

DNNP010

Software Add-Ons for uniVision: ABB Interface Seam Tracking



Operating Instructions

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1. General

The software add-on permits communication between a uniVision application DNNF012 and a robot for seam tracking applications. In this way, a 2D/3D Profile Sensor can be used with a uniVision application for seam detection and tracking in realtime with a robot.

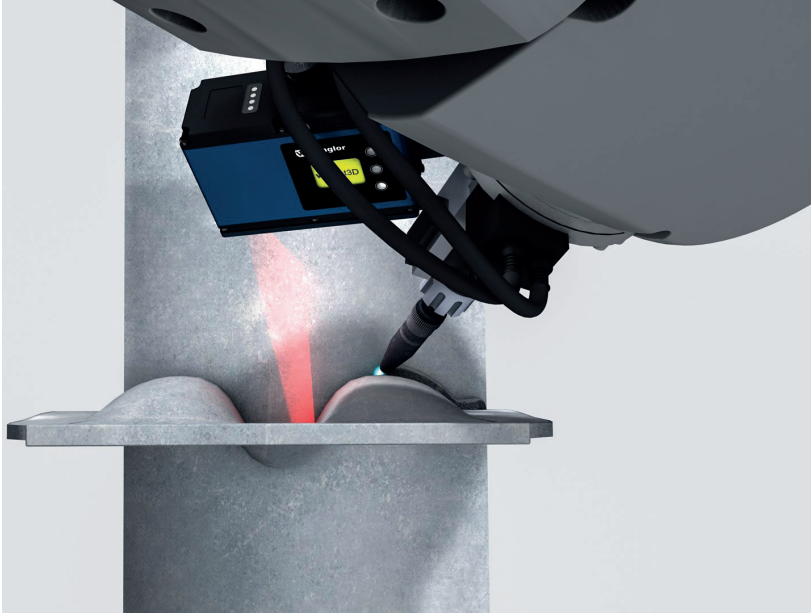


Figure 1: Seam tracking with 2D/3D Profile Sensor and robot



NOTE!

These instructions are limited to a description of the interface between the uniVision application and the robot controller. Comprehensive information regarding uniVision parameters configuring software and the mode of operation of the 2D/3D Profile Sensors can be found in the operating instructions of the respective products. Details concerning available robot commands can be obtained from the respective robot manufacturer.

2. Connection Overview

Communication between the 2D/3D Profile Sensor's control unit and the robot controller takes place via a TCP/IP interface.



NOTE!

Bridge the network settings at the control unit of the 2D/3D Profile Sensor in order to be able to use a LAN interface for the 2D/3D profile sensor and a LAN interface for connection to the robot controller. Open the properties window for the control unit in the device list and set the "Bridge" parameter to "LAN1 and LAN2" to this end.

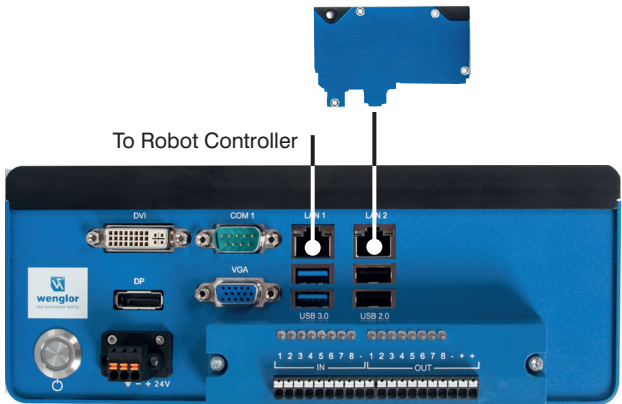


Figure 2: Connection between Control Unit and robot controller

3. Functions Overview

The "robot interface" software add-on is installed to the control unit of the 2D/3D profile sensor. It controls communication between the uniVision application and the robot controller.

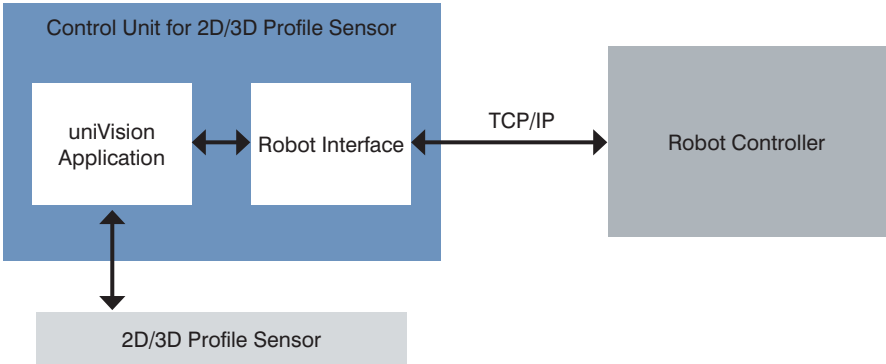


Figure 3: Function diagram

4. Installing the Interface

Install the software add-on to the control unit of the 2D/3D profile sensor.

1. Download the file and save it to a USB stick.
2. Connect the USB stick to one of the USB ports on the control unit.
3. Select the file and copy it to the /media/card/firmware directory.
4. Restart the control unit.
5. The software add-on is installed and started the next time the system is booted.

5. Universal Sensor Interface for Seam Tracking in ABB

5.1 Setting up an uniVision Application Project

The user should create at first a uniVision project and configure it to detect the seam. Once the project is created and configured, the user should save the project using a number as project name.

Example:

- Job number on robot side: 1
- Matching name of the uniVision project: 1.u_p

A uniVision project for robot interface should mainly consist of three basic modules:

1. Module device weCat3D
2. A module to detect the seam (e.g. module Pointcloud Measure)
3. Module Device TCP

Figure 4 shows a simple uniVision project for robot interface to find the V joint.

The user can use the point cloud measuring module together with the find line or find line segment tool, to detect the seam. The start and end points of the detected lines are determined and can be used as points for tracking.



NOTE!

uniVision 2.1.0 or higher provides ready to use templates to find different sets of simple joints. The user is free to modify a template to match his own needs.

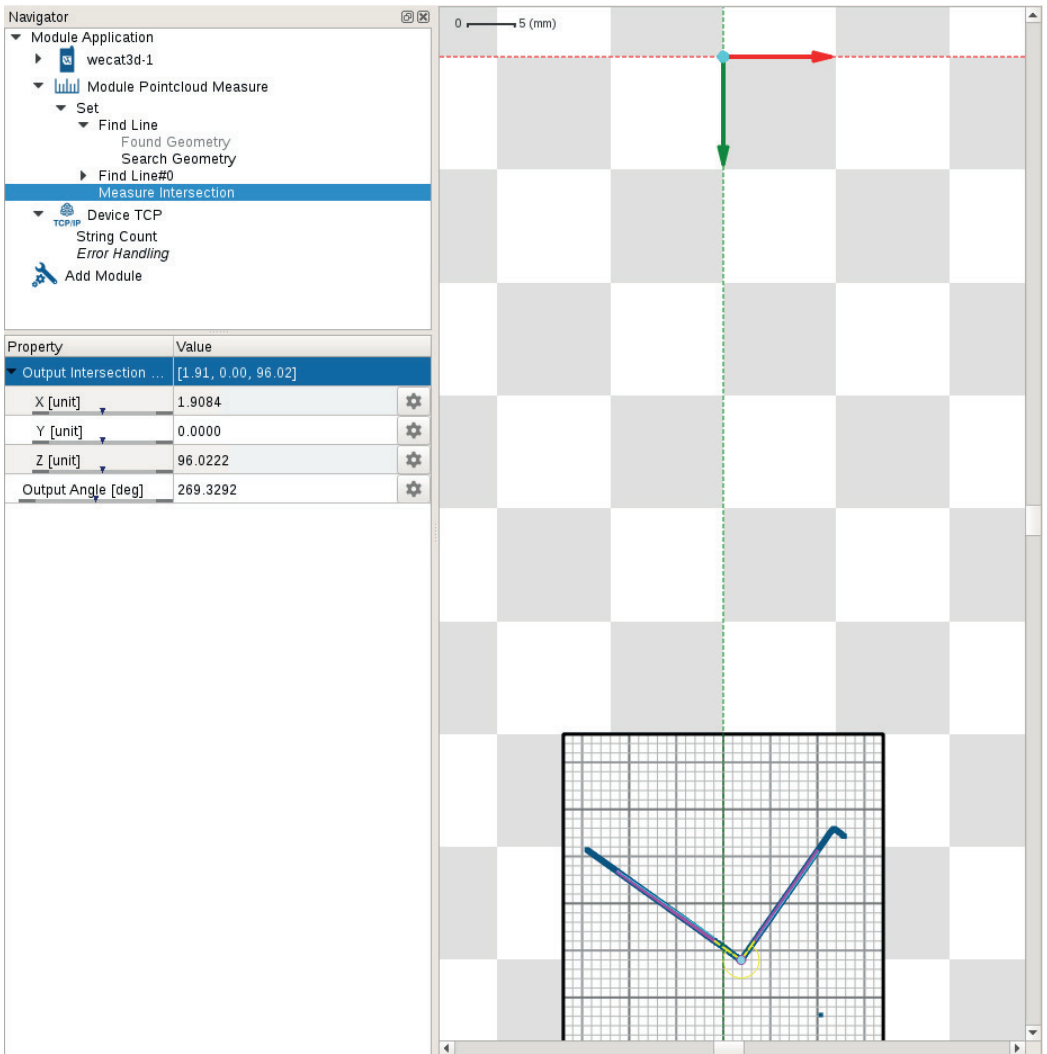


Figure 4: Basic uniVision project to detect V joint

Device TCP module should be configured as follows:

Postamble: ; (semicolon)

Delimiter: , (comma)

Number of characters: 6













| Property | Value | |
|-------------------|--------------------------|---|
| Process Time [us] | 13 |  |
| Module State | 0 |  |
| Interface Type | TCP | |
| Output | 0,1.91785,95.9894,,; | |
| Preamble | |  |
| Postamble | ; |  |
| Delimiter | , |  |
| String Count | 6 |  |
| Output Mode | Unformatted |  |
| Error Handling | Value Substitution |  |
| Connections | 1 |  |
| TCP Port | 32002 |  |
| Blocking Mode | <input type="checkbox"/> |  |

Figure 5: Device TCP module configuration for robot interface

1. Link the values for the character strings using the “number of characters” submodule:

| Character String Number | Linked Value | | | | | | |
|-------------------------------|--|--------------|---------|------------|---------------------------------|-------------------------------|---|
| Character string #1 | <p>Link with a value which provides information concerning the validity of the measured value (e.g. module status of module pointcloud measure).</p> <p> NOTE! The linked value is interpreted as follows:</p> <table> <tr> <th>Linked Value</th><th>Meaning</th></tr> <tr> <td>0 or false</td><td>The ascertained value is valid.</td></tr> <tr> <td>Value not equal to 0 or false</td><td>The ascertained value is invalid. The robot ignores the measured value.</td></tr> </table> | Linked Value | Meaning | 0 or false | The ascertained value is valid. | Value not equal to 0 or false | The ascertained value is invalid. The robot ignores the measured value. |
| Linked Value | Meaning | | | | | | |
| 0 or false | The ascertained value is valid. | | | | | | |
| Value not equal to 0 or false | The ascertained value is invalid. The robot ignores the measured value. | | | | | | |
| Character string #2 | Link to the X-coordinate of the tracking point (e.g. the X-coordinate of the detected endpoint of a line). | | | | | | |
| Character string #3 | Link to the Z-coordinate of the tracking point (e.g. the Z-coordinate of the detected endpoint of a line). | | | | | | |
| Character string #4 | Link to a value which represents information concerning the width of a gap (e.g. the X-value difference at a gap). | | | | | | |
| Character string #5 | Link to a height difference (e.g. the Z-value difference at an edge). | | | | | | |
| Character string #6 | Link to a surface (e.g. a detected surface from the point cloud region module). | | | | | | |

**NOTE!**

Character strings 1 through 3 must be linked, but linking of character strings 4, 5 and 6 is optional.

**NOTE!**

It is fine to add more than 6 strings in the module Device TCP and link them to different values. The robot interface reads only the first 6 strings and ignores the rest.

5.2 Configuring the Robot Interface

The robot interface includes various setting options and results displays.

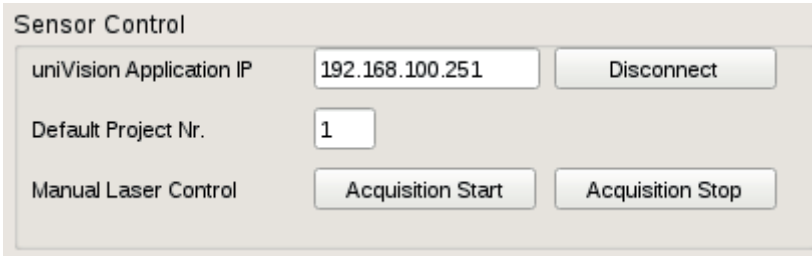
The screenshot shows the uniVision ABB interface with the following sections:

- Help**: A button at the top left.
- Sensor Control**:
 - uniVision Application IP:
 - Default Project Nr.:
 - Manual Laser Control:
- Sensor State**:
 - Connected: ☒ (green square)
 - Acquisition: ☒ (dark green square)
 - Error: ☐ (dark red square)
 - Project Nr.:
- Robot State**:
 - Listening: ☒ (dark green square)
- Sensor Data**:

| | | | |
|---------------|------------------------------------|-----------------|-----------------------------------|
| Measure Error | <input type="text" value="Error"/> | GAP [mm*100] | <input type="text" value="0.00"/> |
| Y [mm*100] | <input type="text" value="0.00"/> | Z Diff [mm*100] | <input type="text" value="0.00"/> |
| Z [mm*100] | <input type="text" value="0.00"/> | Area | <input type="text" value="0.00"/> |

Figure 6: uniVision ABB interface

5.2.1 Sensor Control



The **Sensor Control** window contains the following elements:

- uniVision Application IP:** A text field displaying `192.168.100.251` and a **Disconnect** button.
- Default Project Nr.:** A text field displaying `1`.
- Manual Laser Control:** Two buttons labeled **Acquisition Start** and **Acquisition Stop**.

Figure 7: Sensor control

The robot interface automatically connects to the uniVision project through the given IP. For safety reasons the laser of the 2D/3D Profile Sensor will be automatically deactivated after establishing a connection. You can manually control the laser of the 2D/3D Profile Sensor from the robot interface through the buttons “Acquisition Start” and “Acquisition Stop”.

The robot interface communicates with the uniVision application via a TCP/IP connection.



NOTE!

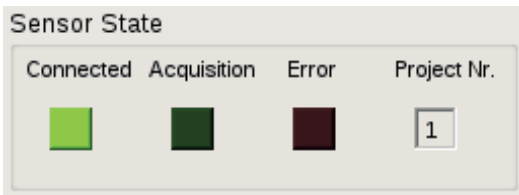
The IP address of the uniVision application is visible in the device list of the uniVision software. The default IP address is **192.168.100.251**.



NOTE!

In case of an open connection between the robot interface and the uniVision project, the uniVision project can be used in live mode. Changing to edit mode is only possible if the connection from the robot interface to the uniVision project is closed before.

5.2.2 Sensor State



The **Sensor State** window displays the following information:

- Connected:** Indicated by a green square.
- Acquisition:** Indicated by a dark green square.
- Error:** Indicated by a dark red square.
- Project Nr.:** A text field displaying `1`.

Figure 8: Sensor state

The table below describes the state of each LED in sensor state.

| Status Value | Meaning |
|----------------|--|
| Connected | <p>Connection status, robot interface to uniVision project:</p> <p>Orange Not connected</p> <p>Possible causes:</p> <ul style="list-style-type: none"> • The IP address of the uniVision application is incorrect. • The uniVision project is in edit mode. <p>Remedy:</p> <ul style="list-style-type: none"> • Enter the correct IP address. • Switch the uniVision project to run mode. |
| | <p>Dark green The connection to the uniVision application is active and the uniVision application project is being loaded.</p> |
| | <p>Bright green The connection to the uniVision project is active and the 2D/3D Profile Sensor is ready.</p> |
| Acquisition | <p>Dark green The 2D/3D Profile Sensor's laser is off.</p> |
| | <p>Bright green The 2D/3D Profile Sensor's laser is on.</p> |
| Error | <p>Dark red No errors</p> |
| | <p>Bright red Problem in communication with the uniVision project</p> |
| Project number | Number (name) of the project which is currently loaded in the uniVision application |

5.2.3 Robot State

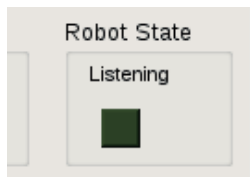


Figure 9: Robot state

The table below describes the state LED in robot state.

| Status Value | Color | Status of connection between controller and robot interface |
|--------------|--------------|---|
| Robot status | Orange | The robot interface software is not licensed. Please refer to section 5.3 to learn more about licensing the robot interface |
| | Dark green | Waiting for a connection from the robot controller |
| | Bright green | Connected |



NOTE!

Please refer to [section 5.4](#) to learn more about configuring the robot controller to build a connection to the robot interface.

5.2.4 Sensor Data

Sensor Data

| | | | |
|---------------|-------|-----------------|------|
| Measure Error | Error | GAP [mm*100] | 0.00 |
| Y [mm*100] | 0.00 | Z Diff [mm*100] | 0.00 |
| Z [mm*100] | 0.00 | Area | 0.00 |

Figure 10: Sensor data

Sensor data shows the linked data in Device TCP module in the loaded uniVision project. If the laser of the 2D/3D Profile Sensor is deactivated or the uniVision project could not compute the tracking point, the measure error label will show "Error" and the data will not be updated.

5.3 RobotInterface Licensing

The robot interface needs to be licensed in order to accept a connection from the robot controller.

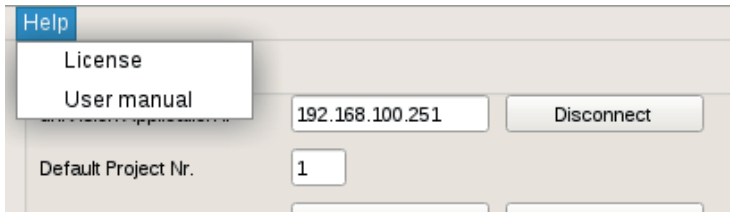


Figure 11: Robot interface licensing

In the Help menu in the menu tool click on license to open the license dialog window.

In the “License Request” tab enter your data to the lines provided for this purpose and activate the checkbox next to the desired module (see [Figure 12](#)). Click “Generate request”, save the displayed license request key on the desktop and send it by e-mail to **order@wenglor.com**.

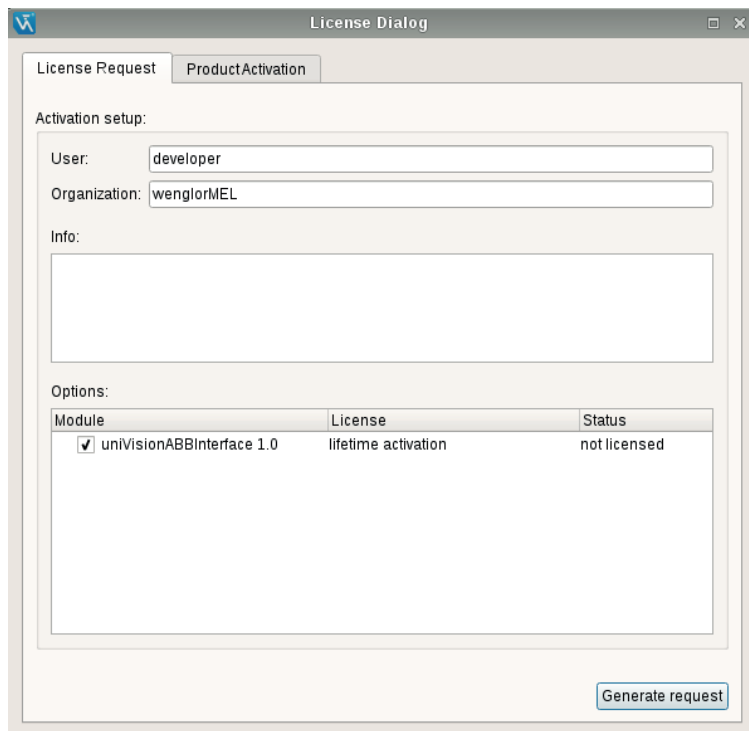


Figure 12: License window


NOTE!

Please make sure that the licensing process is executed on the control unit which will actually be used in the application. The license is restricted to the respective control unit.

You will receive your license activation key. Save it on your desktop. Select the “Product Activation” tab in the license dialog box and open the corresponding file. Click “Activate License” in order to enable the software.

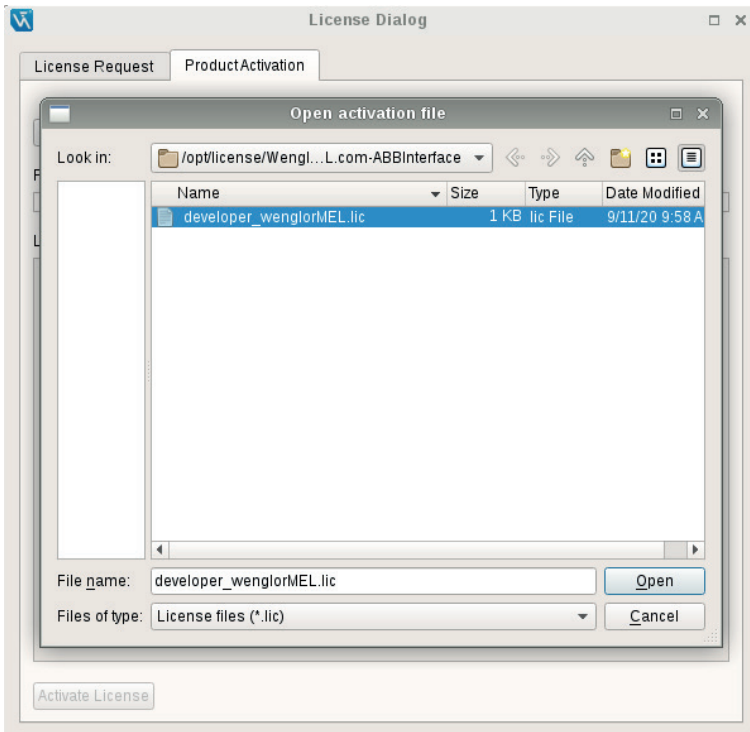


Figure 13: License activation window

5.4 Configuring the Universal Sensor Interface in ABB Robot



NOTE!

This section assumes that the robot programmer has a good knowledge of using and calibrating optical sensors for seam tracking application.

The robot controller should be configured to build a connection to the robot interface. The ABB PlugIn has been tested on IRC5 controller. It is possible to connect the control unit to the following ports on the robot controller: X4 (LAN2) and X5 (LAN3). It is recommended to keep the service port (X2) free. According to ABB documentation, it is mandatory to have the following software requirements:

- RoboWare 6.0 or later
- One of the software options should be installed:
 - » Sensor Interface
 - » Optical Tracking CAP
 - » Optical Tracking Arc

Use the installation manager in RobotStudio to configure, build and download a RobotWare system to the IRC5 controller. For more information please consult your local ABB support.

The options “Sensor Interface” and “Optical Tracking CAP” do not provide ready to use configurations for the sensor. The configuration of sensor communication and sensor properties must be done manually using RobotStudio or the FlexPendant. The option “Optical Tracking Arc” includes a default configuration for sensor communication and sensor properties. This default configuration must be modified to match the installed sensor.

In the table below you can find a brief description of the system parameters used when configuring a sensor communication:

| Parameter | Description |
|----------------|--|
| Name | The name of the sensor e.g. “sensor1:” or “mlwl143:” |
| Type | The type of the transmission control: please select LTAPPTCP |
| Serial port | not used |
| Remote address | The IP address of the control unit (default 192.168.100.252) |
| Remote port | 5020 |



NOTE!

Both the robot controller IP and the control unit IP should be in the same subnet (e.g. 192.198.100.xxx).

After configuring the sensor communication the properties of the sensor should be defined. The table below shows an example of the properties for MLSL143.

| ABB property name | wenglor property value, given in datasheet | Property value * |
|----------------------------------|--|---|
| Name | | MLSL143 |
| Dimension | | 2 |
| Angle camera to laser | | 0 |
| Frequency | | 20 |
| Close Width of Field y ** | Measuring range X (small value) | 62 (field width X start, recommended: 20) |
| Far Width of Field y * | Measuring range X (large value) | 145 (field with X end, recommended: 40) |
| Close Width of Field x | | 0 |
| Far Width of Field x | | 0 |
| Close StandOff * | Working range Z (small value; must be converted to negative value) | -90 (working range Z start) |
| Depth of Field * | Measuring range Z (must be converted to negative value) | -190 (working range Z, recommended: -120) |
| Far StandOff | | -220 (the distance between the zero point of the sensor and the TCP of the robot) |
| Optimal TCP StandOff | | 0 |
| Frame Alignment | | Laser aligned |
| Frame z Orientation | | Into camera |
| Brand | | --- |
| Camera compensates x measurement | | false |

* Some values must be given as negative values, because the coordinate system of the sensor is different to the coordinate system of the ABB system.

** For these sensor properties it is recommended to use smaller values than the values described in the sensor operating instruction document. Those properties are mainly used in ABB controller for the calibration process. Using limited working range make the calibration process in ABB controller more robust.

Please refer to your robot manufacturer support for more details regarding robot controller setup.

5.5 2D/3D Profile Sensor Calibration for ABB Robots

The ABB controller provides its own calibration algorithm and calibration plate. The calibration algorithm from ABB needs specific tracking data from the sensor to perform the calibration, which are:

1. The left joint point on the calibration plate
2. The right joint point on the calibration plate
3. The angle of the middle line segment and the X axis of the sensor



NOTE!

It is also possible to use any calibration plate supported by ABB.

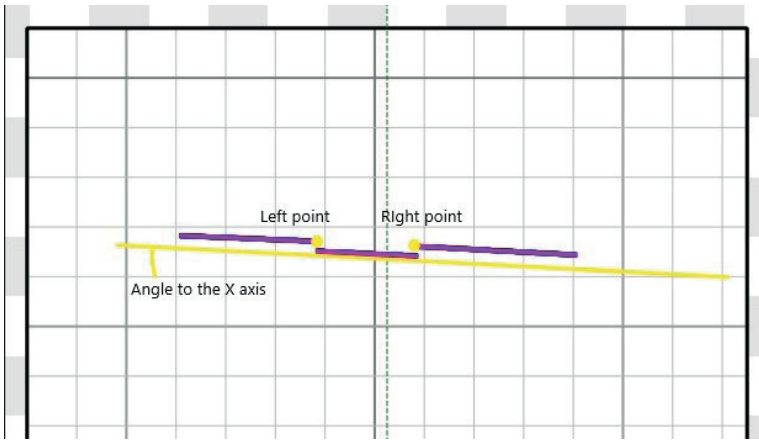


Figure 14: Tracking data for calibration

The user should create a specific calibration project in uniVision and name it “90.u_p”. The user should configure the uniVision project to detect the left point, the right point of the calibration plate and the angle between the middle line and the X axis of the sensor. The tracking data are linked to the TCP module in the uniVision project as follows:

- string #1: Recognition state: 0 if the recognition is OK. Else if the recognition is not OK
- string #2: X coordinate of the left tracking point
- string #3: Z coordinate of the left tracking point
- string #4: 0
- string #5: 0
- string #6: 0
- string #7: The angle between the detected line segment and the X axis of the sensor
- string #8: X coordinate of the right tracking point
- string #9: Z coordinate of the right tracking point

An example of uniVision project for ABB calibration job can be found on the control unit under
/opt/WenglorMEL.com-ABBInterface/help/90.u_p

Please follow the instructions in the Laser Tracker Calibration Graphical User Interface on ABB FlexPendant to perform the calibration procedure. In calibration plate joint definitions on the FlexPendant use the following definition:

- Left joint: 90 (the same name as the uniVision project name created in the previous step)
- Right joint: 91
- Butt joint: not used



NOTE!

The user can change the left joint number and the right joint number in the config.ini file located in /opt/WenglorMEL.com-ABBInterface/bin.

6. Troubleshooting

6.1 The robot is not able to track the seam

Possible reasons:

- The uniVision project is not able to detect the seam.

Solutions:

- Make sure, that the uniVision project is able to detect correctly the seam to be tracked.

6.2 Activating the Debug Output Log

The debug output log saves the communication between the robot controller and the uniVision application. The debug output log helps the support team understanding the issue and find an appropriate solution.

To activate the debug output log go to the config.ini file located in /opt/WenglorMEL.com-ABBInterface/bin and change the value of the variable DebugLog to 1 (default is 0).

The robot interface will create a new file DebugLog.txt.

After doing the tests, disconnect the robot controller from the robot interface, copy the file and send it to your support team for further analysis.



NOTE!

Please deactivate the debug output log at the end of the test.

6.3 Sensor Timeout Error on ABB Controller Side

During calibration or tracking the robot shows error message “sensor timeout”.

Possible reasons:

- The network cable connection from the robot controller to the control unit is loose (does not provide stable connection).

Solutions:

- Check your network cable. If needed, please replace

6.4 Calibration Error

The ABB robot shows an error 80001 calibration error.

Possible reasons:

- Either the sensor is mounted too far from the calibration plate or the sensor type configuration is faulty.

Solutions:

- Mount the sensor near to the calibration plate. The distance between the sensor and the calibration plate should be ideally within the first half of the Z working range of the sensor.
- If it is not possible to remount the sensor, then decrease the value of „far StandOff“ in the sensor properties (see table in section 5.4). Example: If it was -190, then make it -200.