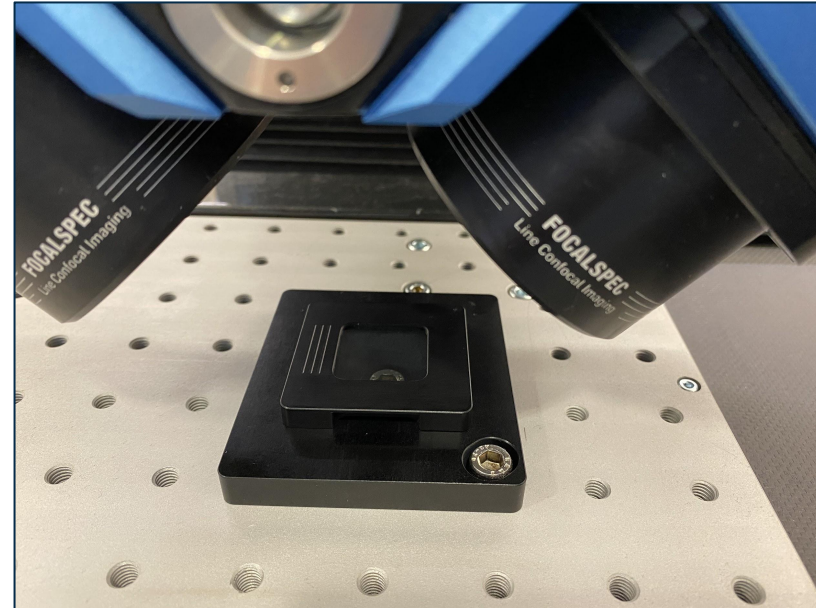
Sensor Z-compensation

A strong surface texture may cause edge artifacts in Z values. In order to reduce edge artifacts, the sensor can be calibrated for Z-Compensation. In this case, a Z-compensation block is used and available from LMI as a new UULA accessory - UULA Z-compensation block CAL-UULA-02.

Z-compensation is done with known flat specimen where texture has intensity variations. Possible Z differences coming from intensity variations are compensated with an algorithm. Compensation is done on the whole sensor Z-range.

Compensation is done separately in sensor X and Y directions.

Z-compensation is most useful for cases when surface has high intensity differences.



Sensor Z-compensation in UULA

Instructions on how to take sensor Z-compensation in use in UULA

1. Order from LMI a new UULA accessory: UULA Z-compensation block CAL-UULA-02

Send an email to orders@lmi3d.com

2. Update UULA SW to version 2.3.1

On the LMI Product Downloads Page (<https://downloads.lmi3d.com/>), select FocalSpec from the Brand dropdown menu and UULA Scanner from the Product dropdown menu and the appropriate files will appear in the Software section. Simply log in or register and you're ready to go.

3. To execute the compensation follow the instructions on SW Help (on top right of SW header) or instructions in UULA user manual

Sensor Z-compensation in UULA

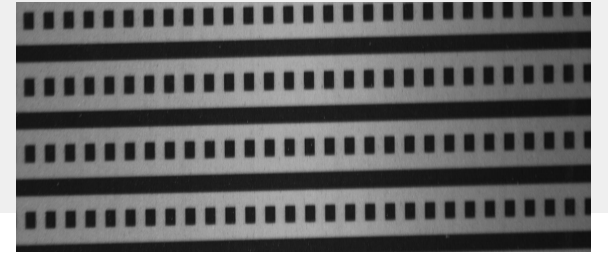
UULA SW 2.3.0 release introduced to Uula the capability to do the new sensor Z-compensation.

UULA SW 2.3.1 release introduced calibration file saving

Calibration file saving and copying has been added. The sensor specific files below can now be copied to be used with FSSDK also on another PC:

- X-calibration
- Z-calibration
- Intensity calibration
- Z-compensation calibration

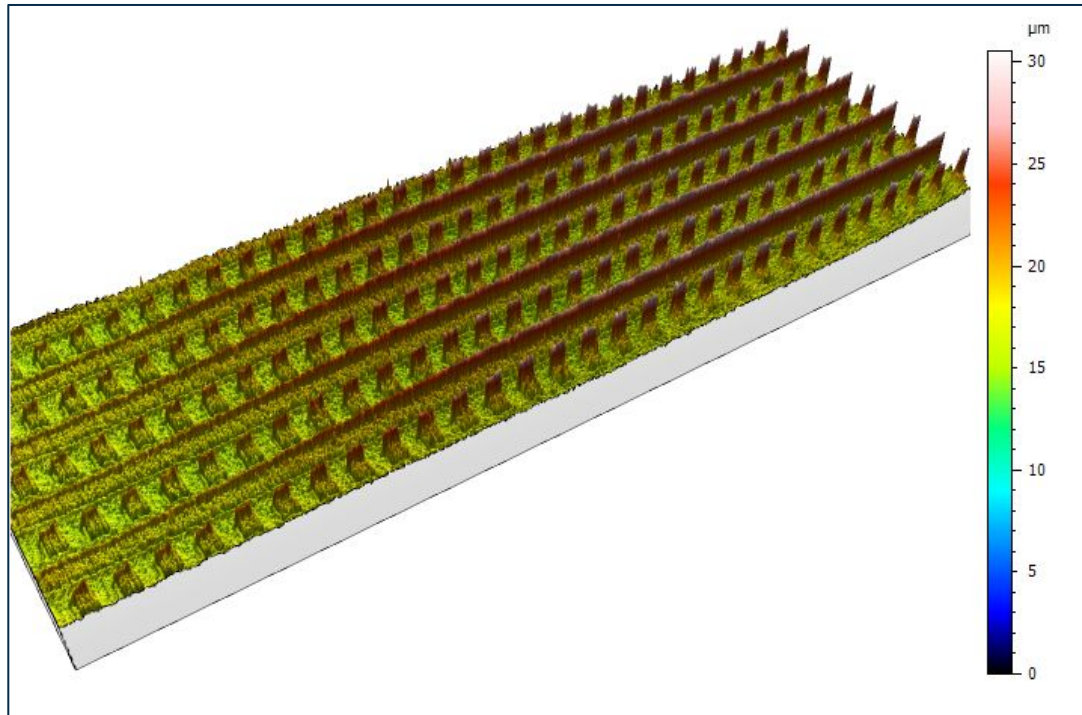
Sensor Z-compensation cases - case 1



LCI1220: Ceramic sample, white sample surface has very close to zero height black pattern on it.

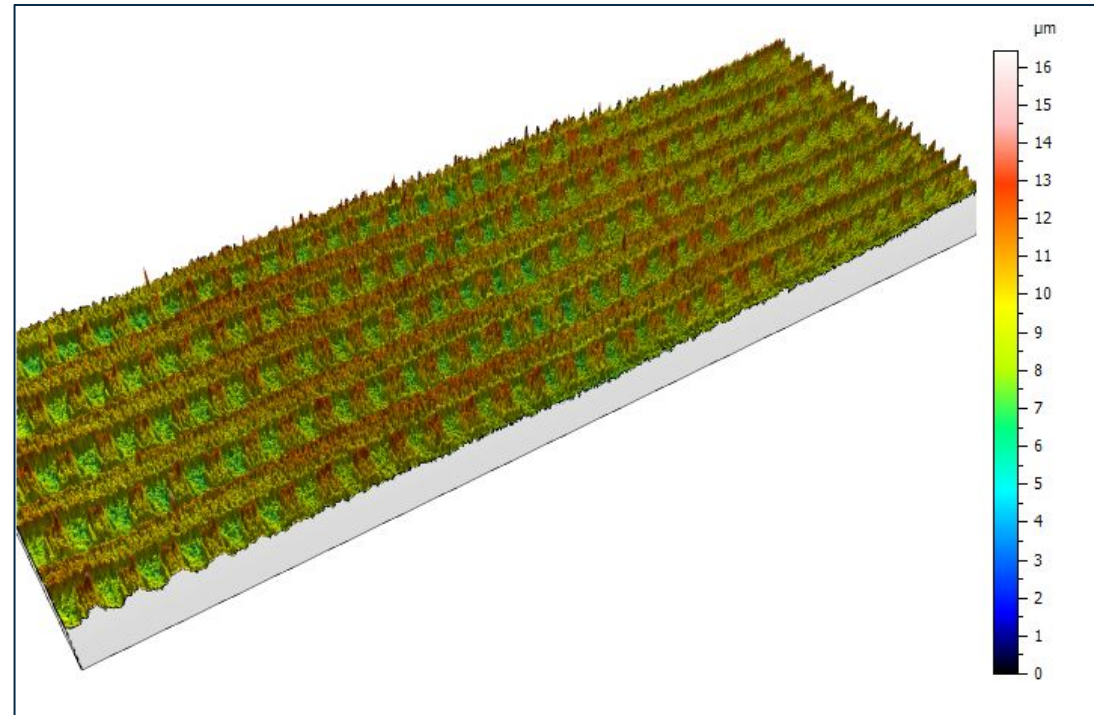
Original

Note: the scale is 0 ... 30 μm

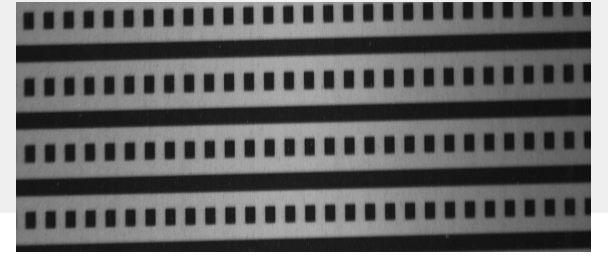


Z-compensated

Note: the scale is 0 ... 16.5 μm



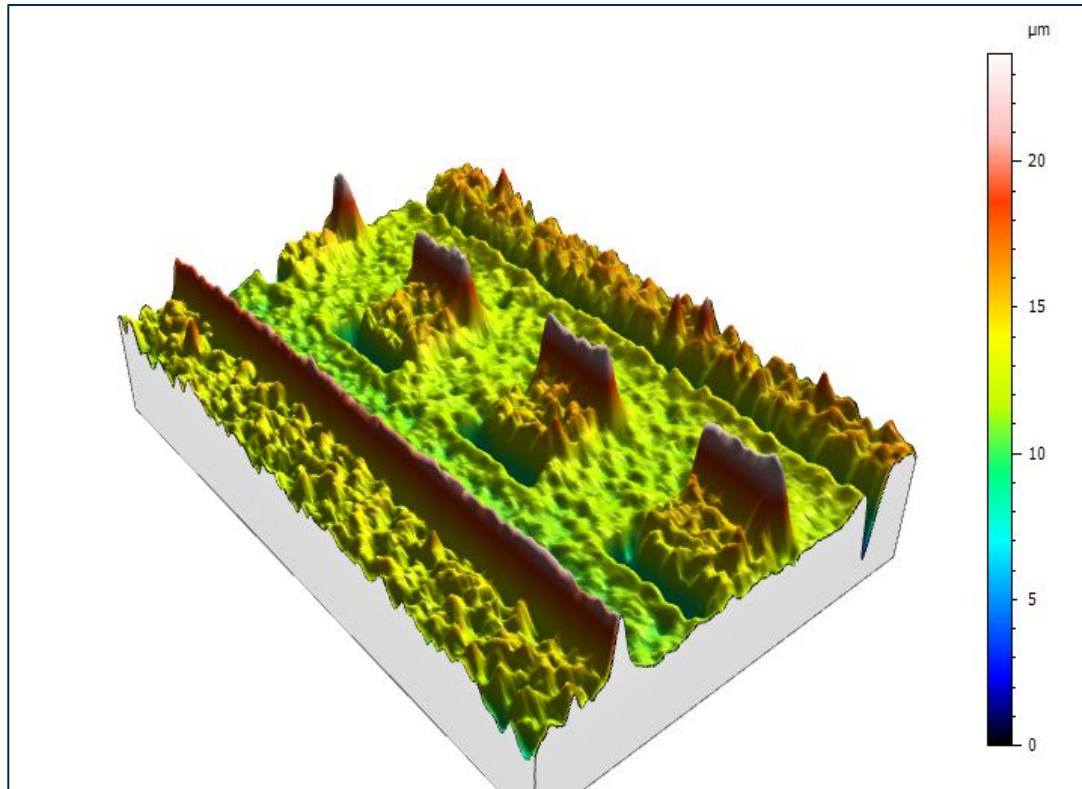
Sensor Z-compensation cases - case 1



LCI1220: Ceramic sample, white sample surface has very close to zero height black pattern on it.

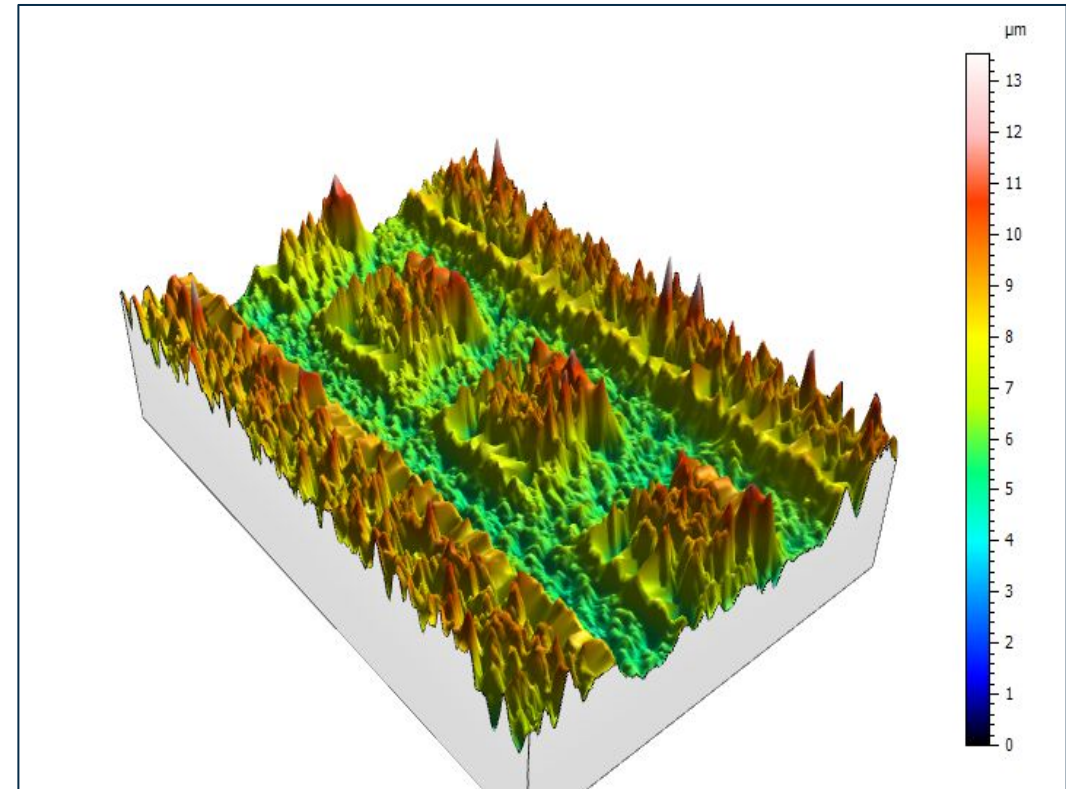
Original

Note: the scale is 0 ... 30 μm



Z-compensated

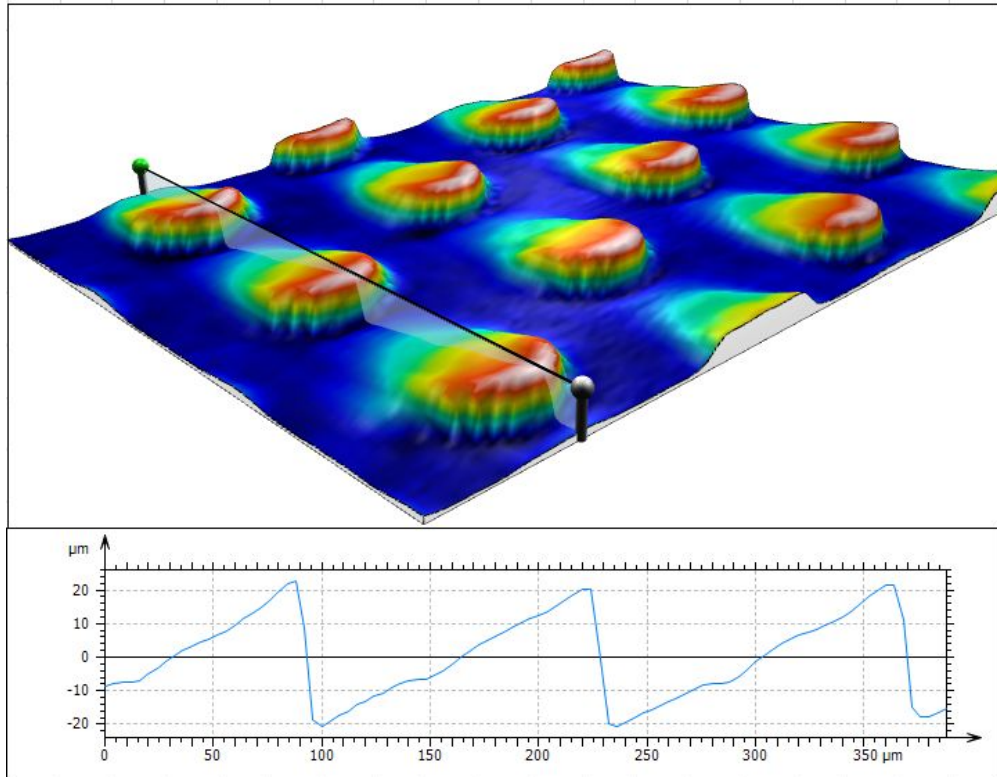
Note: the scale is 0 ... 13.6 μm



Sensor Z-compensation cases - case 2

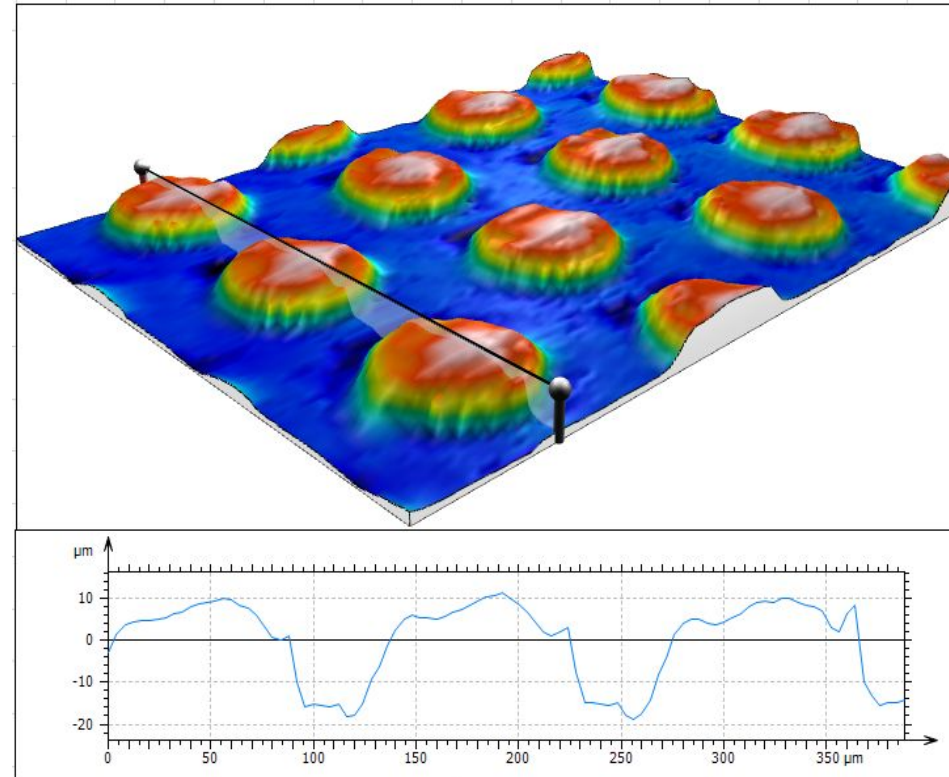
LCI1220: PCB chip contacts

Original



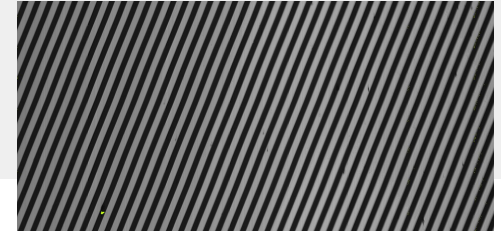
Note: the scale is -24 ... +26 μm

Z-compensated



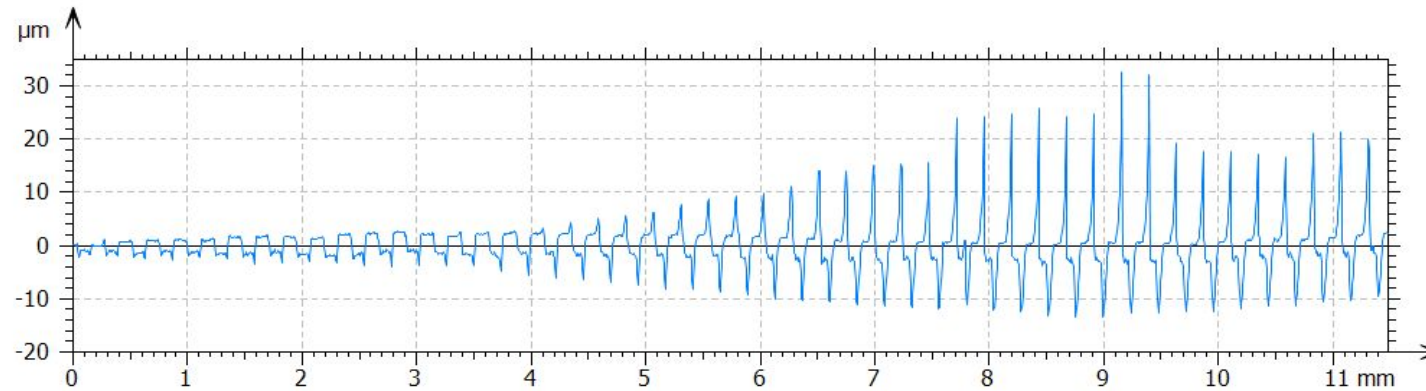
Note: the scale is -22 ... +16 μm

Sensor Z-compensation cases - case 3

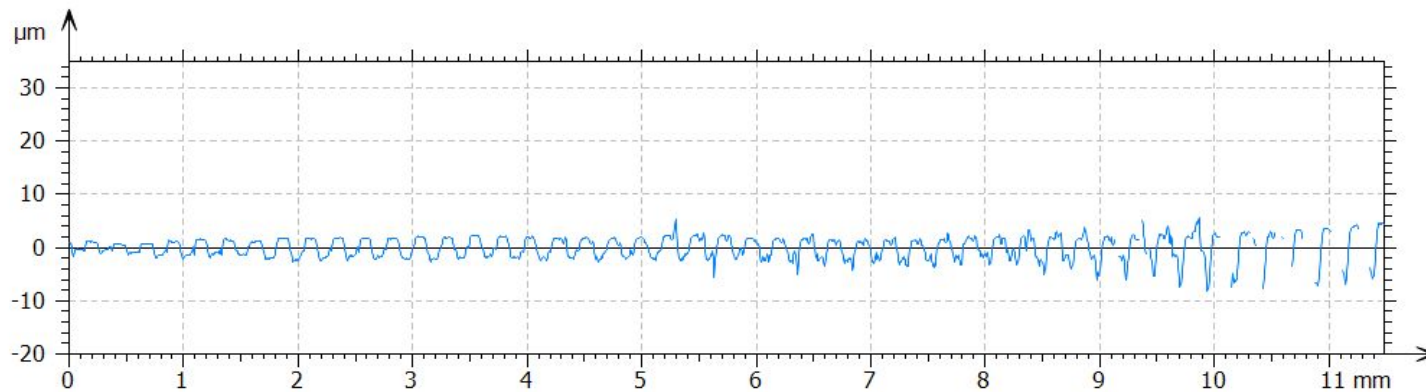


LCI1220: Rotated Ronchi

Original



Z-compensated



Sensor Z-compensation in UULA

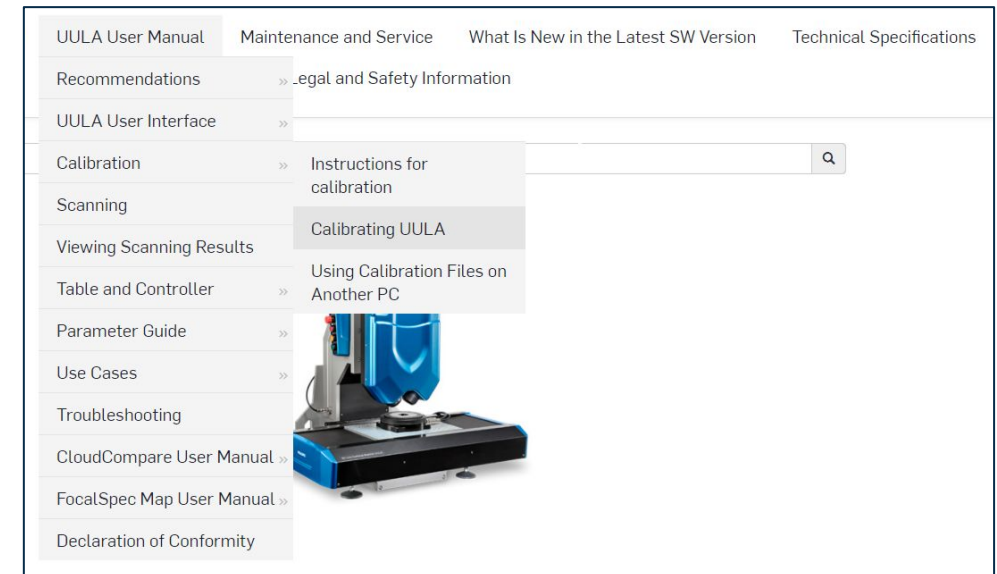
Z-compensation execution in UULA

Uula sensor Z-compensation steps are instructed in Help which can be opened from the SW header:

UULA User Manual / Calibration / Calibrating UULA - step 14.

Alternatively the same instructions can also be found from the pdf version of UULA user manual release 2.3.1 page 45.

The UULA user manual can be downloaded from the LMI Product Downloads Page.



Sensor Z-compensation use in UULA

Z-compensation use

Z-compensation can be enabled / disabled with *Enable/Disable Z-Compensation Calculation* button at the bottom of Advanced Camera Parameters list in Recipe view. This feature is available if Z-Compensation calibration is saved in the Calibration View.

Parameters to fine-tune the compensation are introduced in Help:

[Home](#) / [UULA User Manual](#) / [Parameter Guide](#) / [Advanced Parameters](#) / [Z-Compensation](#)

Alternatively the same information can also be found from the pdf version of UULA user manual release 2.3.1 page 65.

Sensor Z-compensation use in FSSDK

Sensor specific Z-compensation files saved with UULA can be used also with FSSDK for sensor Z-compensation.

Saved calibration files can be copied to another PC. This feature is useful when UULA is used as calibration station for the sensor used by the FSSDK, and the customer application on another PC. FSSDK automatically finds the calibration files at startup, if the files are in folder C:\Focalspec\Calibration on the PC.

FSSDK sensor Z-compensation use is introduced in FocalSpec Sensor API - Version 2.4.0 page 37.

The API document can be downloaded from the LMI Product Downloads Page or it can be found after FSSDK installation under SW installation location from folder FocalSpec Software Development Kit \ Manual, e.g. C:\Focalspec\FocalSpec Software Development Kit\Manual.

In the documentation.html the Z-compensation is covered in Sensor Configuration / Z-Compensation

▼ Sensor Configuration
▶ Sensor Modes
▶ Calibration Files
▶ Imaging Frequency
Depth of Field (Height and Offset of the Image)
▶ Exposure Control
3D Point Detection
Intensity Type Selection
Reordering of Profiles
External Trigger Configurations
Detect Missing First Layer
Thickness Filtering
▶ High Dynamic Range (HDR)
Interpolating Missing Measurement Points
Trim Edges Filter
Recipes
▼ Z-Compensation
Calibration
Calculation

Sensor Z-compensation use in FSSDK

Z-Compensation can be enabled separately for X or Y direction. Y direction means moving direction acquisition with external triggering. Typically, both X and Y direction are needed for compensation calculation.

Note that Z-Compensation in Y direction is available only for BatchCallback data and there is no effect on LineCallback data. Additionally PARAM_MOVING_DIRECTION and PARAM_ENCODER_PULSE_WIDTH parameters need to be set properly when Y direction compensation is used.

A calibration file is read when the user enables either compensation direction. By default, calibration file location is the same as other calibration files (C:\FocalSpec\Calibration). If calibration used this path there is no need to set the file manually. Optionally users can set full path with parameter PARAM_SENSOR_Z_COMPENSATION_FILE .

In console example application X and Y compensations are enabled for batch call back function:

```
status = static_cast<CameraStatus>(_SetIntParameter(camera_ids[0], const_cast<char*>(PARAM_Z_COMPENSATION_X_DIRECTION), 1));  
if (status == CAMERA_OK)  
    printf("Z Compensation X direction enabled\n");  
  
status = static_cast<CameraStatus>(_SetIntParameter(camera_ids[0], const_cast<char*>(PARAM_Z_COMPENSATION_Y_DIRECTION), 1));  
if (status == CAMERA_OK)  
    printf("Z Compensation Y direction enabled\n");
```

Sensor Z-compensation calibration procedure in FSSDK

An example of calibration procedure is implemented in FieldCalibrationTool. The tool can be used as is or it can be customized by using provided source codes.

The separate document *LCI Sensor Z-Compensation in FSSDK 2.4.0* describes the routines implemented in Field Calibration Tool. Similar calibration routines can be integrated to customer application if needed.

To download the document, go to the LMI Product Downloads Page (<https://downloads.lmi3d.com/>), select FocalSpec from the Brand dropdown menu and either High Speed or Standard from the Product dropdown menu and the instruction will appear in the Software section / FocalSpec SDK Release 2.4.0. Simply log in or register and you're ready to go.



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