

Programming Manual & Sample project “Windrow Following” Mobile 3D smart sensor Efector 250

O3M151
Line Guidance



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1. Preliminary note

These instructions explain the 3D O3M151 Smart Sensors Line Guidance function and a CODESYS sample project to demonstrate the usage of the sensor output.

For a detailed description of the device, please read the Operating instructions of the O3M151 sensor (chapter 2ff) and the Programming manual of the ifm Vision Assistant (chapter 6ff).

2. Step by step setup guidelines

At first: set all devices free of voltage!

See also Figure 1: Wiring of the O3M151 below.

1. O3M950 Illumination
 - a. assembly
 - i. mount the E3M100 at an appropriate place
 - ii. mount the O3M950 into U-clamp E3M100
 - iii. measure the exact position of the O3M950
 - b. power supply cabling
 - i. plug the E3M132 into the O3M950
 - ii. connect the E3M132 with the power supply (2x brown: 9...32V, 2x blue: GND)
2. O3M151 Sensor
 - a. assembly
 - i. mount the E3M100 at an appropriate place
 - ii. mount the O3M151 into a U-clamp E3M100
 - iii. measure the exact position of the O3M151
 - b. MCI
 - i. E3M122: plug the cable into sensor and illumination
 - c. Ethernet
 - i. Screw the E12283 in into the middle M12-connector
 - ii. Connect the E12283 with the Switch
 - d. CAN
 - i. Screw the E11594 into the remaining M12-connector
 - ii. Connect the E11594 with the CAN-bus
3. Display
 - a. Power supply
 - i. Screw the EVC071 in the M12-connector #1
 - ii. Connect the EVC071 with the power supply (Pin1+Pin5: 9...32V, Pin3: GND)
 - b. CAN
 - i. Screw the E11594 into the M12-connector #2
 - ii. Connect the E11594 with the CAN-Bus
 - c. Ethernet
 - i. Screw the E12283 in to the M12-connector #4
 - ii. Connect the E12283 with the Switch
4. CAN-Bus
 - a. Power supply
 - i. Ensure that the CAN-Bus is supplied correctly with power (respective Pin2: 9...32V, Pin3: GND)
 - b. Termination
 - i. Ensure that the CAN-Bus is terminated at the beginning and end each with 120 Ohm.
5. Computer
 - a. Ethernet
 - i. Connect the Computer with the Switch
 - b. CAN
 - i. Connect the CANfox with EC2114 or EC2113 with the CAN-Bus
 - ii. Connect the CANfox with USB with the Computer (see users guide of the CANfox)

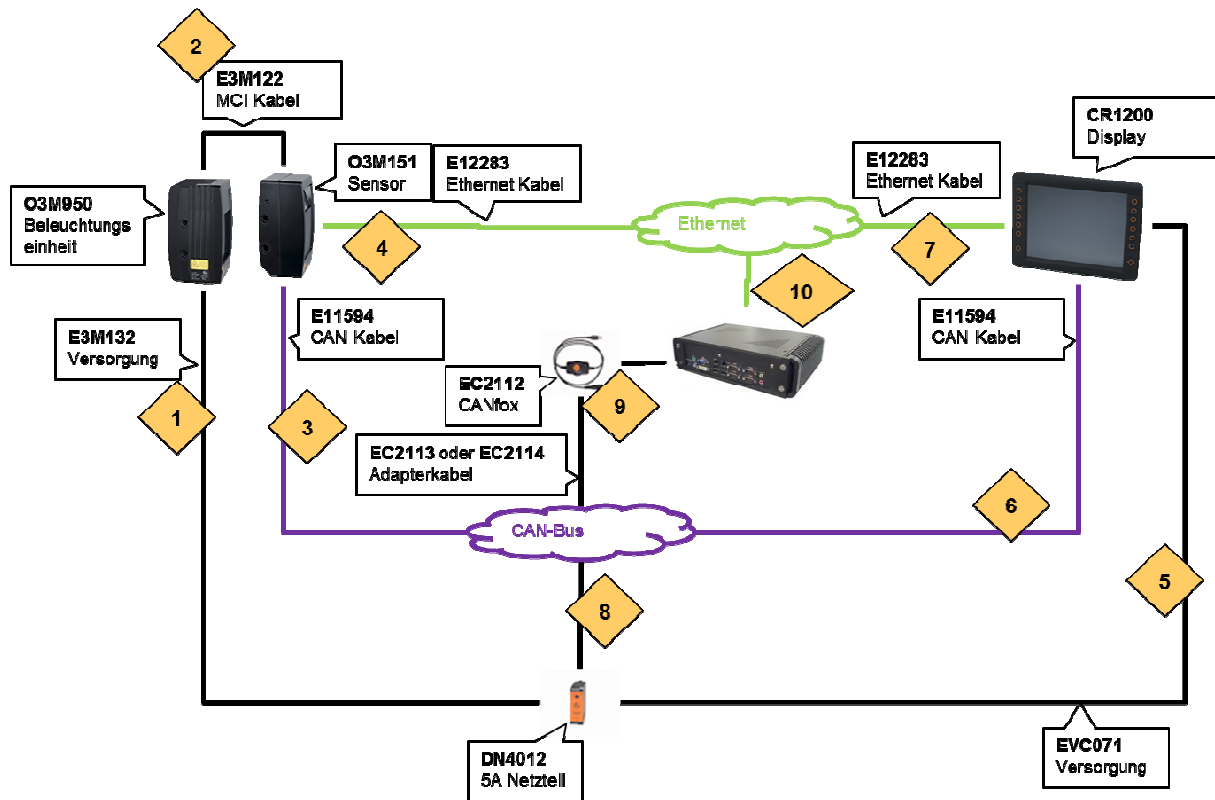


Figure 1: Wiring of the O3M151

3. Downloading and starting the Vision Assistant parametrizing software

This chapter explains how to install the Vision Assistant. No administration privileges are needed.

The Vision Assistant Software (will be called furthermore "The Vision Assistant") can be downloaded from the ifm electronic web site:

- Go to <http://www.ifm.com>,
- Click on „Select your country“, select your country, e.g. Germany/English,
- Enter „O3M151“ in the field „New Search“,
- Click on the tab "More Information",
- Click on "More information is available under Software / Download"
- In the middle display window, scroll down to the grey highlighted caption "O3M15X - operating software"
- Click on the word "Download" to start the download. Please select Version 1.2.5 or higher.
- The downloaded file has the naming schema "ifmVisionAssistantV1_2_5.zip"
- Notice the path of the downloaded Vision Assistant.
- Open the path in the Windows Explorer.
- Right click on the downloaded file and select the menu item "Extract all". The following window will open:

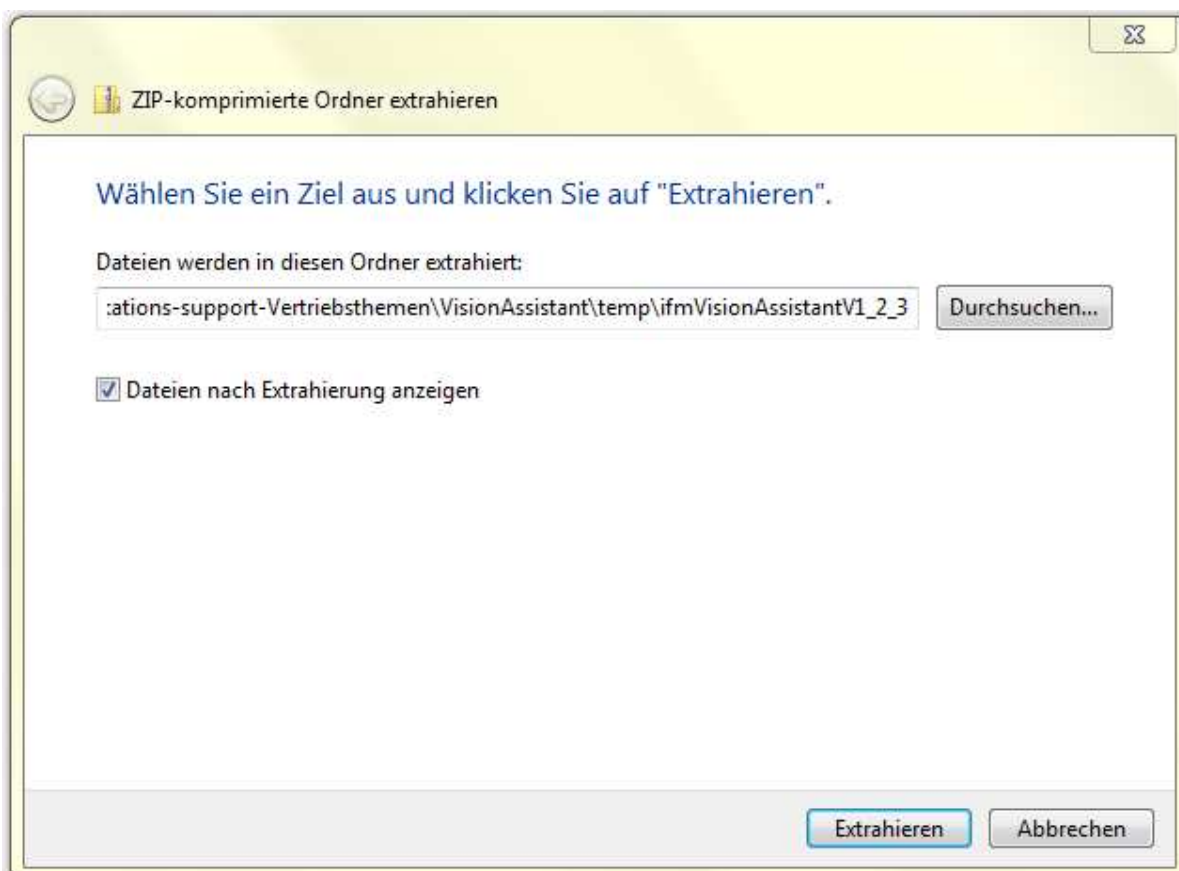


Figure 2: extract Vision Assistant

- Leave the suggested folder. Windows will create the specified folder, if not available, and will extract the content from the downloaded file.
- The specified folder will be opened. Maybe a subfolder with a subfolder will be created.
- The folder with the file "ifmVisionAssistant.exe" will be called the "Vision-Assistant-folder" from now on.

Installation is finished. The Vision Assistant can be used now. No administration privileges are needed.

3.1 Starting the Vision Assistant

This is about how to start the Vision Assistant:

- Open the Vision-Assistant-Folder with the Windows Explorer.
- Double Click on the file "ifmVisionAssistant.exe":

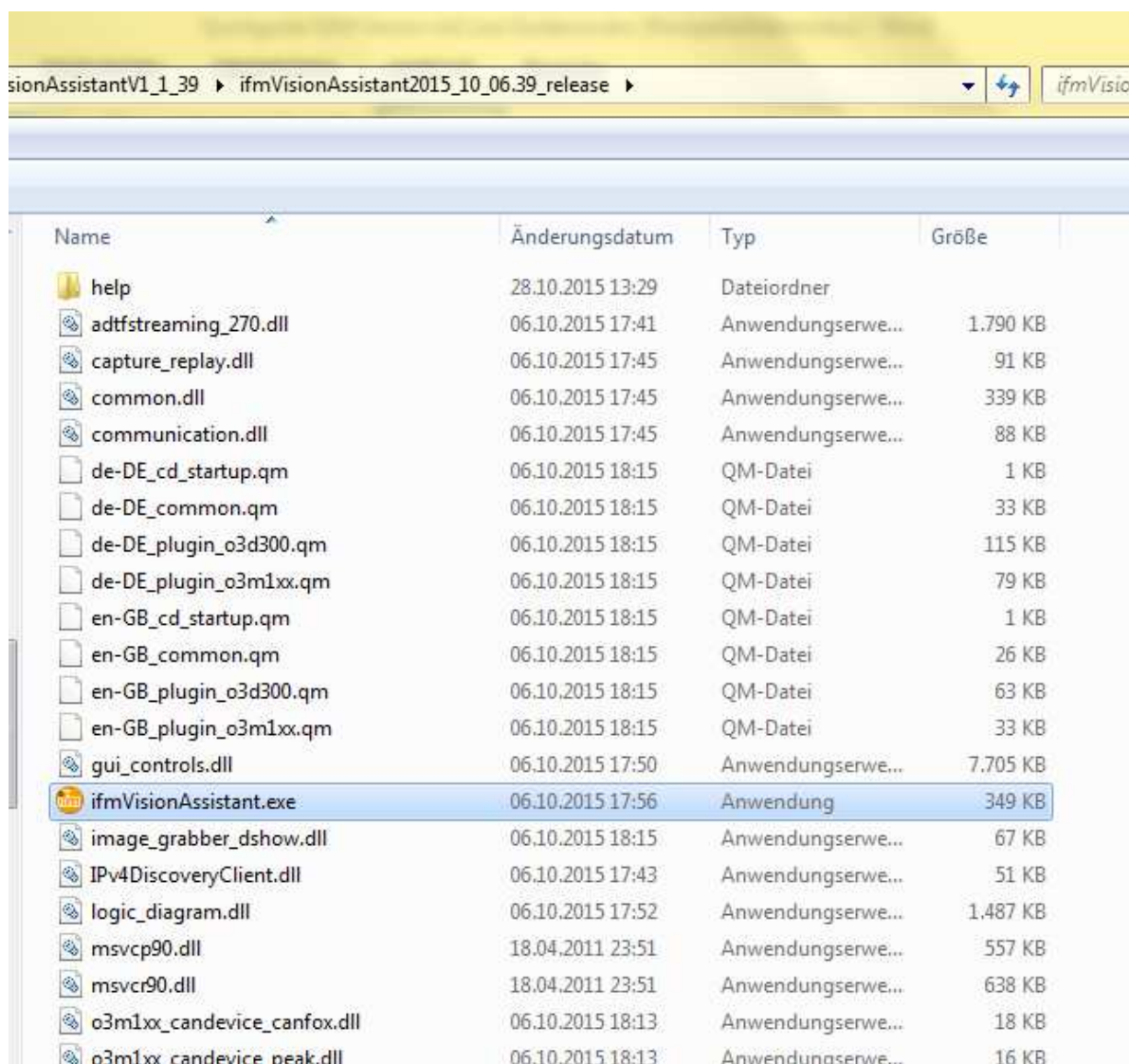


Figure 3: open the Vision Assistant

- The application will start, possibly an hour glass will be visible for short time.
- The following startup window will be displayed:

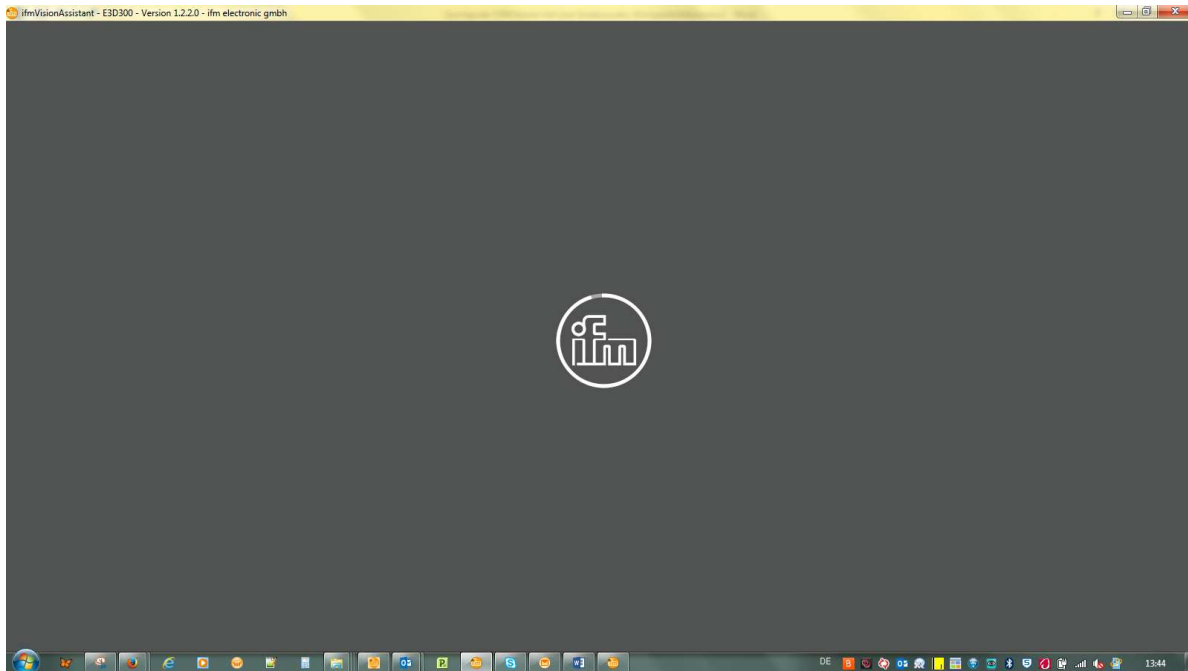


Figure 4: startup window

- The Vision Assistant is starting, please wait.
- The startup procedure is finished, if the following window is displayed:

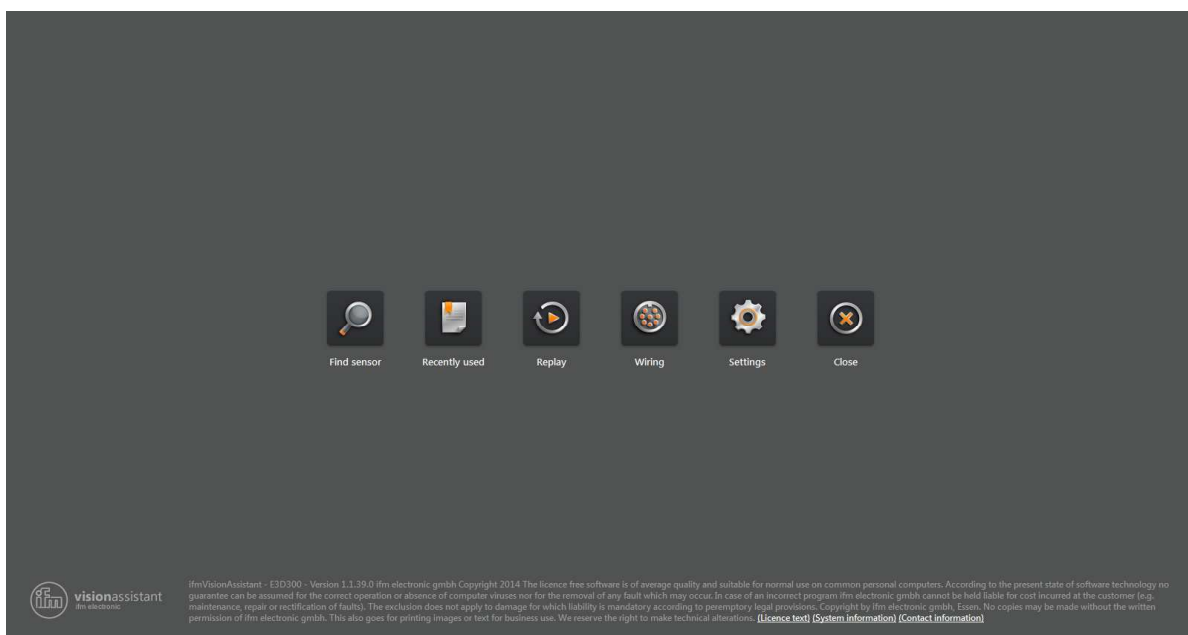


Figure 5: startup finished

The startup procedure is finished.

4. Download and activate the function “Line Guidance“

Perform the following steps as follows:

1. Download the firmware from the ifm website (see chapter “Downloading the firmware from the ifm-Website“ below)
2. Connect PC and Sensor (see the chapter “Step by step setup guidelines“ above)
3. Start the Vision Assistant (see below)
4. Download and flash the firmware into the sensor

These steps will be described in the following sub chapter.

4.1 Downloading the firmware from the ifm-Website

- Goto the ifm website <http://www.ifm.com>
- Click on „Select your country“, select your country, e.g.: Germany/English.
- Click on the tab “Service“.
- Click on “Download“.
- Click on “Industrial Imaging“.
- In the middle display window, scroll down to the grey highlighted caption “O3M15X - firmware”
- Start the download by clicking on the word “Download” on the right of “O3M151 – Vx.y.z Line Guidance”. Vx.y.z is the version. Please select a version equal to or higher than V3.4.9 Line Guidance.
- The Download starts for the according file with name “ifm_O3M_LG_3.4.9.zip” (or according version)
- Notice the download path of the firmware.
- Open the path of the firmware.
- Right click on the downloaded file and select the menu item “Extract all”. The following window will open:

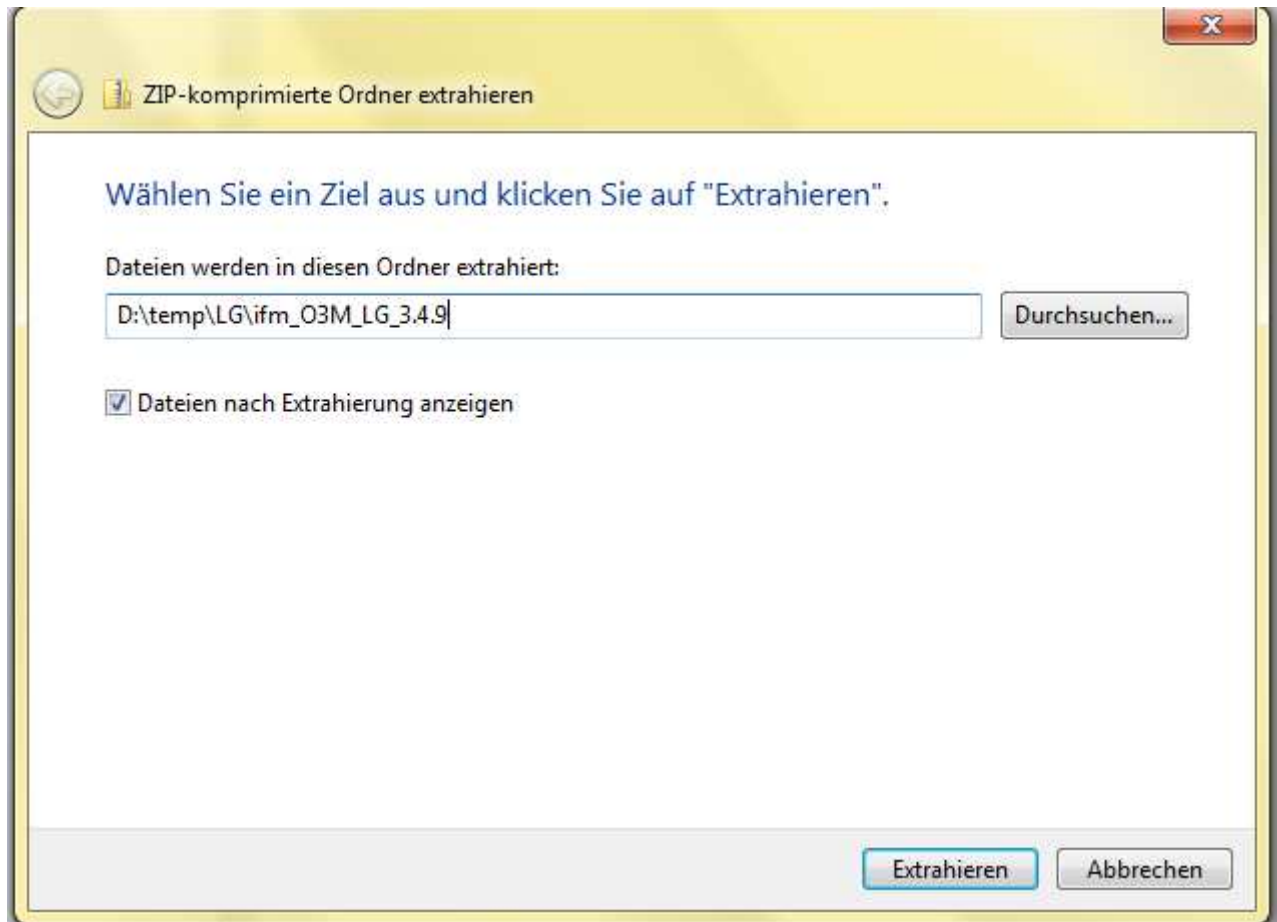


Figure 6: extract the firmware

- Leave the suggested folder. Windows will create the specified folder, if not available, and will extract the content from the downloaded file.
- The specified folder will be opened. Maybe a subfolder with a subfolder will be created.
- The folder with the file "ifm_O3M_LG_3.4.9.fcr" will be called the "Firmware-folder" from now on.
- Connect the sensor with the computer according to the chapter "Step by step setup guidelines"
- Start you Vision Assistant according to the chapter "Starting the Vision Assistant"
- Click on the startup window of the Vision Assistant on the button "Find Sensor". A hint will be displayed "searching for device", then appears the following choice:

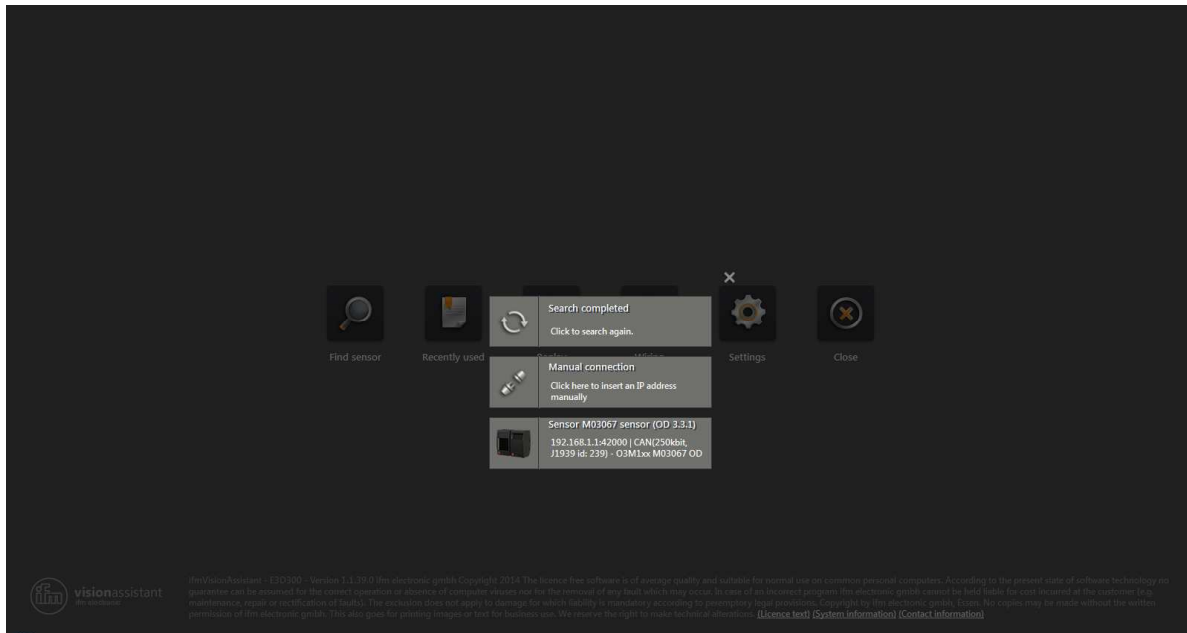


Figure 7: Find sensor - search completed

- Click on “ Manual connection”
- A window to select the device type is displayed:

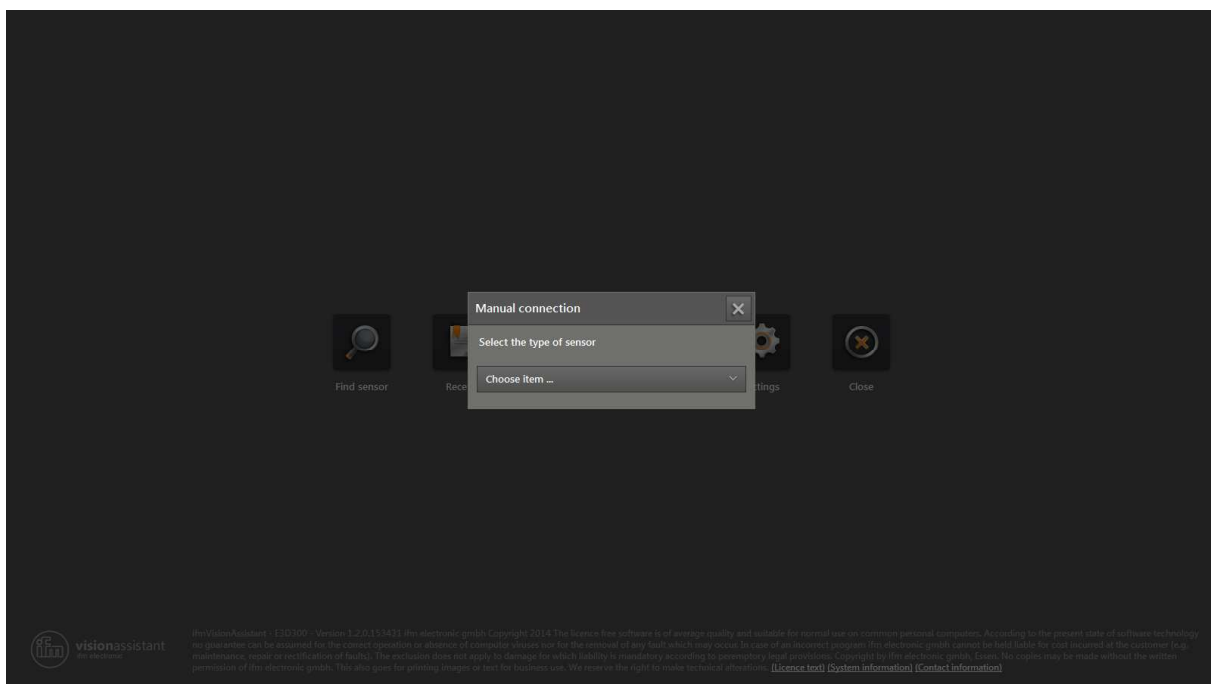


Figure 8: manual connection

- Select „O3M1xx manual connection“

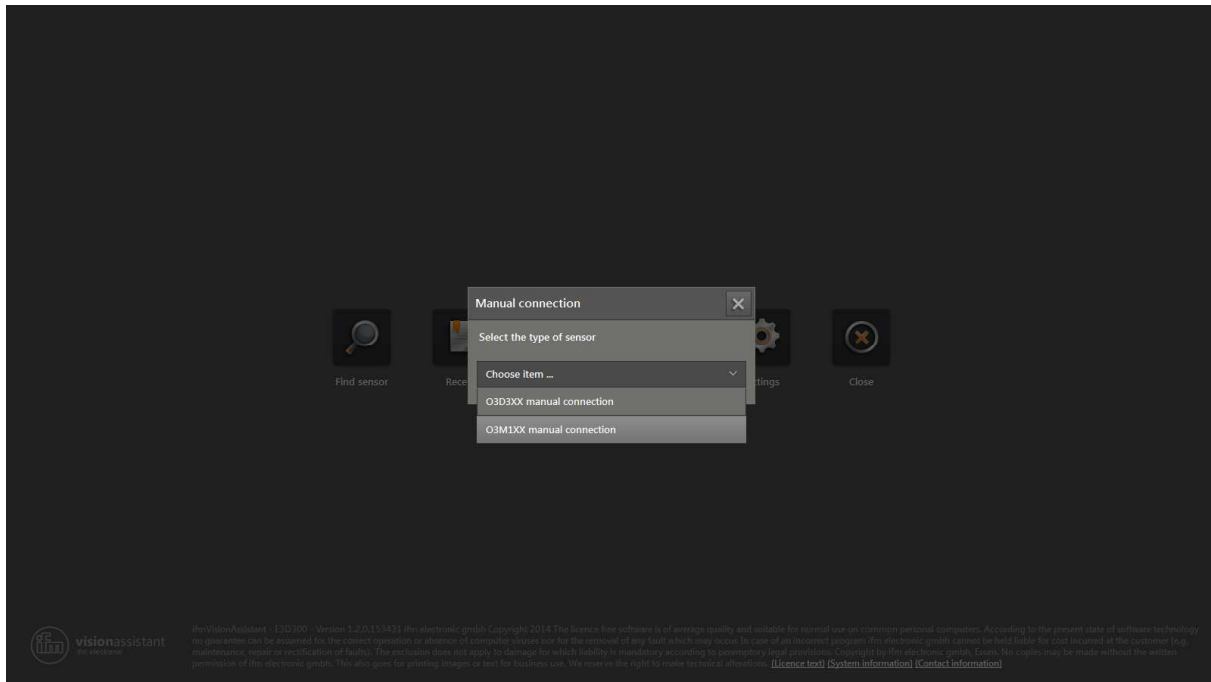


Figure 9: choose manual connection

- After selecting the O3Mxxx, a selection for manual connection is displayed:

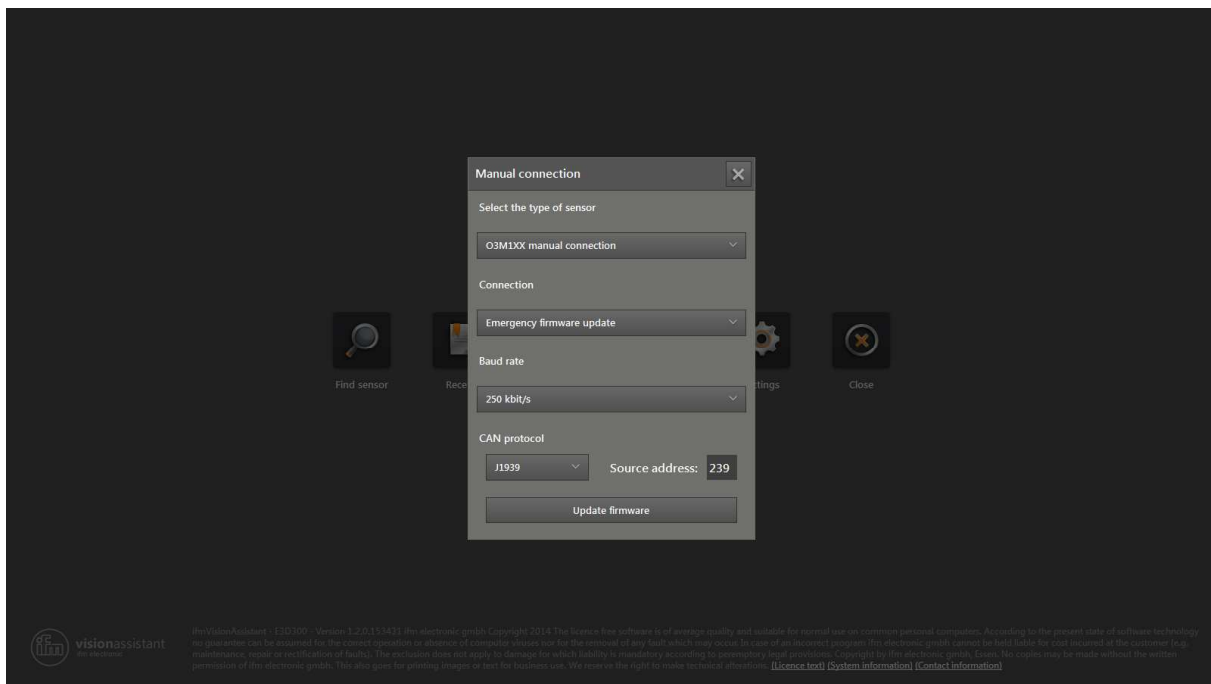


Figure 10: configure the manual connection

- Select the following values:
 - o Device type: O3M1xx manual connection
 - o Connection: emergency firmware update
 - o Baud rate 250kbit/s

- o CAN protocol: J1939
- o Source address 239
- Afterwards press button „Update Firmware“
- Hint: no other applications should be running
- A file selection dialog for selecting the firmware appears.

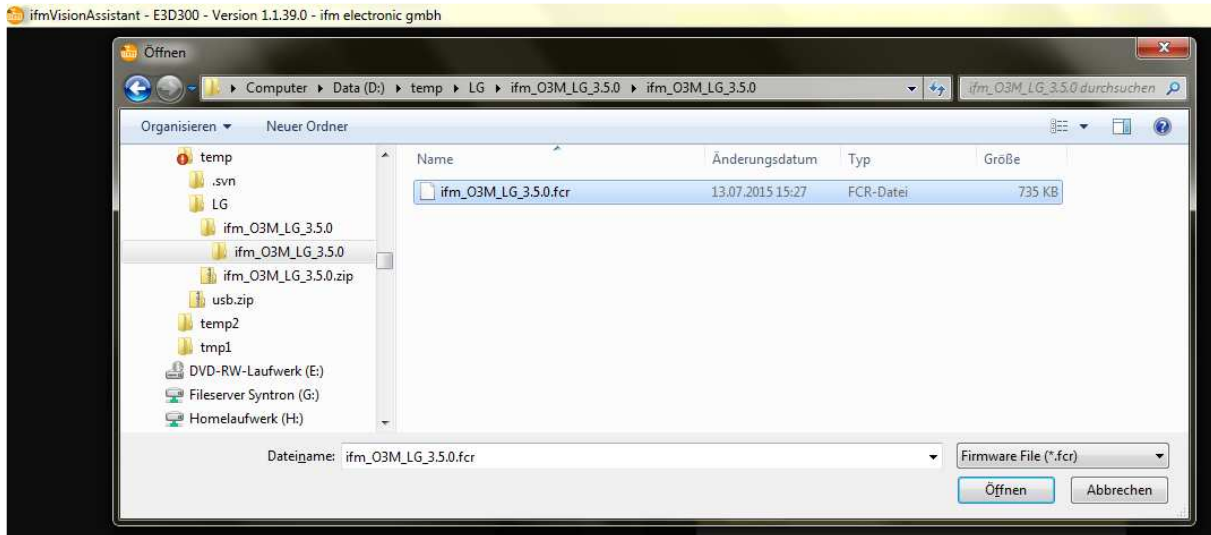


Figure 11: file selection dialog for the firmware

- Select the firmware folder with the downloaded firmware
- Click the *.fcr file
- Click the button „Open“.
- A dialog opens with the hint „starting firmware update“
 - o Please wait, the process needs some time according to the computer configuration
 - o No other applications should be running
- After some time the same screen appears, the process is finished, the function line guidance is active.

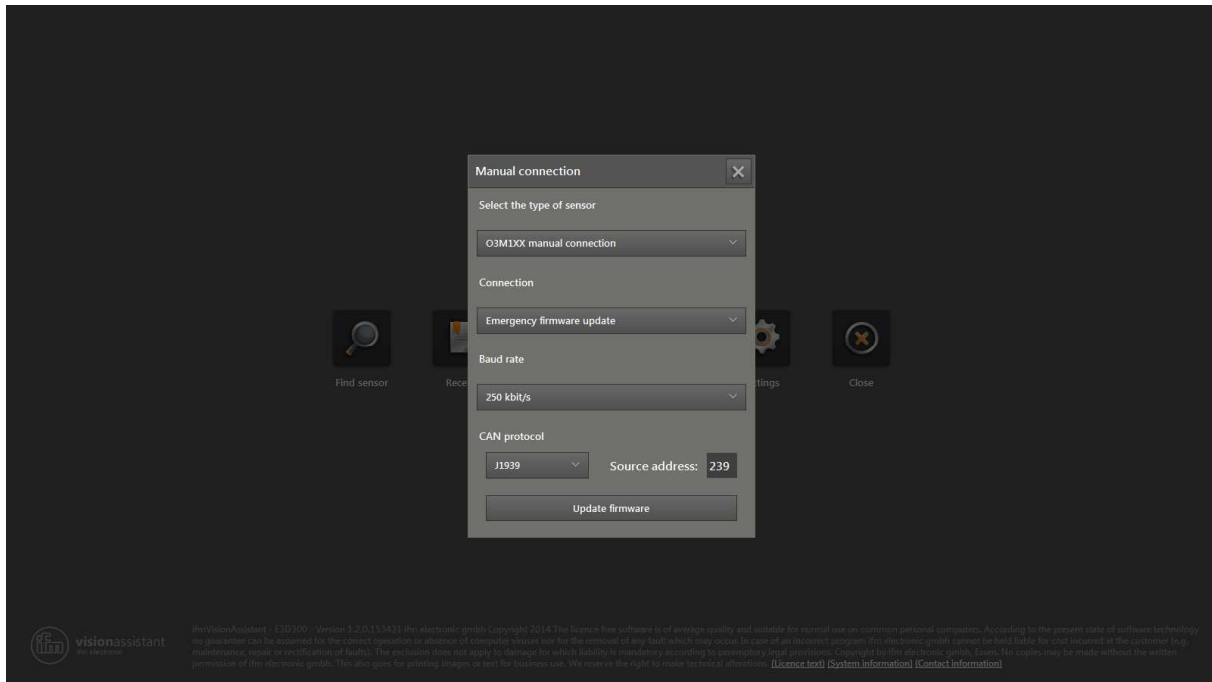


Figure 12: screen after the update of the function

- Close the dialog

The firmware update is finished and the function Line Guidance is available on the sensor.

The O3M151 is measuring and calculating now the function "Line Guidance".

5. Configuration of the sensor

Please see also the document “ifm Vision Assistant User Manual O3M1XX”.

For all following sub chapters it is assumed, that the Vision Assistant was started and connected to the sensor.

5.1 General configuration of the sensor

5.1.1 CAN-Configuration

- Select Device Settings in the left hand menu
- Select CAN setting in the sub menu
- The following screen is displayed:

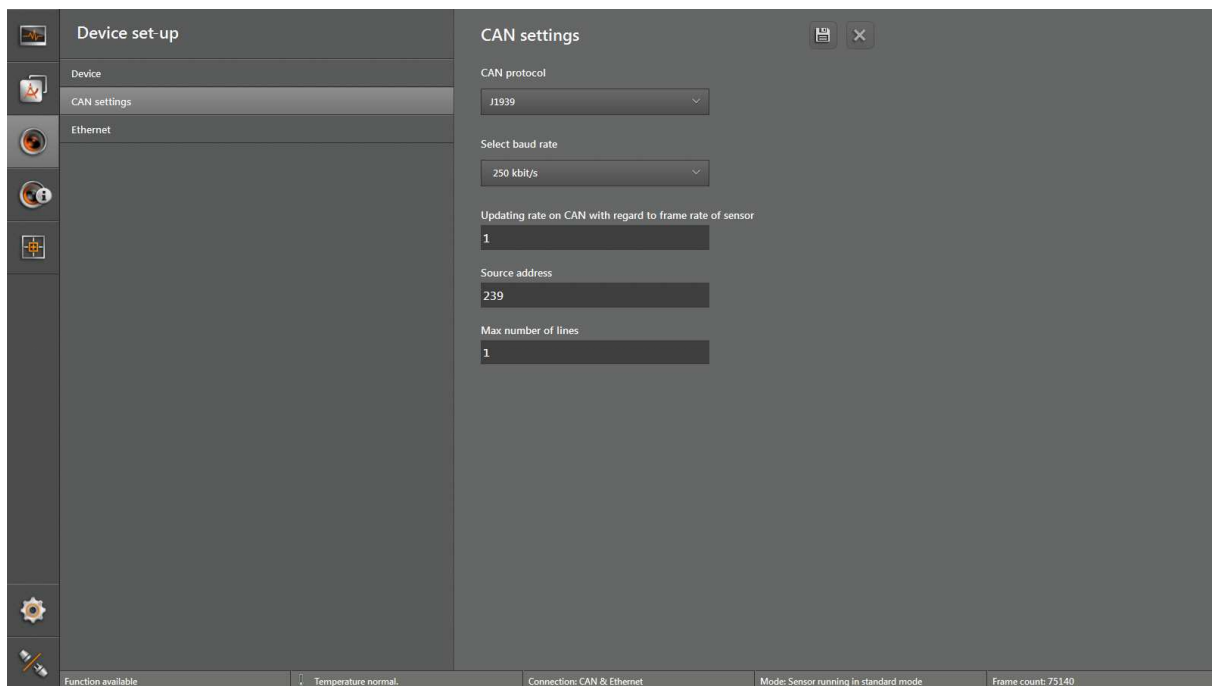


Figure 13: CAN settings

- In this screen the according CAN settings can be set.
- Additionally in this screen the number of lines (Line Guidance), that shall be sent out on CAN by the sensor, can be configured. The Sensor could send out up to max. 2 line objects.

5.1.2 Ethernet configuration

- Select Device Settings in the left hand menu
- Select Ethernet in the sub menu
- The following screen is displayed:

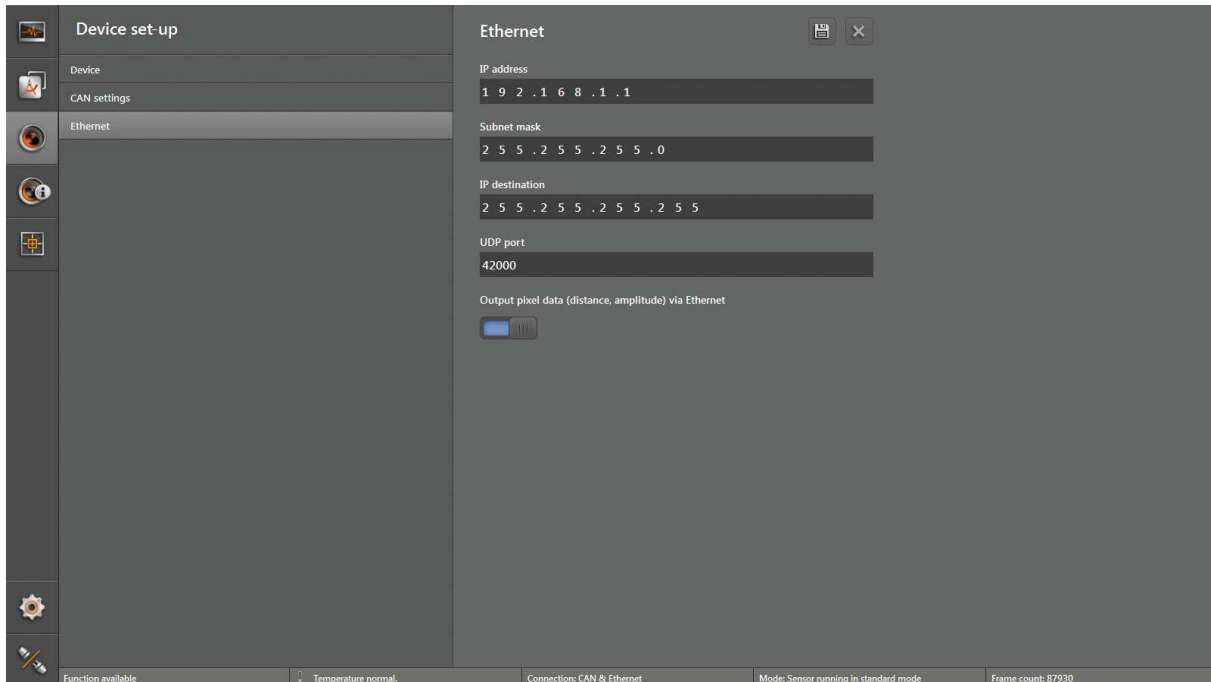


Figure 14: Ethernet settings

- In this screen the according Ethernet settings can be set.
- Additionally the output of the distance and amplitude values can be set to off or on.

5.2 Monitoring of the sensor

- Select monitoring on the left hand side menu
- The current output of the sensor is displayed:

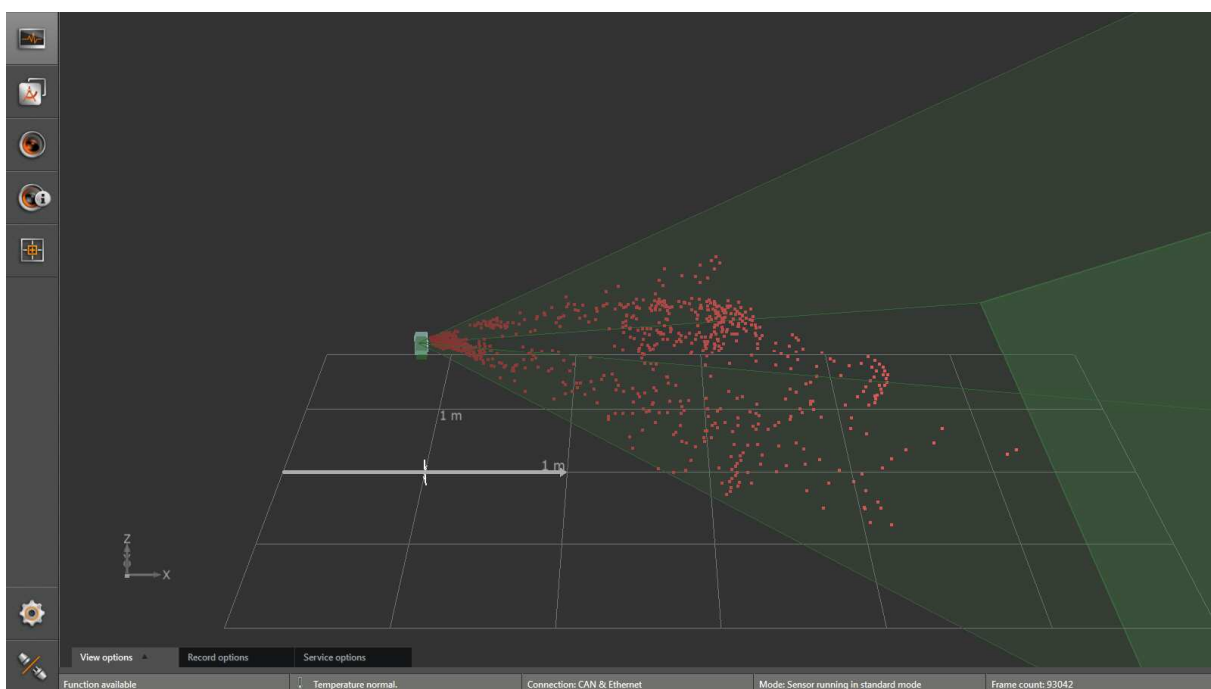


Figure 15: Monitoring the sensor

- Select View Options to change the display
- Select Record options to write the sensor output to a log file
- Select Service options to view or store the current sensor status and error memory

5.3 Configuring the application with the template

After clicking on the left menu on the item “Application”, the Line Guidance Template starts.

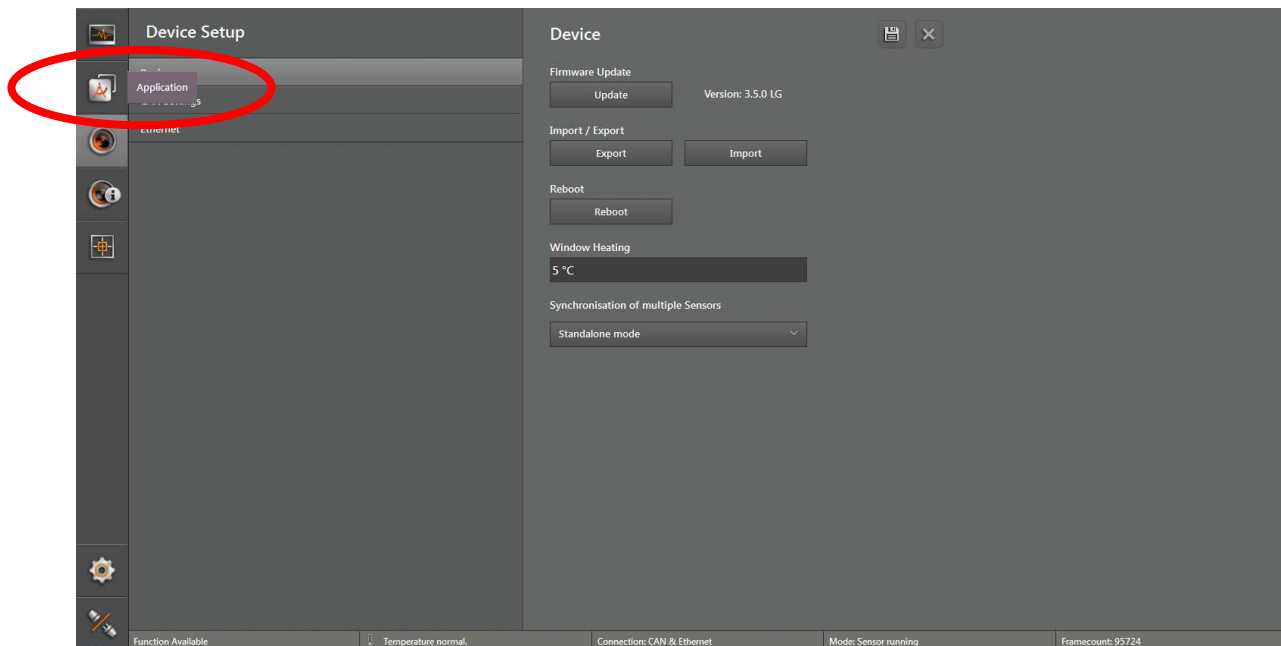


Figure 16: select application

- The screen for choosing the template will be displayed:

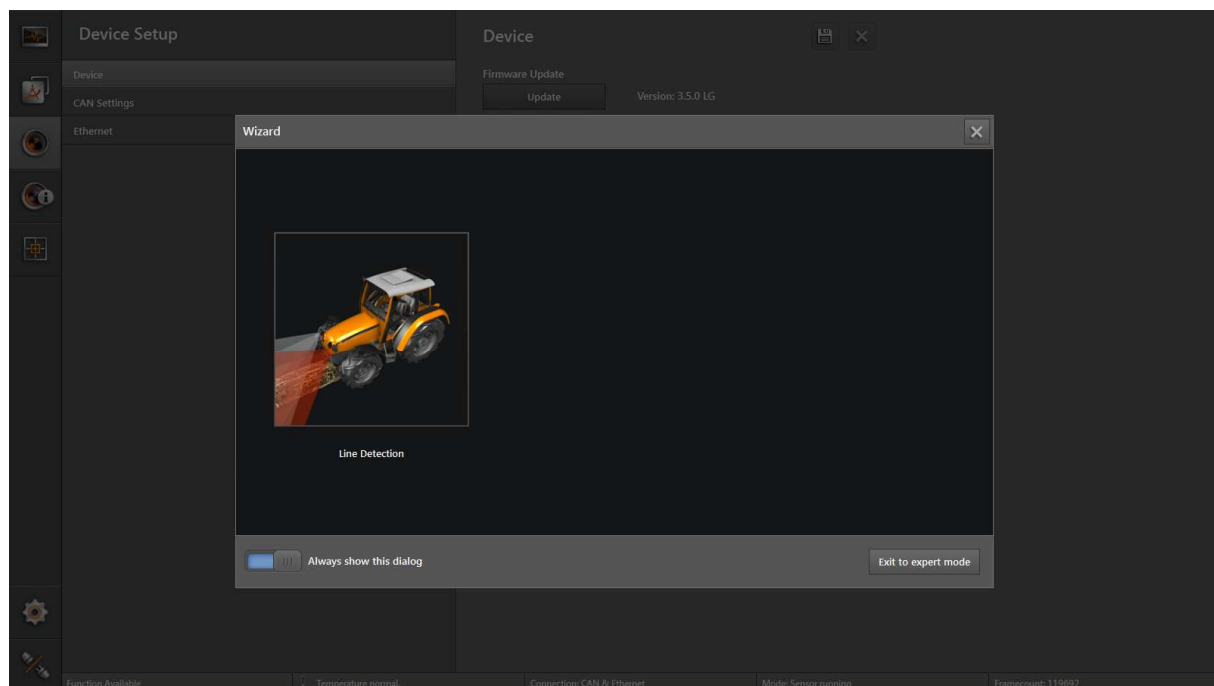


Figure 17: select the template

- Click on the symbol for Line Guidance to start the template:

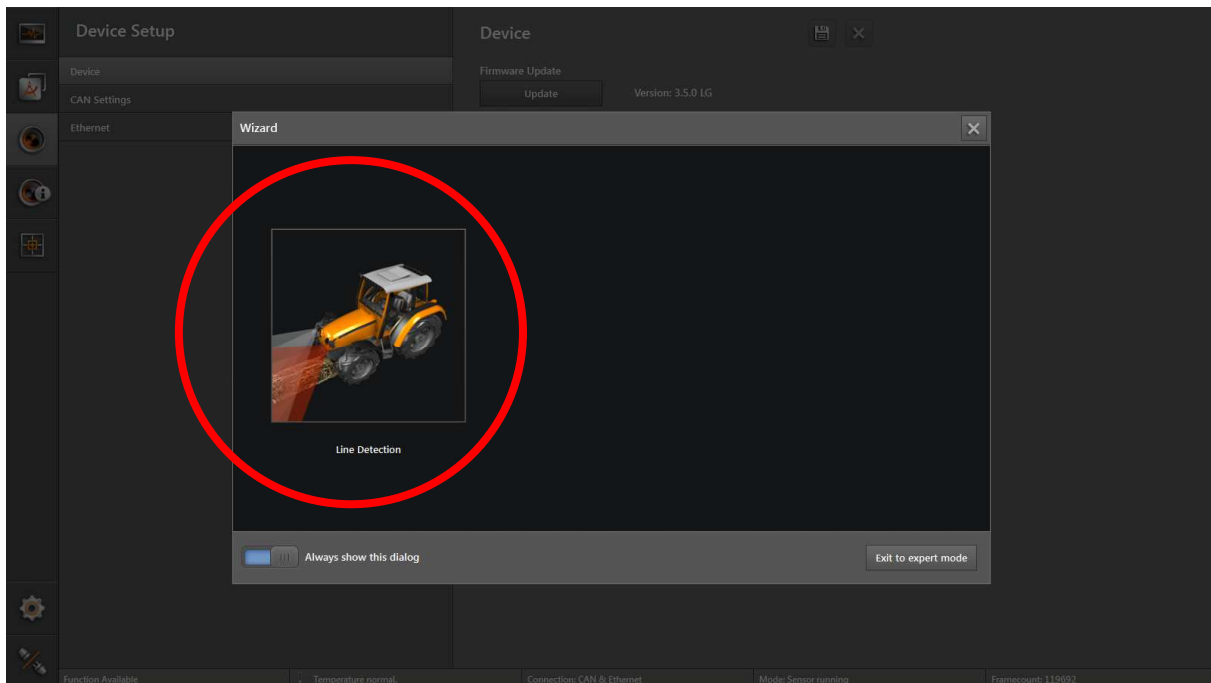


Figure 18: Select the template

- The screen for the Line Guidance template will be displayed:

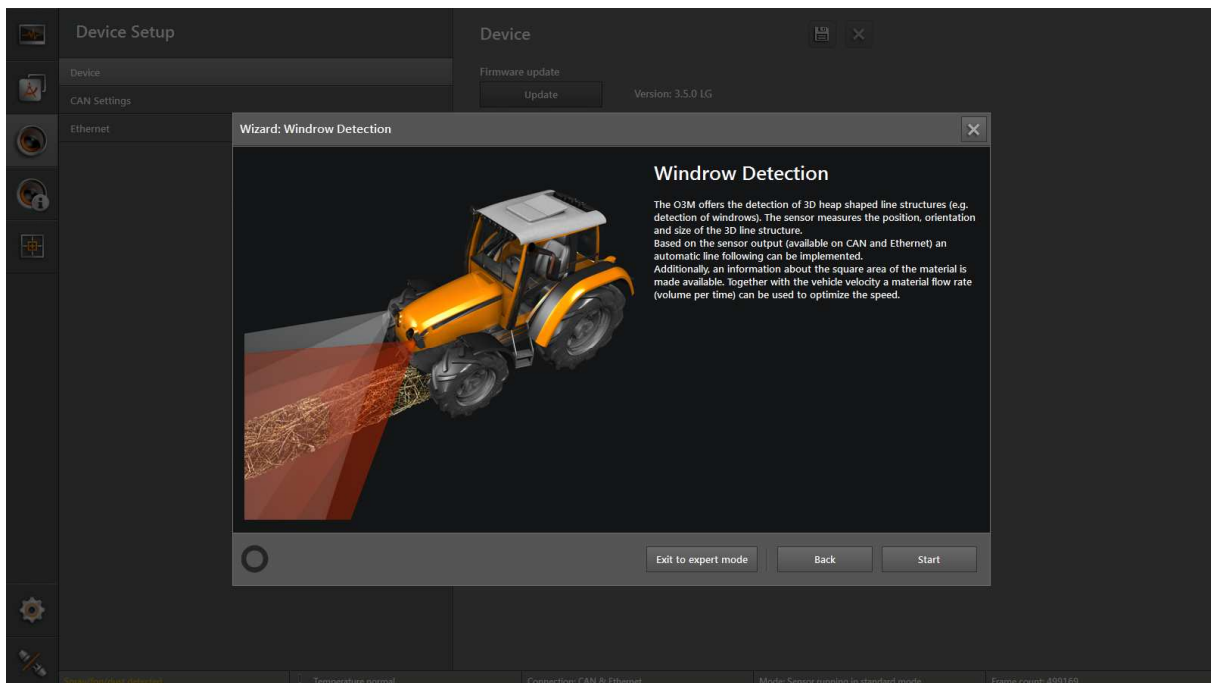


Figure 19: Start of the Line guidance template

- On this screen, some explanations are displayed. Please read carefully.
- The expert mode will be explained below.

- The sensor needs some specifications of the mounting position for correct evaluations. After click on the button "Start", the page for entering the mounting position will be displayed:

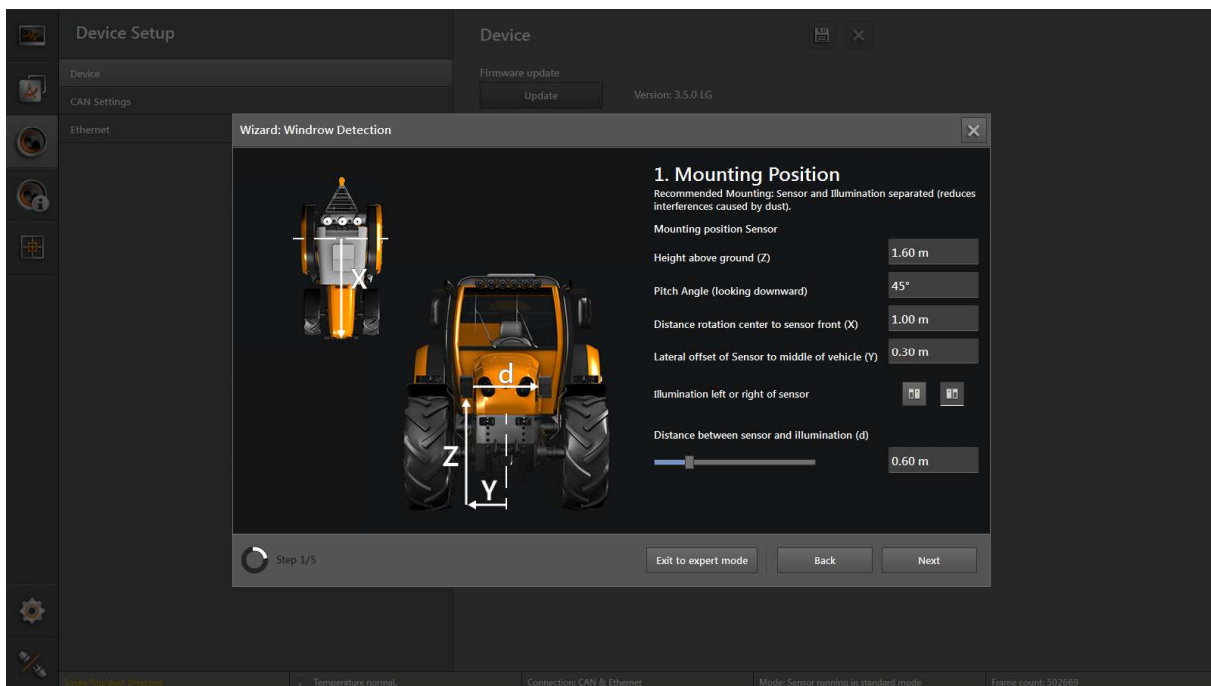


Figure 20: Mounting Position

- On this screen, the following specifications shall be entered:



The illumination is left mounted to the sensor (view from front).



The illumination is right mounted to the sensor.

- In the following input fields, the position of the sensor and illumination will be defined in relation to the world coordinate system. All function results of the sensor are related to the defined coordinate origin. Hence it is recommended to define the origin on the ground (ground plane is $z=0\text{m}$) in the vehicle center ($y=0\text{m}$ is in the center between the tires).
- Input field "Front (x)": distance of the sensor and illumination in driving direction (x-axis, positive values in driving direction) to the origin of the world coordinate system.
- Input field "Height (z)": the mounting height of the sensor and illumination above ground
- Input field "Pitch angle": the inclination or pitch of the sensor and illumination (angle around the y-axis) in Degree
- Input field "side shift (y)": distance of the mounting position of the sensor and illumination to the center of the vehicle. In case the sensor is left of the vehicle center (in view direction of the sensor), then the value is positive, if the sensor is right of the vehicle center, then the value is negative.

- By clicking on the button “next”, the second parameter screen for Verification and Adjustment can be reached. The current values will be downloaded to the sensor.
The fine adjustment of the mounting position is needed for ideal function evaluation.

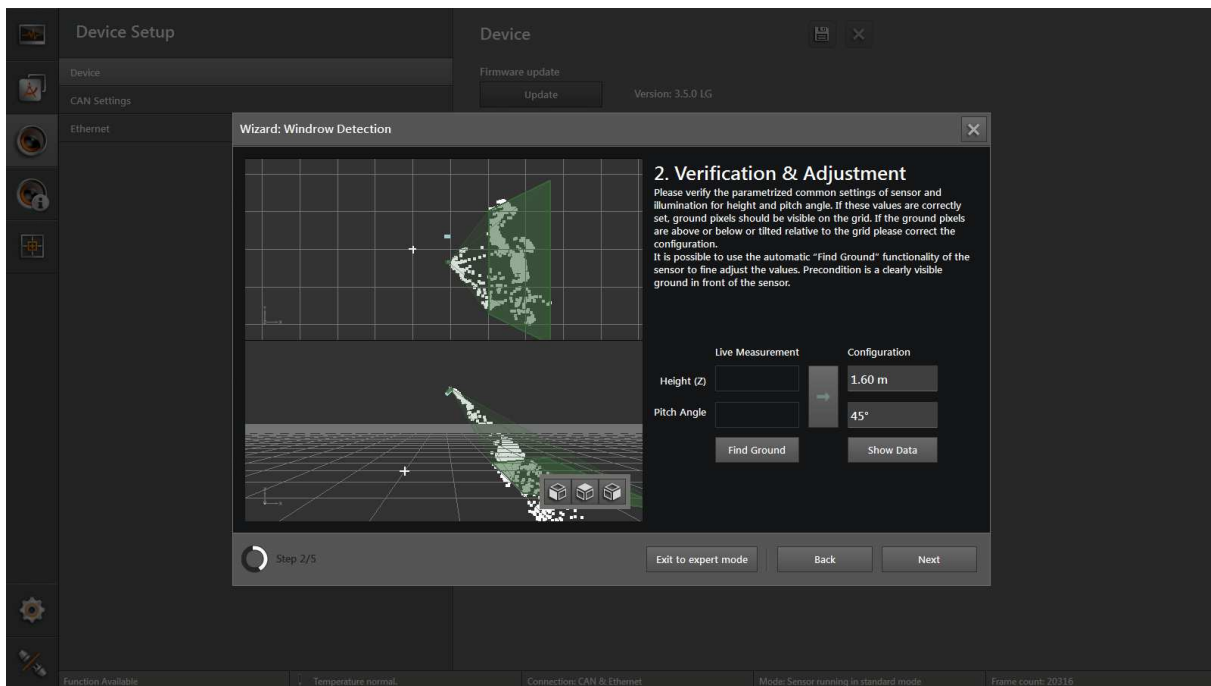


Figure 21: Verification and Adjustment

- With the verification and adjustment dialog the current settings can be checked by the sensor and semi-automated be corrected.

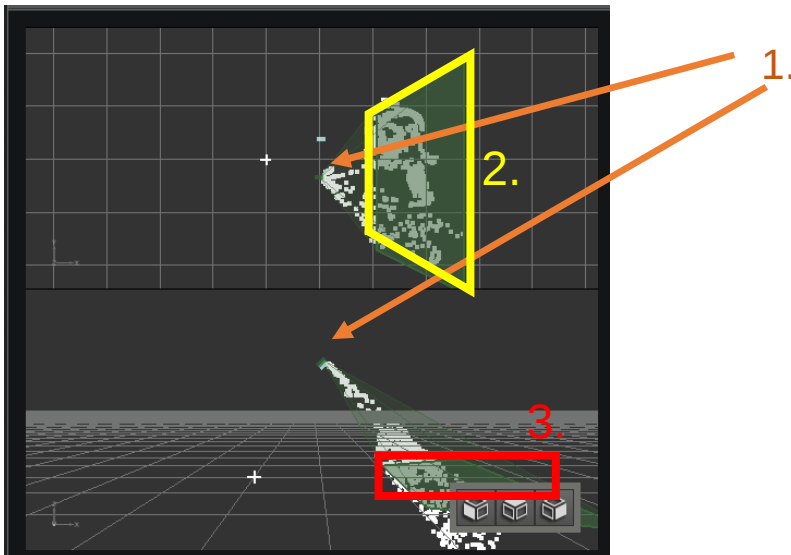


Figure 22: Monitoring the dynamic Compensation

- The vision assistant displays the measuring results of the sensor in the monitoring screen.
- There is a small box to show the position of the sensor (1.). The direction of view of the sensor is illustrated by outgoing green lines.
- The upper chart is a top view of the sensor and its mounting position. The intersection of the sensor view with the ground is displayed by the green field (2.). The white pixels represent measured 3D distances.

- The lower chart is another view of the sensor and its field of view. The intersection of the sensor view with the ground is displayed by the green field (3.). The view to this scene can be changed by pressing the dices or moving with a pressed left mouse button.



The scene chart changes to front view (left button), to top down view (center button) and to left view (right button).

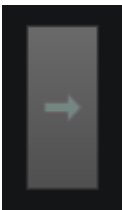
- With the button „Find Ground“, the mounting position and the pitch angle can be readjusted by the sensor by measuring the ground plane. The ground should be free of obstacles and be plane. When pressing the button “Find Ground“, the sensor starts an automated ground plane measurement for ca. 1 minute. The Vision Assistant shows during this time a wait symbol. After finishing the measurement, an according dialog will be shown. If no successful measurement is possible, then it is recommended to perform the measurement on another, dry ground or in the shadow.

Live Measurement

Height Z

Pitch Angle

The measurement result will be shown below the Label „Live Measurement“



If the measurement result is correct and shall be used, press the button with the right arrow.

Configuration

1.60 m

25°

The measurement result for ground detection will be transferred in the fields below the label “Configuration”.

Show Data

The values of the fields “Configuration” will be transferred and stored in the sensor by clicking on the button „Show Data“. Subsequently the measurements will be evaluated live with the new configuration and shows the data according to the new configuration.

- The next screen for the configuration of the 3D line structure will be opened with a click on the button „Next“.

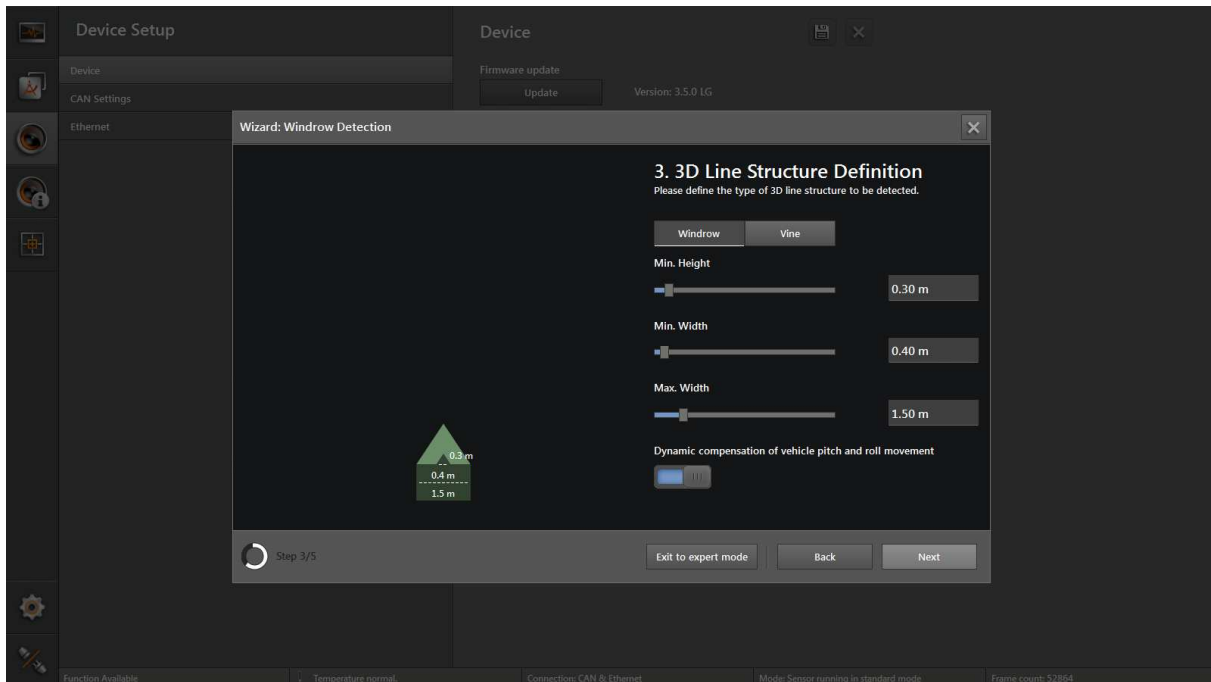
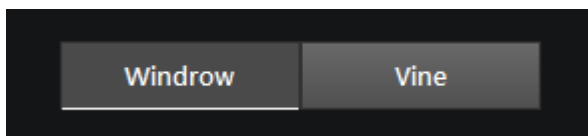
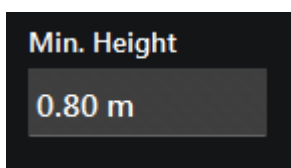


Figure 23:3D line structure definition

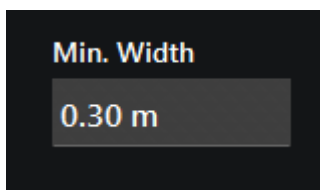
- The specifications of the expected and to be detected structures are entered on this screen.



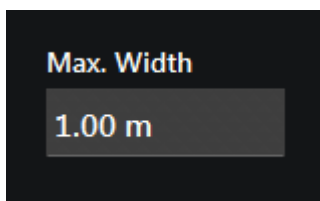
The default parametrization for „Windrow“ detection or „Vine“ detection will be selected by clicking one of these buttons. The first selection (Windrow) denotes a heap like or swath like 3D line structure, the second selection (Vine) is a narrow but high (grape vine) 3D line structure.



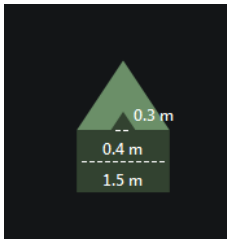
The minimum expected, to be detected height will be defined in the field „Min. Height“. Lower line objects will not be detected and not emitted.



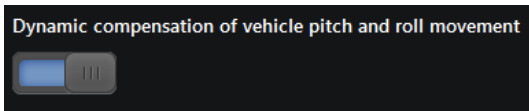
The narrowest line object to be detected, is entered in the field “Min. Width”.



The widest line object to be detected, is entered in the field “Max. Width”.



The info graphics shows the entered proportions.



Switches on or off the dynamic compensation that will be evaluated online at measurement time.

- The screen "RIO Definition" will be shown after click on the button "Next". "ROI" is the region of interest, the selected field of view, where the sensor will search for line objects as defined.

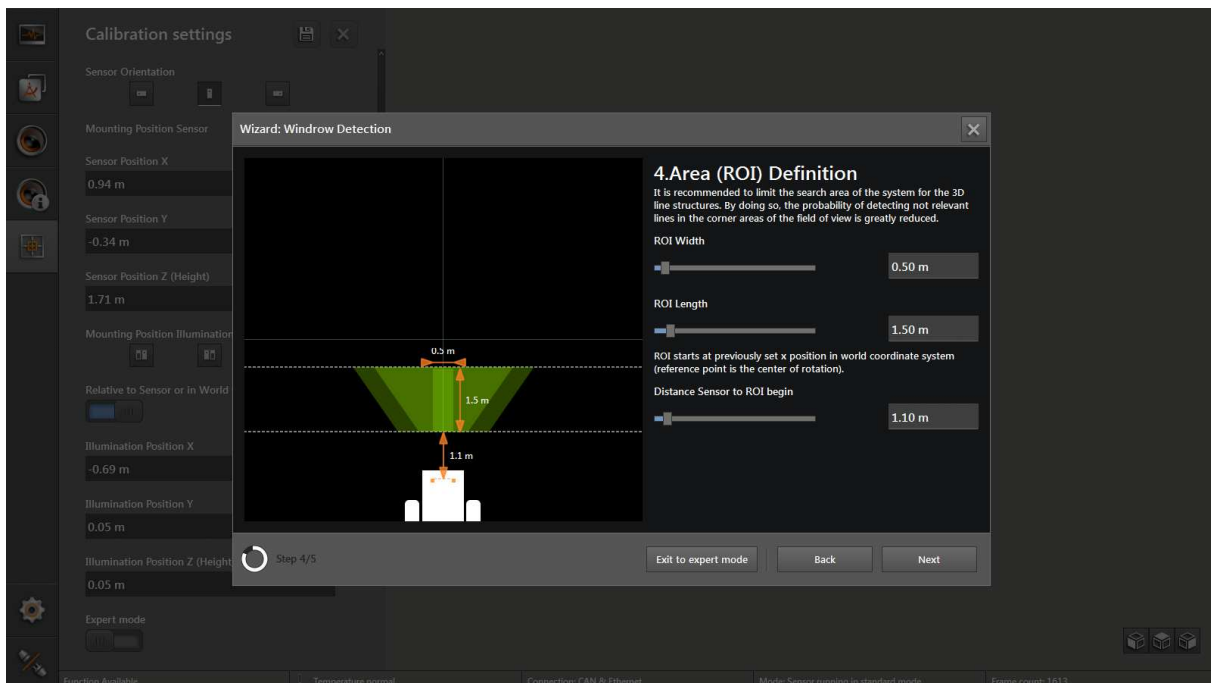


Figure 24: ROI definition screen

- The settings for the ROI definition will be visualized in the graphics on the left. The triangular regions denote the field of view of the sensor and the illumination. See also below.

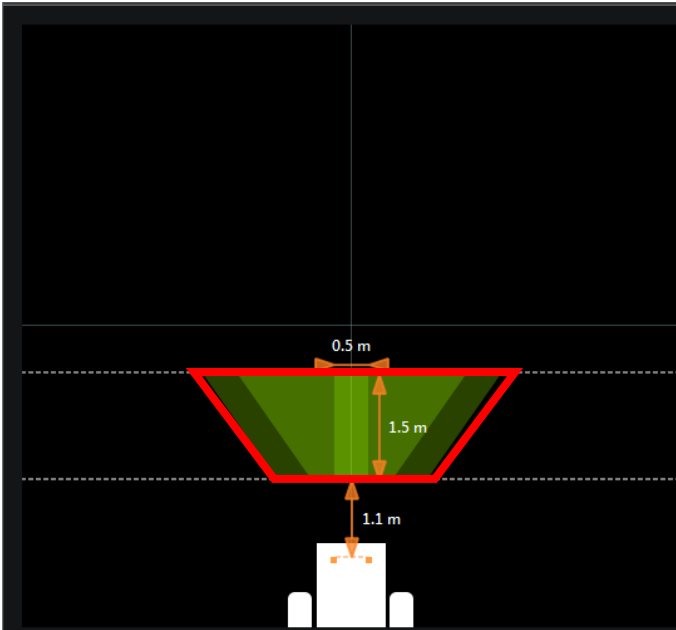


Figure 25: Field of View

- Green trapezoid: intersection of the field of view of the sensor and the ground.

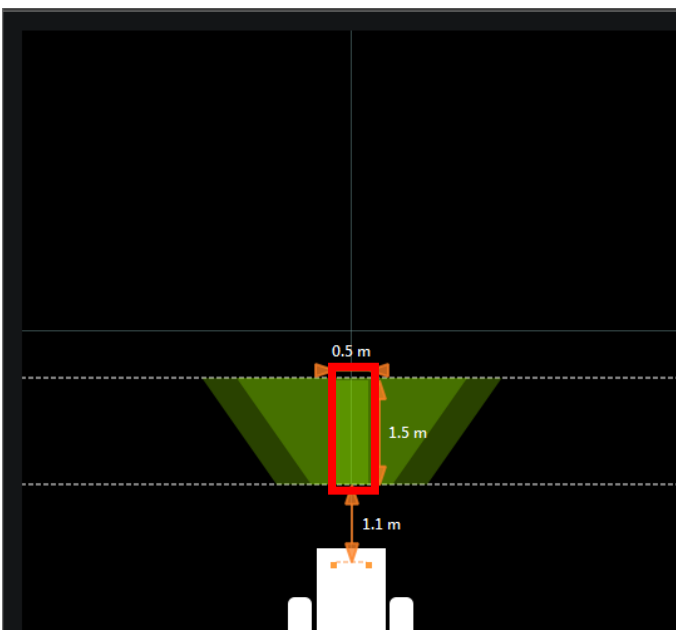


Figure 26: Defined ROI

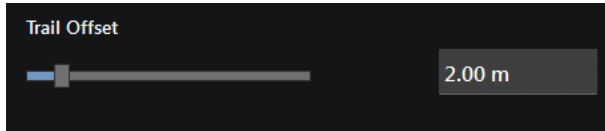
- Green rectangle: defined ROI, region for the evaluation of the line guidance function.
- If the values of the definition of the ROI are changed then the according proportions will be updated and displayed



The width of the ROI can be adjusted with the slider or by direct entering.



The length (in driving direction) of the ROI can be adjusted with the slider or by direct entering.



The distance of the ROI in front of the vehicle can be adjusted.

- The settings will be finished with the button “Next”, the completion screen will be displayed:

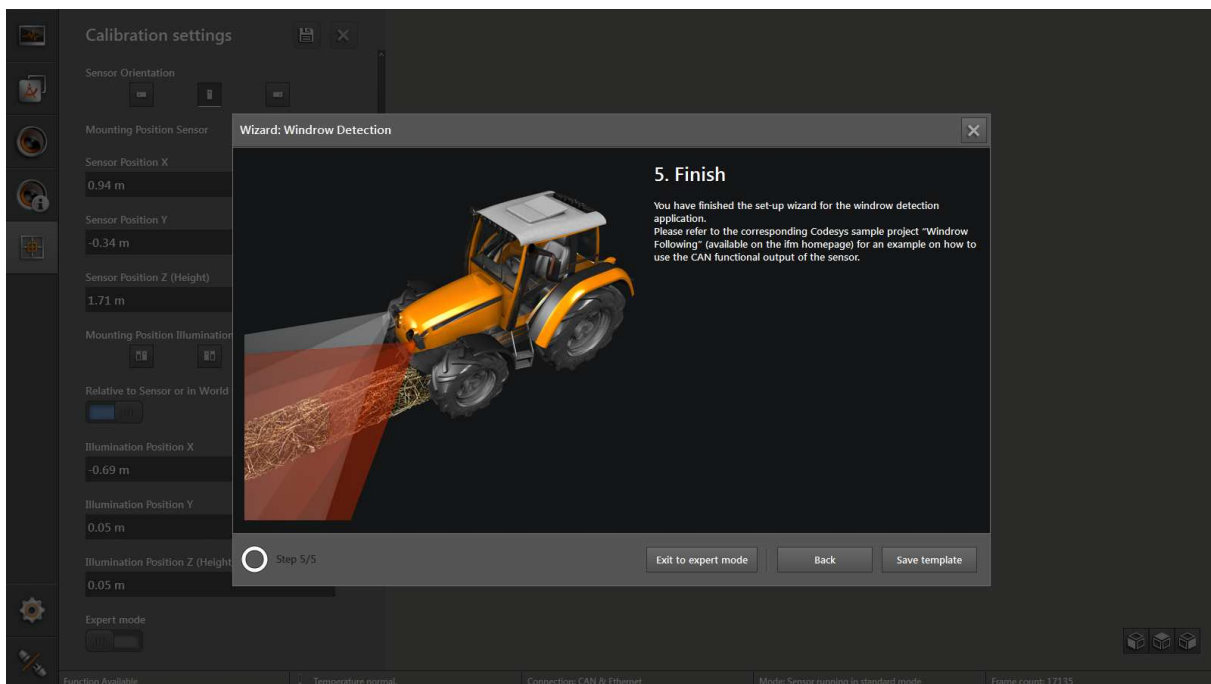


Figure 27: Finished with the template

- The final screen is displayed.
- The settings will be stored in the sensor with click on the button “Save Template”. This procedure will take some time according the speed of the computer.

The specification of the parameters with the Line Guidance template is finished.

5.4 Expert Mode

At any time in the template, the expert settings can be reached with the button “Exit to Expert mode”. This way the detailed individual values can be entered.

Because there are many values in the expert mode and none of the default settings of the template are available, this expert mode could lead in undesired results and is recommended only for experiences users.

- The screen for the expert mode is divided into the following three parts:

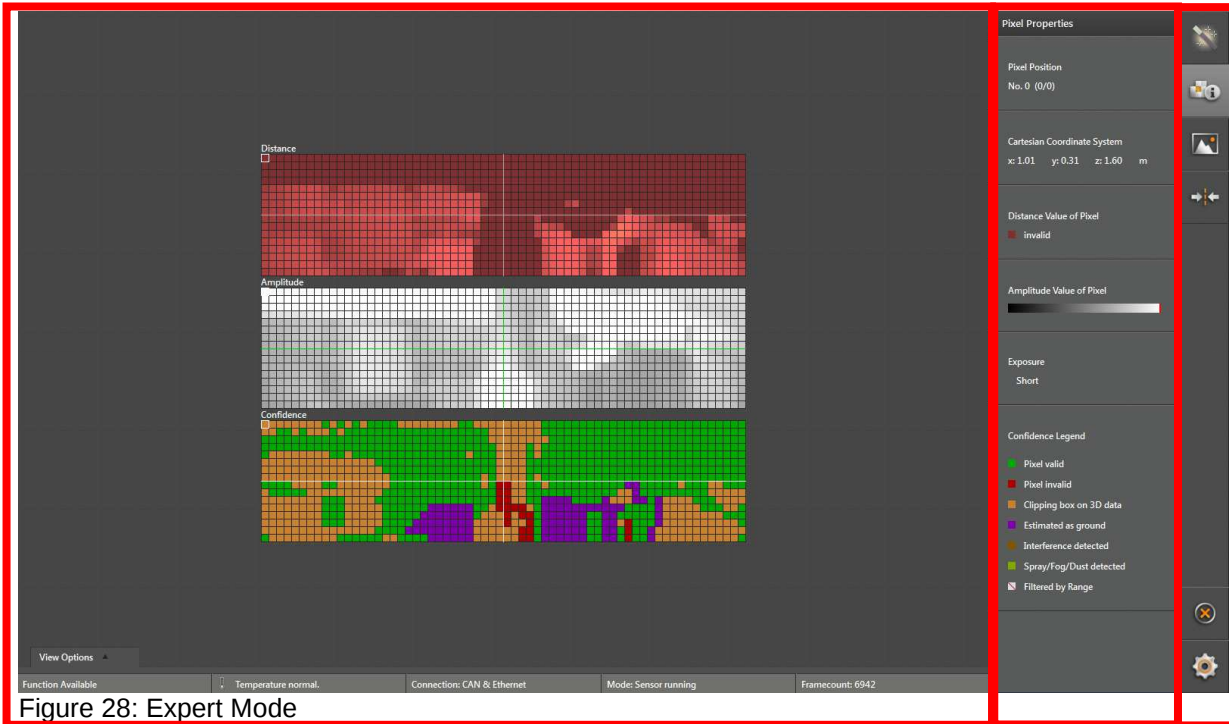


Figure 28: Expert Mode

Left handed is the 2D monitoring view, center right is the detailed view, right is the menu.

5.4.1 2D Monitor view and pixel properties

- In the right handed menu click on the item pixel properties to monitor the sensor output. This can be used to observe the effects of settings as described in the chapter “Line Guidance settings”.

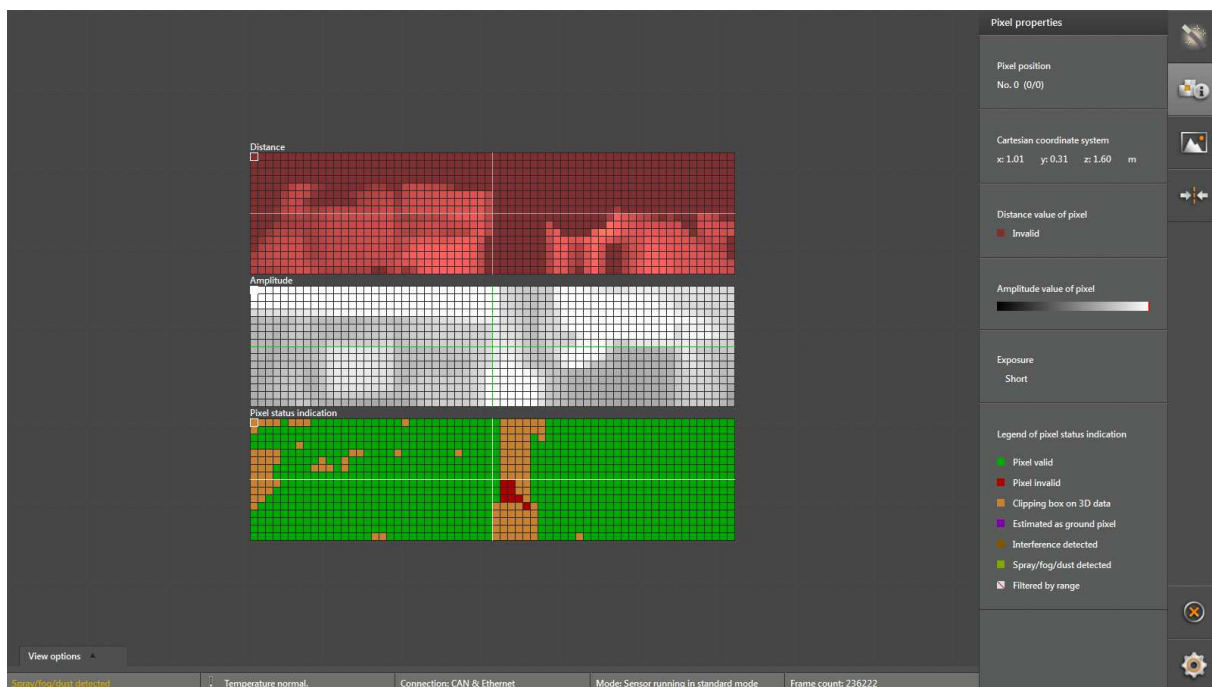


Figure 29: Pixel properties view

- All the pixel information of the sensor is displayed in the monitoring view. For details of the marked pixel, see in the detailed view. By clicking on a pixel, the details of this pixel can be displayed.

- On the left bottom by clicking on the View Options tab, additional settings for the presentation of the matrices can be displayed:

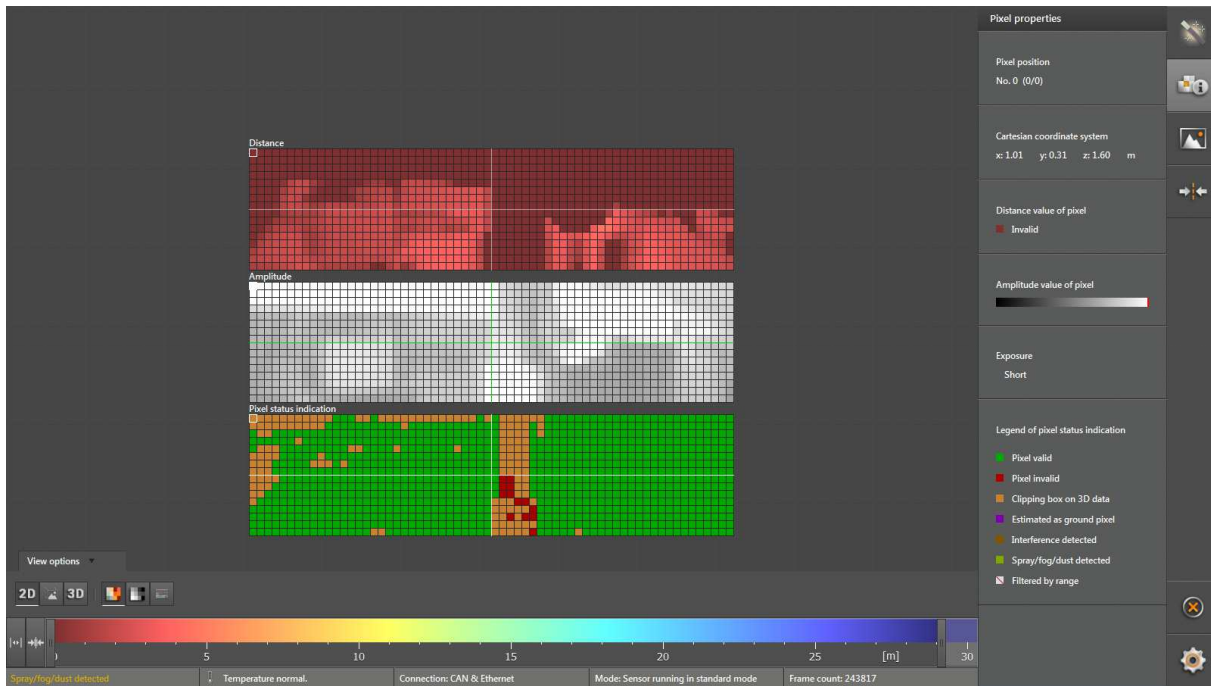


Figure 30: 2D view options

- This is an example for a selected Pixel:

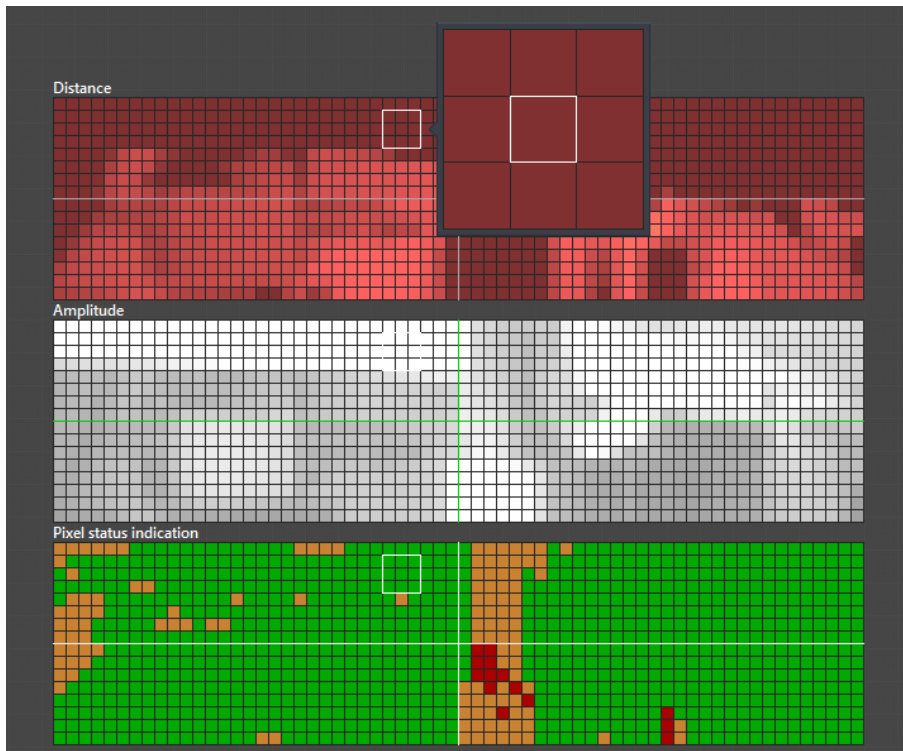


Figure 31: selected Pixel in the 2D presentation

- By clicking the 3D button, additional options for the 3D presentation are available:

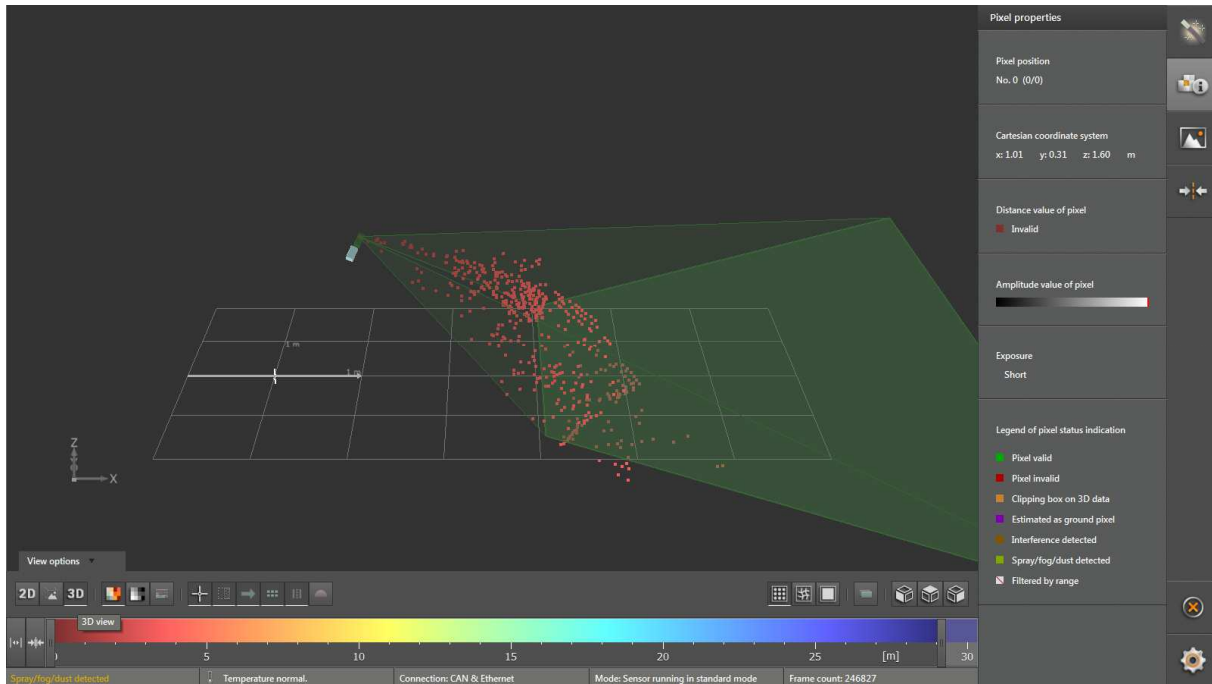


Figure 32: 3D view options

5.4.2 Image settings

- To improve the line detection, there are some image filter settings that can be adjusted in the “Image Settings sub menu”. These are filters and functions that are calculated by the sensor in real time and online:

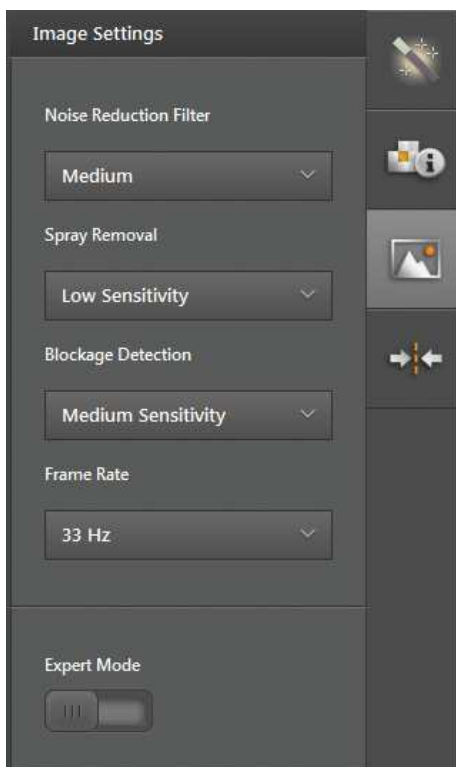


Figure 33: Image Settings sub menu

- Noise reduction filter: evaluates an averaging over consecutive images. This can improve the quality of the sensor function in case of “nervous” images.
- Spray/fog/dust detection: there are different sensitivities for detection of these disturbances. Select low sensitivity if the detection disturbs the application, select high sensitivity if the application relies on safely detection of lines.
- Blockage detection: Select low sensitivity if the detection disturbs the application, select high sensitivity if the application relies on safely detection of lines.
- Frame rate: The higher the speed of the vehicle, the higher should be the frame rate. If hot environment or lot of sun radiation is expected, then a lower frame rate could compensate this.
- Show advances parameters: enables further settings. See below.

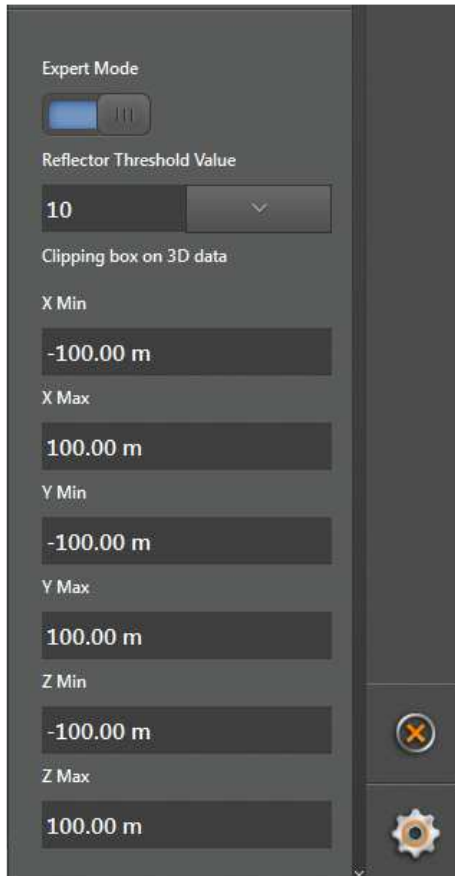


Figure 34: Expert Mode of the image settings menu

- Reflector Threshold Value: defines, which objects will be detected as reflective objects.
- Clipping box on 3D data: defines a box for detecting and emitting objects. Positive values for X are in front of the vehicle, Positive values for Y are to the left of the vehicle, positive values for Z are above the ground.

5.4.3 Line Guidance settings



Choose the menu item “line Guidance” parameters. Selecting this item, the expert parameters and the expert view for Line Guidance are available.

Line Guidance

Max angle to driving direction



0°

Minimum height of windrow

0.80 m

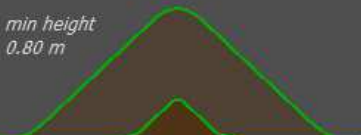
Minimum width of windrow

0.30 m

Maximum width of windrow

1.00 m

min height 0.80 m



min width 0.30 m

max width 1.00 m

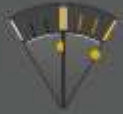
Expert Mode



Detailed settings can be adjusted in the detailed view for the Line Guidance.

These will be described in the following steps:

Max angle to driving direction



0°

Line like objects will be detected and emitted only until a certain angle. Objects with a larger angle across to the driving direction or direction of view, will not be detected as relevant objects. This feature avoids the wrong detection of not relevant line objects.

Minimum height of windrow

0.80 m

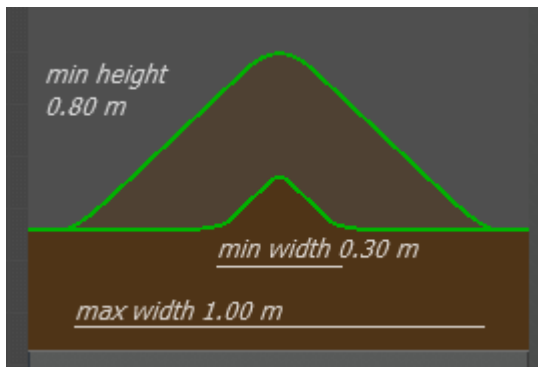
Minimum width of windrow

0.30 m

Maximum width of windrow

1.00 m

Settings for height and width of the relevant objects, see above.



Symbolic presentation of the setting of the height and width of the objects. The graph will change according to the settings for the height and width.

Expert Mode

☐

Additional parameter values are suppressed. Additional parameter values can be displayed and set by clicking on the slider. Maybe not all parameters are shown. In this case the window can be moved with the scroll bar at the right side.

Expert Mode

☒

All parameters are displayed and can be adjusted.

Ground plane Detection

☒

The ground detection can be turned on and off by clicking on the slider. Here, in this case the ground detection is turned on.

Search area for line detection

Minimum in x-direction (in front)

0.40 m

Maximum in x-direction (in front)

2.40 m

Minimum in y-direction (left)

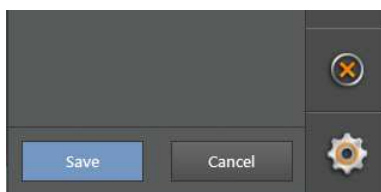
-2.00 m

Maximum in y-direction (right)

2.00 m

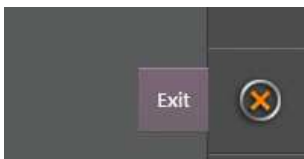
The view port, within that the sensor will evaluate and emit line objects, can be adjusted in this fields. See also the template, step "ROI Definition".

- The following parameters can be adjusted:
 - Field "Minimum in x-direction": in the direction of view, the beginning of the ROI. Negative values mean that the beginning of the ROI is behind the front of the vehicle.
 - Field "Maximum in x-direction": In the direction of view, the remote end of the ROI. Must be larger than the "Minimum in x-direction".
 - Field "Minimum in y-direction": In the direction of view, the "left border" of the ROI. Negative values mean that the left border is on the right from the center of the view.
 - Field "Maximum in y-direction": in the direction of view the "Right border" of the ROI. Must be larger than the "Minimum in y-direction". Positive values mean that the right border is left of the center of view.
- If any value of the parameters in the expert mode is changed, then a save button and cancel button will appear at the buttom of the detailes view:



Pressing save will store the current values of the parameters on the sensor.

- Clicking the cancel button will dismiss all values, restore all former values and will not store any value on the sensor. The application stays in the expert mode.



At the bottom of the menu bar is the exit button. When exiting the expert mode, all changes that were not saved, will be lost. The user is transferred back to the main menu.

Further settings might be added to the expert menu as needed and for the user convenience with or without explicit notice.

6. Preliminary note for the CODESYS sample project “Windrow following”

This sample project

- help to establish the communication between an O3M151 smart sensor and an ifm controller via the integrated CAN J1939 interface
- Describes the use of the sample CodeSys project program.

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- (d) the software will be compatible with third party software;
- (e) any errors in the software will be corrected

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7. General introduction to the sample project

In agriculture business some machines like hay balers need to be driven precisely over a windrow. In order to automate this task, the O3M151 with embedded function called "Line Guidance" is used. With this function on the O3M it is possible to detect and measure 3D line like structures. The sensor will calculate an offset at a parameterised position (e.g. middle of vehicle front) and an offset to the driving direction. In addition, the projected area of the 3D structure is given out and can be used to calculate a volume on the controller, if the vehicle velocity is available. With this information the vehicle speed can be optimized for picking-up always the right volume in the hay baler.

O3M151 camera with "Line Guidance" functionality can be used to measure & detect 3D line like structures in agricultural machines, earth moving machines and other fixed or moving machinery.

The example uses an O3M151 along with an ifm controller.
It is a driver assistant application.

7.1 "Windrow following" application details

A hay baler machine is used to prepare bales of crop. As of now, amongst other controlling tasks, driver also need to regulate the vehicle speed, so that a right volume is picked up in the hay baler. This application detects windrows automatically. Also it provides positional and dimensional details of selected windrow. Using this information driver can follow selected windrow and optimize the vehicle speed depending on the windrow dimensions.

Conventions followed:

- For camera, the world coordinate system is as following
 - o Positive Z-axis is pointing upward
 - o Positive Y-axis is pointing towards the left
 - o Positive X-axis is pointing in driving direction.
- Reference point – The origin point of camera projected on ground. Shown as red circle in visualisations.
- Driving direction – Driving direction of vehicle.
- The windrows are detected as lines by camera. So "line" word symbolises a "windrow".

Inputs configurable by user:

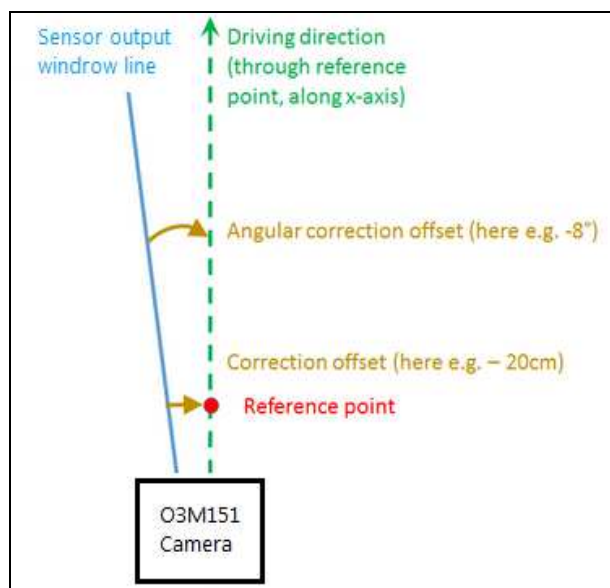


Figure 35. Description of offsets

- o Sensor configuration parameters (via ifmVisionAssistant software)
- o Sensor calibration parameters.

- Correction offset
- Angular correction offset

These values can be manually entered by user from GUI or can be automatically calculated during teach mode.

Refer Figure 35 **Fehler! Verweisquelle konnte nicht gefunden werden.** for this.

- o Amongst windrows seen by camera, user can select windrow that he/she wants to follow.
- o Start/stop teach process.
- o Adapt system to taught parameters.
- o Switching between teach, monitor and settings mode.

Outputs available to user:

Note: Please refer Figure 40 for the snapshot of GUI, showing outputs of controller.

- Sensor availability status, printed as text on display.
 - o Sensor running - Sensor is up and running.
 - o Sensor not available - Sensor is not available. User should check that camera connections are correct and camera is powered on.
- Last teach status, printed as text on display.
 - o TEACH ABORTED – Teach is aborted.
 - o COMPLETED – Teach is successful.
 - o IN PROGRESS – Application is in process of teaching values.
- Virtual grid showing windrows as lines. The lines simulate the orientation and positioning actual of windrow as seen by camera.
- Following details for selected windrow.
 - o Detection status of active line in current frame [as text]:
 - Line detected: Windrow detected
 - No line detected : Windrow not detected
 - o Selection mode of windrow [as text]:
 - Line chosen by user: User has made the selection of windrow.
 - Line not chosen by user: Application has automatically selected first windrow available in the CAN message.
 - o Area of cross section of heap structure [in m²]
 - o MFR [in m³ / s]: Volumetric flow rate.
Calculated as "Area of cross section * vehicle velocity".
 - o The corrected offset to the reference point [in cm].
 - o The corrected angular offset to the reference point [in degrees]
 - o The width of the heap structure [in cm]
 - o The maximum height of the heap structure [in cm]
 - o The speed of vehicle [in m/s]
 - o Required direction of steer (shown by blinking arrows).

7.2 Assumptions

- The camera is mounted facing towards driving direction of vehicle.
- User knows how to install and use CAN-to-USB cable for debugging purposes in codesys.
- All the other assumptions of O3M151 LG variant are fulfilled.

7.3 Supported hardware

Following ifm controllers are supported

- CR1200
- CR1201

7.4 Restrictions

- This application takes user input via push buttons on CR120x controller only. Tactile input is not allowed in this application.

- Auto-steering for vehicle is not supported currently, but code can be easily extended for same.
- This is a driver assistant application and not a safety application.
- At a time application can be running in only one out of three modes (teach, monitoring or settings mode).
- Only windrows having detection quality of 60% or above are processed.
- Once the end of selected windrow is reached, the tracking of windrow will be stopped.
- The CAN specific parameters of the IO ports "CAN_Channel", "CAN_Baudrate" cannot be changed during the run time.

7.5 Prerequisites

7.5.1 Software prerequisites

Required

- PC with Codesys 2.3 installed in it. (to flash and debug "Windrow following" application)

8. Setup Procedure for the sample project

8.1 Setting up camera

See chapter “Step by step setup guidelines” and following.

8.2 Setting up ifm display controller

8.2.1 Installing CodeSys 2.3.xxx

Install Codesys 2.3.xx software to the PC.

For details on how to install CodeSys, please refer

www.codesys.com.

After successful installation, “CodeSys 2.3” IDE is seen amongst the installed programs, as shown in below figure

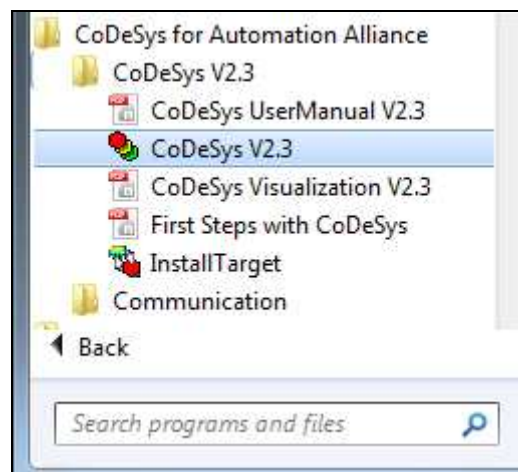


Figure 36. List of programs showing installed CodeSys software

8.2.2 Hardware Setup

1. To know basic installation process of display controller, refer following link.
This will help to get head start with remaining installation configurations.
www.ifm.com > select your country > [Data sheet search] > (ifm display controller part number) > [Operating instructions] > [Installing instructions].
2. Connect the power supply port of controller to the power supply.
3. Power on the controller.
Connect the ethernet cable from ethernet port of controller to LAN card of your PC.
Configure the IP settings of controller so that it is accessible by PC.
For e.g. if settings of PC's LAN card are as follows:
IP address : 192.168.0.5
Subnet Mask : 255.255.255.0
Gateway : 192.168.0.201

Then set the Ethernet configuration of display controller as following:

IP address : 192.168.0.10
Subnet Mask : 255.255.255.0
Gateway : 192.168.0.201
Save the settings to the controller.
Restart the controller.

Note: Make sure that the ip address of PC LAN card and the display controller are different and on the same subnet.

Hint: One way to ensure that controller is accessible by PC is to ping the ip address of controller using command prompt.

4. Currently application code is configured with following CAN settings:
 CAN channel: 1.
 CAN baud rate: 250
 So ensure controller is running at CAN baud rate 250 kbps and CAN channel 1 port is connected to CAN bus.

8.2.3 Downloading "Windrow Following" application to controller

1. Open the application codesys code on PC, using codesys 2.3 software.

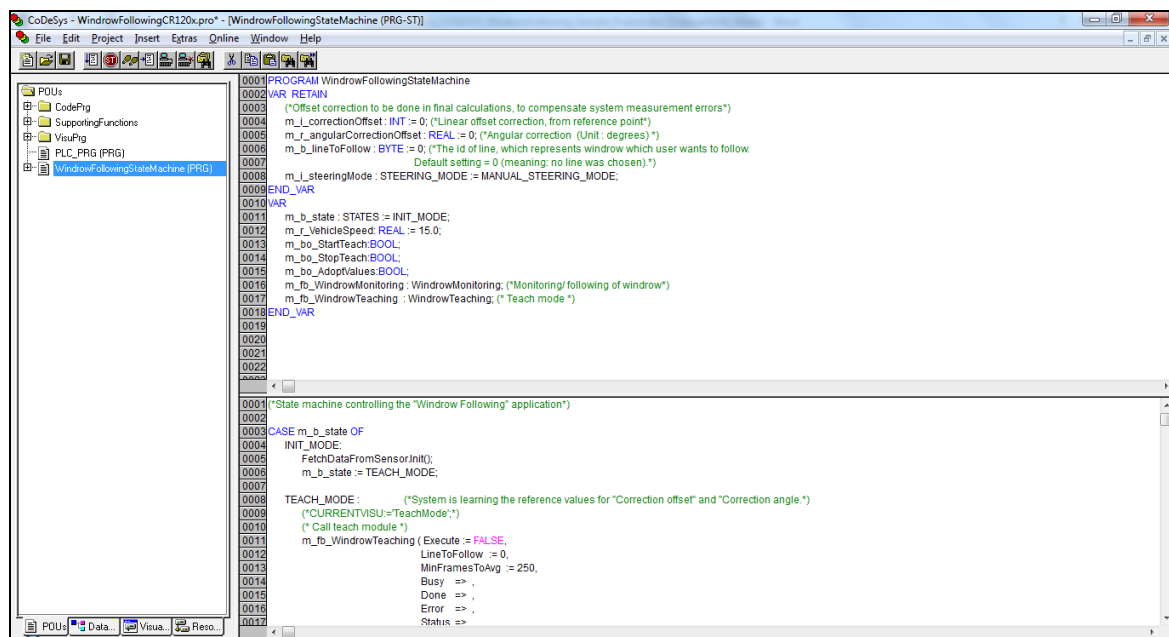
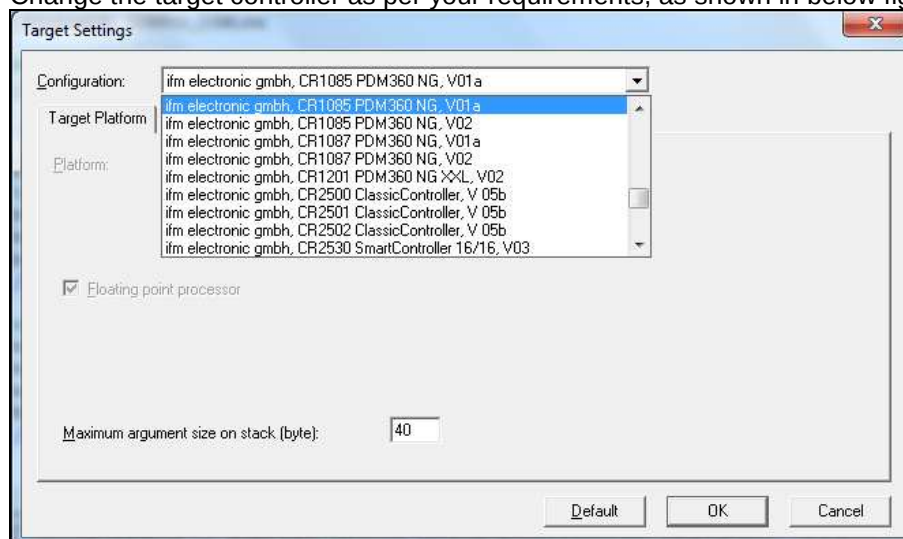
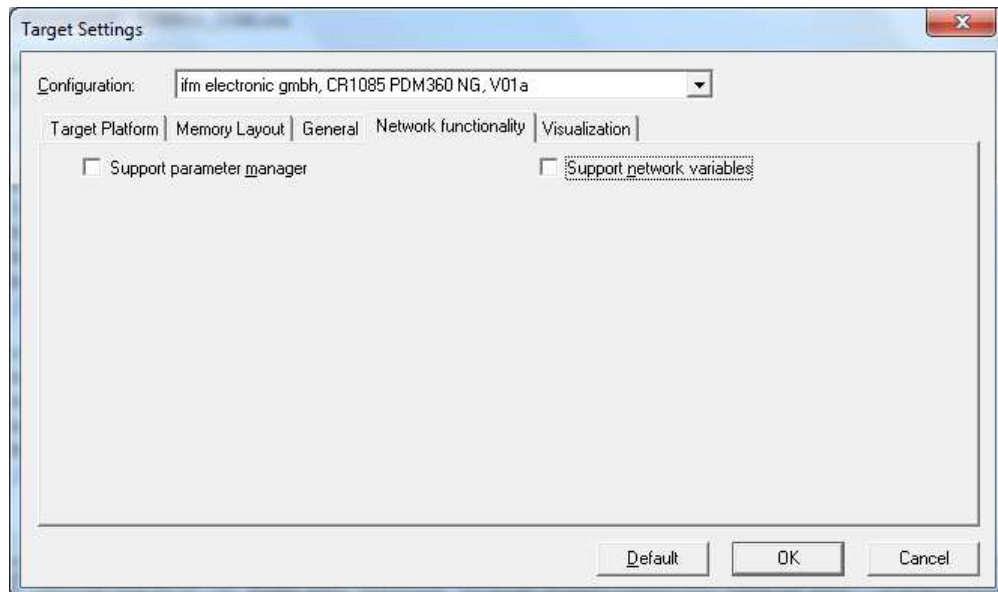


Figure 37. Snapshot of "Windrow Following" code

2. The target of application code is currently CR1201 controller.
 In case user wants to change the target to one of the supported controllers, follow given steps, else directly go to step 2.
 i. Go to [Resources] > [Target Settings] > [Target platform].
 Change the target controller as per your requirements, as shown in below figure



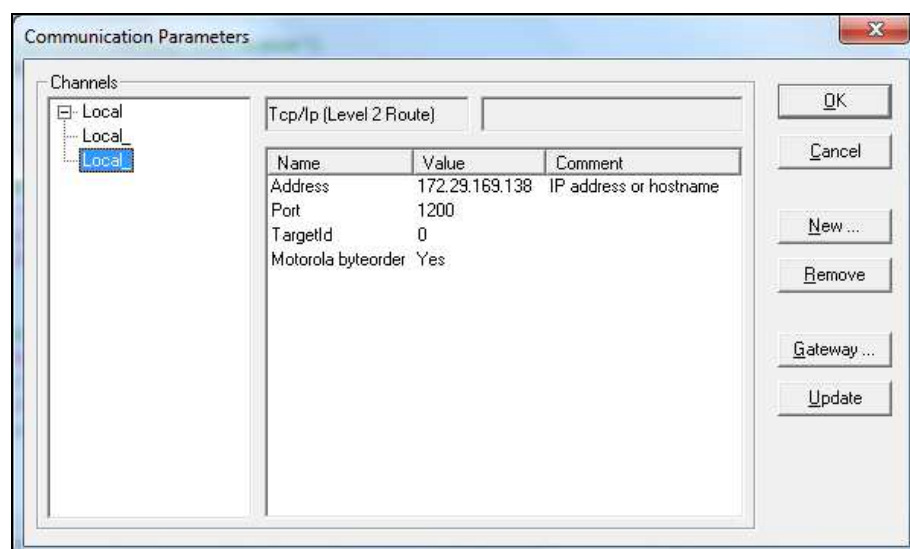
Go to [Network functionality] and uncheck “support parameter manager” and “Support network variables” options, as shown in following figure.



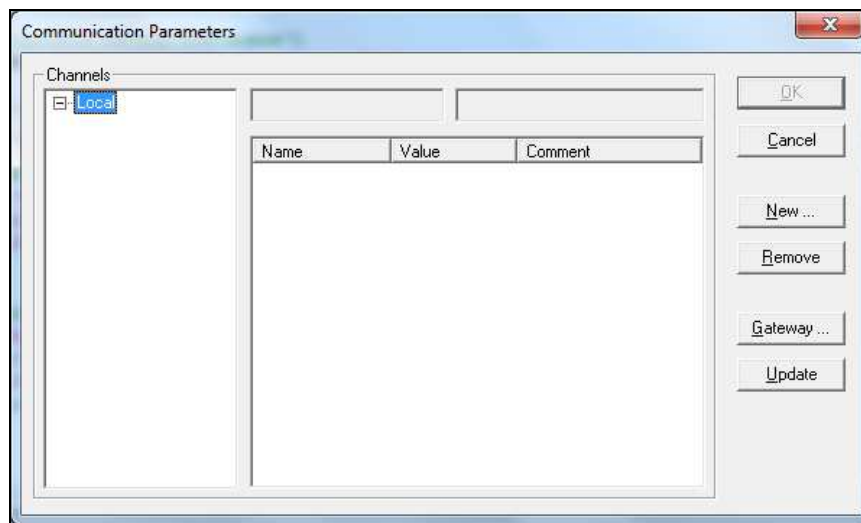
Save it by pressing [OK].

3. Compile the code and ensure it compiles successfully without any errors.
4. Download application.
 - i. Power on the display controller and make sure it is accessible by PC over ethernet.
 - ii. Downloading code to the controller.
 - a. Set the communication parameters for CodeSys.

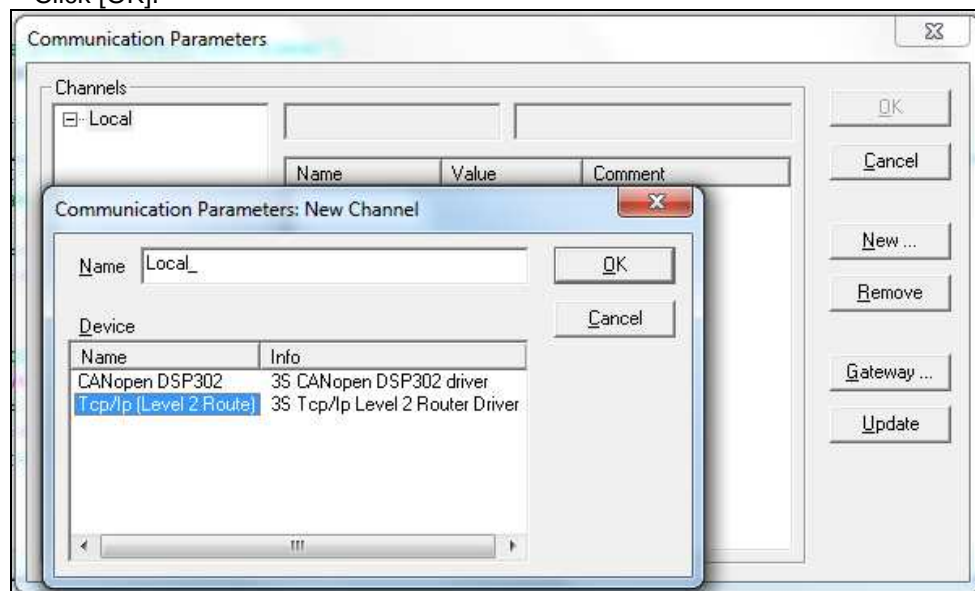
The program shall be downloaded to controller via Ethernet interface.
So, go to [Online] > [Communication Parameters].
This menu shall show existing CAN and ethernet channels as shown in below figure.



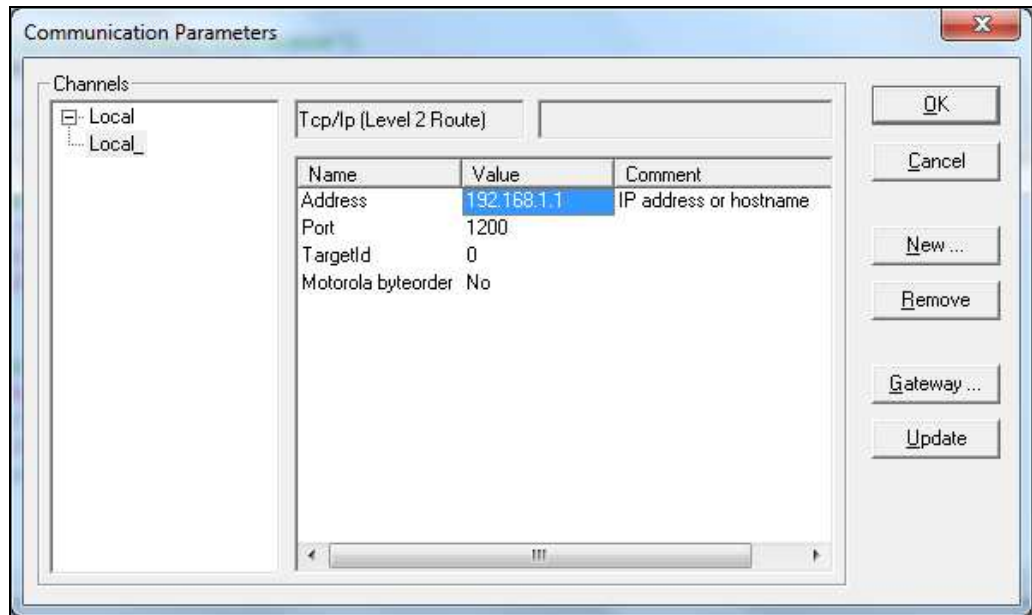
Delete all the pre-existing ethernet channel configurations, by using [Remove] button.
So now all ethernet configurations are deleted, as shown in below figure.



Now add a new Ethernet connection by clicking [New..] and selecting [Tcp / Ip (Level 2 Route)].
Click [OK].

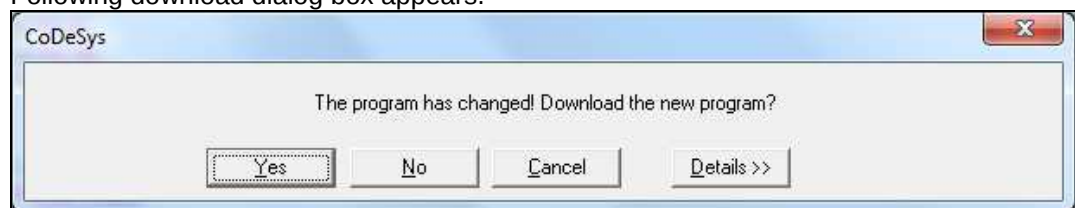


A new Ethernet channel gets added.
Suppose ip address of controller is 192.168.1.1.
If user wants to download application code to this controller then change "Address" field of newly added ethernet channel to "192.168.1.1". This is shown in below given figure.



Press [Update] and [OK].

- b. Go to [Online] > [Login].
Following download dialog box appears.



Click [Yes].

- c. Go to [Online] > [Run] to run the application on controller.
Following GUI should be visible on the GUI, which ensures that setup is ready to work as "Window Following" application.

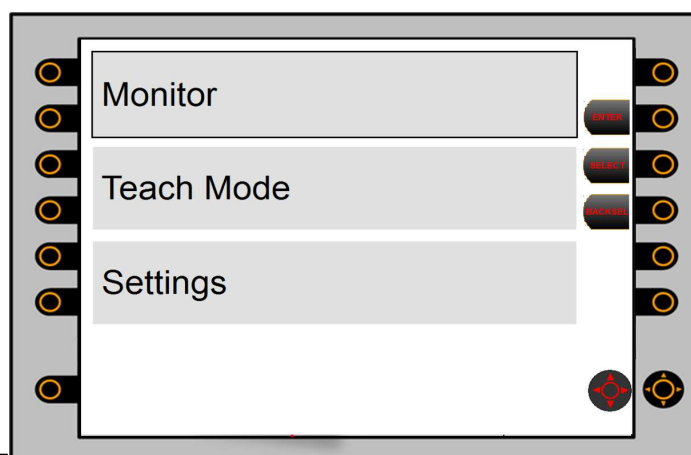


Figure 30: Window Following application running on controller

9. “Windrow Following” Application Handling

Windrow following application has three states ‘Monitor’, ‘Teach Mode’ & ‘Settings’. At power ON of system default page is displayed as shown in below image. From this operator can switch to any mode using navigation keys and ENTER key.

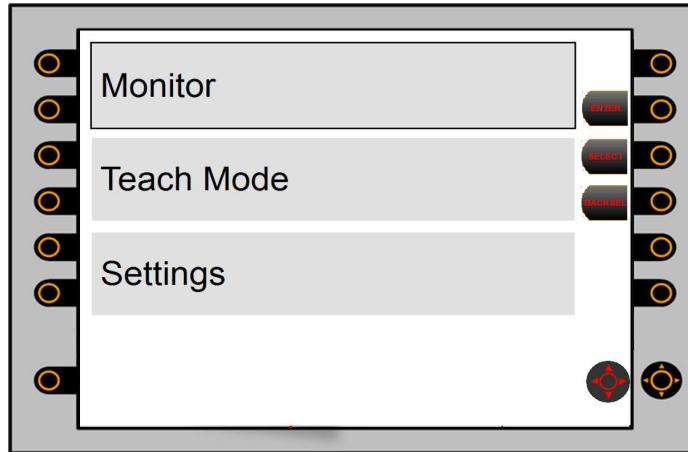


Figure 39: Default Page

Selected option is indicated by black border and after pressing ENTER key system gets switched to selected mode.

9.1 Monitor

Note: Before entering to monitoring mode all required settings should be done.

Following figure gives details of Monitoring page.

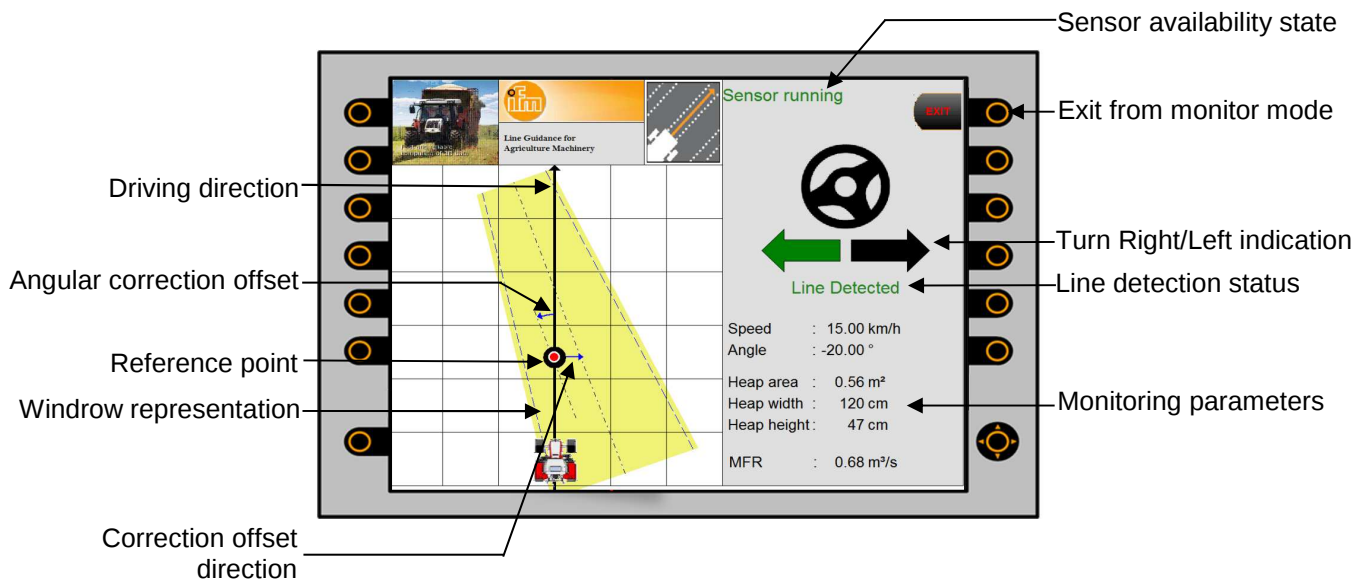


Figure 40: Monitor Page

9.2 Teach Mode

In teach ‘Correction offset’ and ‘Angular correction offset’ values are calculated automatically. System guides the operator to complete the below steps of teach mode

1. Press START key

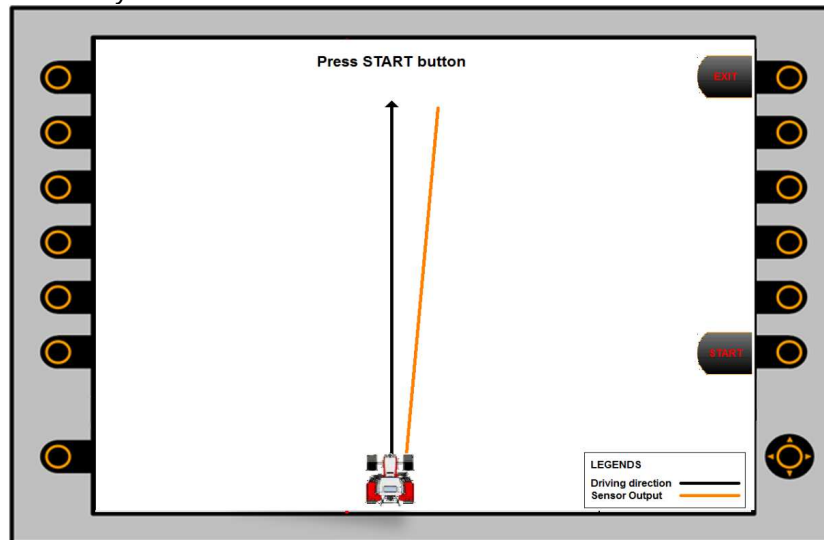


Figure 41: Teach mode - Start

2. Drive vehicle on windrow till the ADOPT VALUES key gets activated.

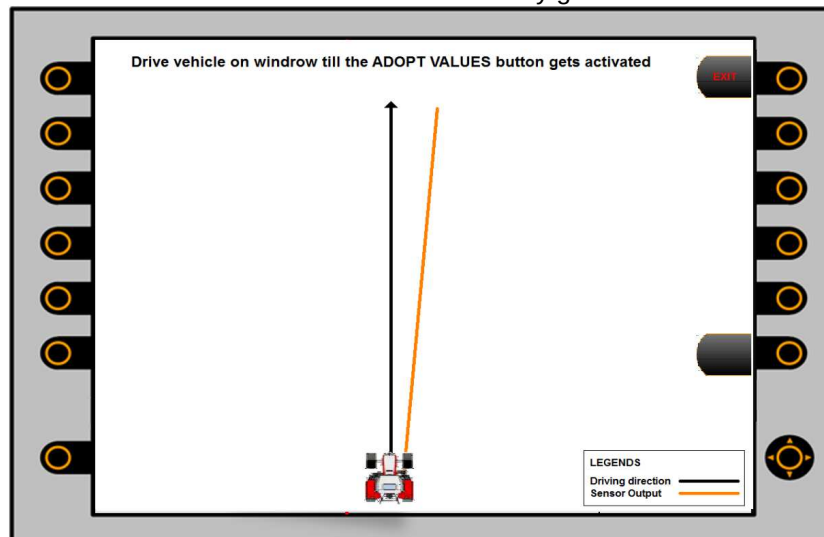


Figure 42: Teach mode - Drive vehicle on windrow

Note: Till system calculates the offset values, Exit & Start/Adapt Values keys are disabled.

3. Press ADAPT VALUES key to save the calculated offset values

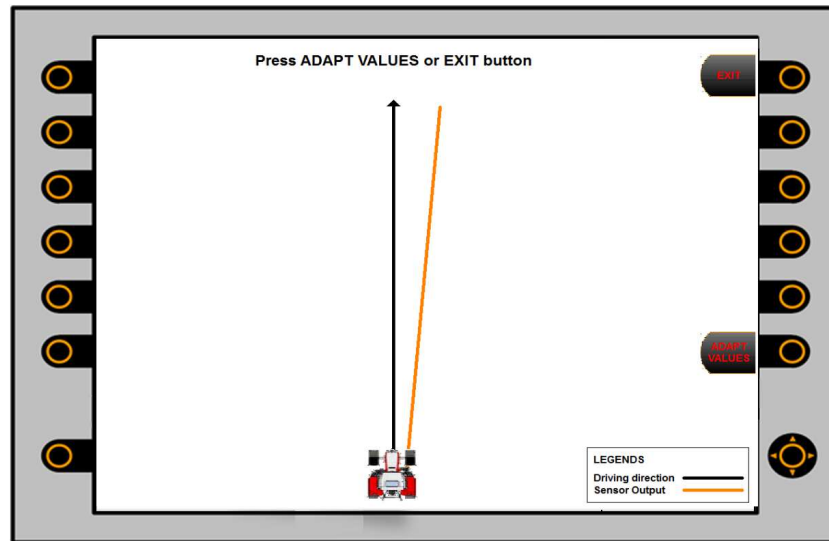


Figure 43: Teach Mode - Adapt Values

4. Exit from Teach mode. If user press Exit key without pressing key Adapt Values, offset values will not be stored.

9.3 Settings

Settings mode is used to choose the windrow line to follow and set offset values manually (if not set using teach mode).

9.3.1 Choose Windrow

GUI to choose Windrow line will appear on entering to settings mode. GUI shows detected number of windrow lines with their ID. Detected windrow lines will be arranged as per their distance from driving direction. Refer the below figure more details.

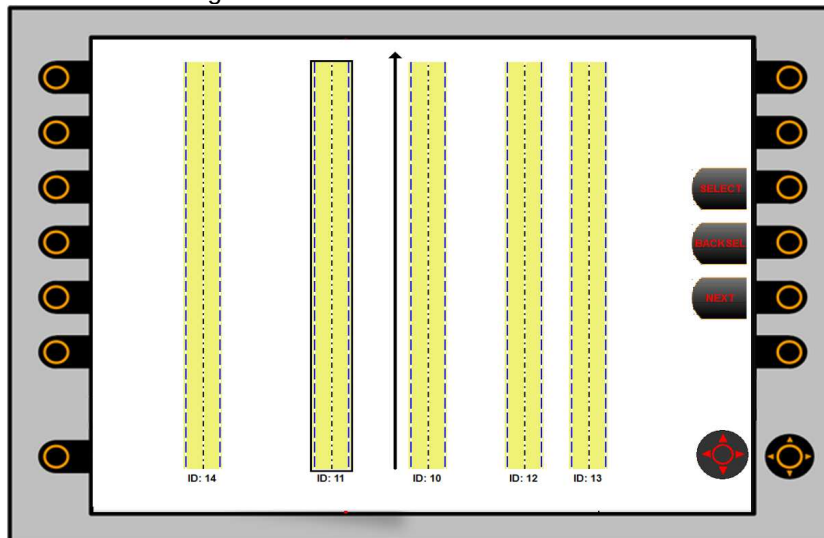


Figure 44: Choose Windrow

Border for selected windrow line is highlighted as shown in figure. Windrow line selection can be changed via navigation keys or SELECT/BACKSEL keys. Press Next key to switch to set offset parameters.

9.3.2 Set Offset values

This GUI should be used only if user wants to set correction offset and angular offset manually. If offsets are already set using teach mode, there is no need to set it again.

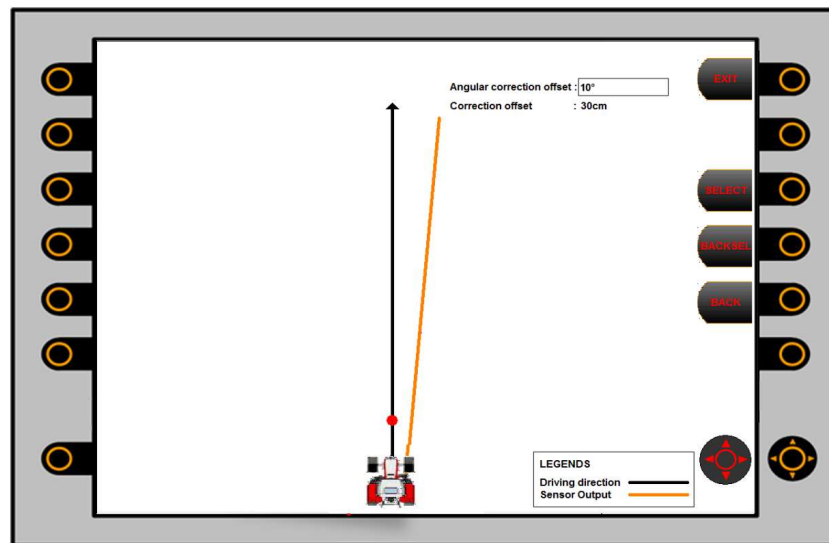


Figure 45: Set offset values

This is the last GUI from Settings mode. Press EXIT key to exit from setting mode or press BACK to go to previous GUI.