FREESTYLE3D AND SOFTWARE
USER MANUAL
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FARO®

Release Notice

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This is the 2016 version of the FARO® Scanner Freestyle3D, Freestyle3D X, and Freestyle3D Objects User Manual. It applies to the FARO Scanner FARO® Scanner Freestyle3D, Freestyle3D X, Freestyle3D Objects, SCENE Capture 6.2, and SCENE Process 6.2.

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Chapter 1: General Information

1.1 Notes and Signs

You may see a few new words. It is important that you understand the meaning of these words before proceeding.

WARNING

A WARNING notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in severe personal injury or death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

CAUTION

A CAUTION notice denotes a hazard. It calls attention to an operating procedure, practice, or similar that, if not correctly performed or adhered to, could result in personal injury. Do not proceed beyond a CAUTION notice until the indicated conditions are fully understood and met.

NOTICE

A NOTICE denotes a hazard. It calls attention to an operating procedure, practice, or similar that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a CAUTION notice until the indicated conditions are fully understood and met.

Note

	A note denotes additional information that aids you in the use or understanding of the equipment or subject.

Chapter 2: Freestyle3D and its Equipment

Unless otherwise stated, we use the term Freestyle3D for all the members of Freestyle3D family: Freestyle3D, Freestyle3D X, and Freestyle3D Objects.

2.1 Freestyle3D Components

Figure 2-1: Freestyle3D, Components on the upper side

① **Start/Stop** button and Status LED lights
② USB cable and plug

Figure 2-2: Freestyle3D, Components on the lower side

③ Infrared cameras
④ Color camera and LED flash unit
⑤ Infrared projector with class 1 laser

2.2 Freestyle3D Kit

Freestyle3D is shipped with the following standard equipment:

Figure 2-3: Freestyle^{3D} Objects Equipment

① Transport and carry case

② Quick Start Guide

③ Freestyle^{3D}

④ USB stick with the SCENE Capture, SCENE Process and SCENE installation files, Quick Start Guide and this User Manual

⑤ Optical cleaning kit

⑥ Calibration plate which may also be useful when it comes to placement and measurement

⑦ Tablet PC

⑧ Tablet hand-holder

⑨ Red microSD card to save scan projects, and green microSD card which provides the calibration plate data

⑩ USB card reader

	Retain all packaging materials as you may need them later.

Chapter 3: How Freestyle3D works

FARO® Scanner Freestyle3D enables anyone to capture objects and environments in a 3D view.

To accomplish this, the device has to be moved along or around the object of interest.

While Freestyle3D is moved, three integrated sensors track what they capture, and send this data to a tablet computer or notebook via a USB connection.

The pixels or points are then used to build up the colored 3D model of the captured object or environment.

Once 3D data has been captured, you may view and analyze it by, for example, measuring distances between objects. You may also export the data to different file formats and import it into third party applications, like CAD programs.

The main features are:

- High and specified accuracy.
- High resolution: scan thin cables, ribs of small skeletons, etc.
- Scanning range: Freestyle3D and Freestyle3D X: 3m, up to 10m indoors. Freestyle3D Objects: 0.3m up to 0.8m.
- Power supply via USB: no extra battery/power supply required.
- Intuitive handling: no need for long-winded preparation - just scan!
- High mobility due to its small size and light weight, the scanner comes in a ruggedized case.
- Photorealistic 3D color scans due to the integrated color camera.
- Seamless integration with Focus laser scan data.
- No artificial targets required.

Some technical details

The projector projects a pattern of small infrared dots on the surface of the object.

Figure 3-1: Light pattern, made visible by a special camera

The two infrared cameras take photos of this pattern.

The 3D coordinates are then calculated using a mathemathical method called triangulation.

Commonly used terms

Simultaneously, a color camera integrated in the sensor takes an ordinary color photo.

This photo is enriched with the 3D coordinates of the points in the pattern which were detected parallely, and is hereafter referred to as a **frame**.

While the device is capturing, this procedure is repeated in high speed.

The data generated while capturing is transferred directly to your PC via cable and USB port. Depending on the object or the scene, you may need a laptop or tablet PC which you can carry around while capturing.

The software detects clearly identifiable elements such as corners in the color picture. Those elements are called **features**.

Following the features from frame to frame is called **tracking**. With tracking, it is possible to reconstruct the movement of the sensor in space, and thereby putting all 3D points of the individual frames in a common 3D context.

A set of frames resulting from one capturing sequence is called a **scan**.

Loop closing is necessary because small errors from frame to frame may accumulate over time, resulting in gaps if you return to the same position again.

When you capture an object or a scene several times, you will accordingly get several scans. These scans have to be spatially aranged to receive a coherent overall picture. This is called **Place Scans**, or **Registration**.

The software manages the conversion from frames to scans automatically. For the scans, you will have to perform a **manual placement** or another placement method (*See "Modifying the scan's view" on page 50.*)

The vast number of points generated in one or several scans of a scene can be arranged to a so-called **point cloud**. A point cloud - out of one or of several registered scans - is more or less a complete 3D picture of what you scanned with Freestyle^{3D}.

Chapter 4: Safety Precautions

Please read this User Manual carefully and completely and refer to it before using the product. Pay close attention to all warnings and follow the instructions step by step.

4.1 Intended use

Freestyle3D and Freestyle3D X are designed to scan objects in a distance range between 3m and approx. 10m.

Freestyle3D Objects is designed to scan objects in a close-up distance range between 0.3m and approx. 0.8m.

4.2 Improper use

- Improper use means using the product other than described in this User Manual, or under operating conditions which differ from those described herein.
- Improper use of the product may impair the protection provided by the product, and product damage or serious personal injury may be caused.

4.3 Users

In the interests of safety, Freestyle3D and its accessories should only be used by competent, suitably trained users after they have read and understood this User Manual, and considered any hazard that might be involved.

4.4 General Safety Information

Material damage or bad measuring accuracy

Do not expose Freestyle3D and its accessories to

- extreme temperatures. The ambient temperature should not be lower or higher than given in the specifications found in *"Technical Data" on page 109*.
- dust, sand or other abrasive materials which will damage the glass covers of the cameras.

4.5 Laser Safety

Freestyle3D is classified as laser class 1 in accordance with IEC 60825-1:2007: Safety of laser products. Part 1: Equipment classification and requirements; Edition 2.0

Freestyle3D is safe under reasonably foreseeable conditions of operation. The maximum permissible exposure (MPE) cannot be exceeded. It is harmless to the eyes if it is used and maintained in accordance with the instructions in this User Manual.

4.6 Electrical Safety

Damage to electric or electronic components

- Do not immerse Freestyle3D nor the tablet computer into water or other liquids.
- Do not use Freestyle3D near strong magnetic or electrical fields.

- Do not touch the metal rings around the glass covers on the lower side of Freestyle^{3D}.
- Do not expose the tablet computer to dust or sand which may get insides the device and cause short-circuits.

When Freestyle^{3D} and the tablet computer are transferred from a cold to a significantly warmer environment, water may condense on some of the components inside the devices. To avoid this, place Freestyle^{3D} and the tablet computer in an airtight plastic bag before bringing it from a cold to a significantly warmer environment. This allows the condensation to form on the bag and not inside the device.

4.7 Mechanical Safety

Do not open the housing. By opening the housing,

- you can damage the device, which will affect the device's warranty.
- the calibration will be lost. Each device passed an initial calibration before shipping. The calibration process described in chapter 12 can not replace it.

4.8 Safety during work

Danger of explosions or fire

Do not use Freestyle^{3D} and the tablet computer

- in an explosive atmosphere.
- in the presence of flammable gasses or fumes.

Before operating Freestyle^{3D} and its accessories in hazardous areas, contact the local safety authorities and safety experts.

Damage to electric or electronic components

- Do not use Freestyle^{3D} in vicinity of strong magnetic or electrical fields.
- When scanning outdoors or in dirty surroundings, protect the tablet computer from liquids and humidity, but also from dust and dirt which may damage the electronic components.
- Do not use Freestyle^{3D} near heat sources such as radiators, heat registers, or other products (including amplifiers) that produce heat.

Strobe light

The flash-light is a strobe light and can be hazardous to persons who may be susceptible to epileptic seizures.

In case of doubt, switch the flash-light to OFF.

4.9 Transport

- When carrying Freestyle^{3D}, take care not to drop it. Strong impact may damage Freestyle^{3D} and render it incapable of proper operation.
- When shipping and transporting Freestyle^{3D} by rail, sea, air, or in a road vehicle, make sure to use its original transport case and a suitable outer cardboard box for best protection against shock and vibration.

4.10 Storage

Pack Freestyle3D in its transport case to protect it from environmental hazards.

Store in an environment with

- low humidity level,
- relatively stable temperature,
- no extreme temperatures,
- no extreme environmental conditions (dust, dirt, etc.)
- no heavy vibrations.

4.11 Servicing

- Servicing and repair must only be done by qualified service personnel authorized by FARO.
- Refer servicing to qualified service personnel under the following conditions:
  - The USB cable or plug is damaged.
  - The device has been exposed to rain, water, or other liquids.
  - The device has been dropped or damaged in any way.
  - Objects have fallen onto the device.
  - The device does not operate normally when following the standard operating instructions.

Chapter 5: Installation

5.1 SCENE Capture, SCENE Process and SCENE

SCENE Capture manages the scanning using one of the supported sensors. SCENE Capture comes with a simple user interface and is optimized for the usage on tablet computers. The program has limited support for processing, displaying and exporting scans. The program is free.

SCENE Process manages the processing of scans. SCENE Process comes with a simple user interface and should run on a desktop machine because of the required computing resources. The program has support for processing, displaying and exporting scans. It supports the registration of scans from any source (Laser scanner, or Freestyle3D, …) using sophisticated algorithms.

SCENE has all capabilities of SCENE Process and much more. The comprehensive user interface give access to all function necessary to manipulate scans from any source. SCENE has an App interface allowing the user to add new functions to the program.

5.1.1 System Requirements for SCENE Process and SCENE

	Minimal Specifications	Recommended Specifications
Processor	64-bit (x64) with at least 2-gigahertz (GHz) (For example, Intel Core i7)	Quad-core x64 Intel Core i7/Xeon, 8 physical cores
Graphics Card	OpenGL 4.1, or higher At least 2GB Memory.	Dedicated graphics card At least 4 GB Memory OpenGL 4.1 Nvidia Quadro (required for stereo rendering)
Main Memory	At least 16GB	64GB
Hard Disk	256 GB Solid State Drive	512GB Solid State Drive + Regular HDD
Operating System	64-bit Windows 7	64-bit Windows 7 64-bit Windows 8, 8.1 or higher
Display	1366 x 768	1920x1080
Accessories	Mouse with 2 buttons and a scroll wheel Network card as it is required for licensing SCENE Capture	

5.1.2 Licensing the Software

Once installed, you may fully test any SCENE version for 60 days without the need of a software license. After the trial period, you need a permanent license to further use the SCENE.

At that moment, the **License Manager** will show up in which you can license the software.

See the SCENE User Manual for detailed information.

This chapter will provide preliminary steps and basic operations and will guide you step-by-step from setting up your sensor to capturing your first scan.

5.2 Install SCENE Capture on your tablet computer

	SCENE Capture is already installed on the tablet computer that came with the Freestyle^{3D}kit.

1. Ensure that the sensor is not connected to your tablet computer.
2. Make sure that you have administrator rights.

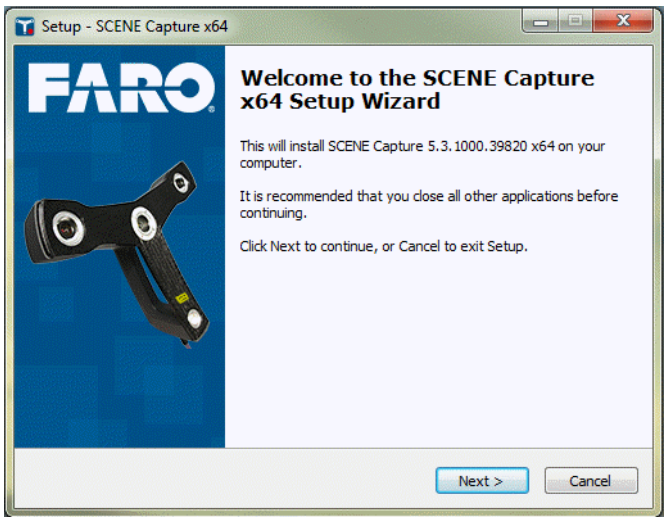


Figure 5-1: SCENE Capture setup

3. Start the SCENE Capture setup and follow the instructions on the screen.

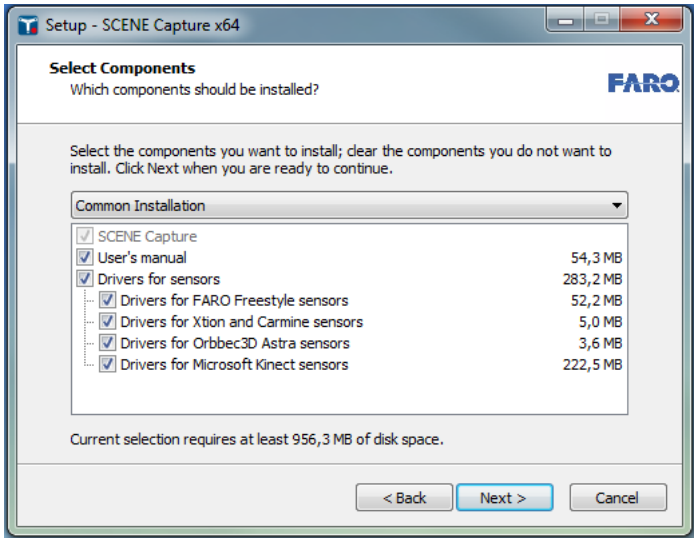


Figure 5-2: SCENE Capture setup

4. By default, the drivers all types of sensors will be installed. If you are working with a specific sensor, we recommend to uncheck the others here.
5. You will be guided through the installation routines of the selected sensors.

	SCENE Capture is installed in the language which is set in Windows. If this language is not available in SCENE Capture, the default language English (US) is used.

5.3 Install SCENE Process on your workstation

1. Make sure that you have administrator rights.

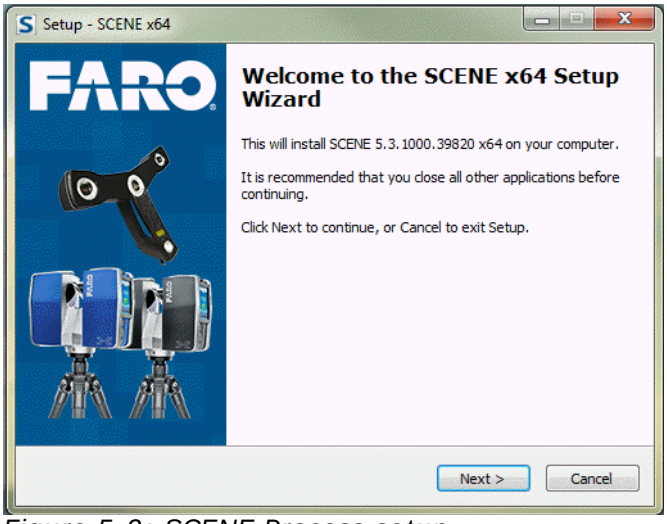


Figure 5-3: SCENE Process setup

2. Start the SCENE Process setup and follow the instructions on the screen.

	SCENE Process is installed in the language which is set in Windows. If this language is not available in SCENE Process, the default language English (US) is used.

Chapter 6: Getting Started

6.1 Connecting the sensor

For detailed information on the sensors, please see chapter *Supported Sensors.*

Freestyle3D

1. Start SCENE Capture, or SCENE.
2. Plug the sensor‘s USB cable into an USB3 port of your computer. The red Status LED will light up. If the speakers of your computer are switched on, you will hear an acoustic signal as well.
3. Wait until the software detected the sensor. A **Loading** message will be shown. As soon as the sensor is ready, the red Status LED is switched off.

SCENE Capture and SCENE both start with the **Home screen** by default. Its **Project Selector** presents all the scan projects known at that time.

Other sensors

1. Start SCENE Capture, or SCENE.
2. Plug the sensor‘s USB cable into an USB port of your computer. If the speakers of your computer are switched on, you will hear an acoustic signal as well.
3. Wait until the software detected the sensor. A **Loading** message will be shown.

Home screen

SCENE Capture and SCENE both start with the **Home screen** by default. Its **Project Selector** presents all the scan projects known at that time.

6.2 Acoustic signals

If the speakers of your computer are switched on, you may hear an acoustic signal when

- Sensor is connected to the computer
- Sensor button pressed
- Tracking is lost
- Sensor is disconnected from the computer.

The type of signal depends on your Windows® signal settings. The sensor connect and disconnect signals correspond to the **Device Connect** and **Device Disconnect** signals. The **Tracking is lost** signal corresponds to the **Warning signal**.

6.3 Hints & Tips

- Due to usability, we recommend connecting Freestyle3D to the tablet computer which is shipped together with the Freestyle3D kit. SCENE Capture is already installed on this device. Perform scanning with this configuration. To process the scans, a workstation with SCENE Process installed would be a good solution. Simply transfer your scan project with the microSD card.
- If you prefer a notebook computer to the tablet computer, you can use SCENE for both, scanning and processing.
- The tablet computer that came with Freestyle3D does not automatically rotate its display when you move it. This function is locked because it would cause handling problems while scanning. If you need this function, you can activate it again: swipe from the right side to get the

Charm panel, then tap the **Settings** button, then the little **Screen** button (the padlock sign in it indicates that the function is locked). In the panel that is displayed now, tap the **Screen** button again. The padlock sign is replaced by a bent arrow. The rotating function is now active, and you can swipe the panel off.

6.4 microSD Card

The Freestyle^{3D} data will be stored on a removable microSD card.

A suitable microSD card is included with the Freestyle^{3D} kit. This microSD card is ready to use. This chapter is in case you need more microSD cards.

CAUTION	
	**Corrupted data or defective microSD card** • Do not remove the microSD card from the computer while it is busy, otherwise you risk corrupting the data on the card. • Always use the “Safely Remove Hardware” option from the system tray in Windows. Double-click on the **Safely Remove Hardware** button in the system tray, then select the device you want to remove from the list.

6.4.1 Type of microSD card

For more information, see “Type of microSD card” on page 110.

6.4.2 Formatting

Format the microSD card in NTFS format. The reason is, that NTFS supports larger sizes for individual files compared to FAT32.

6.4.3 Inserting the microSD card

The microSD card slot is behind the kickstand.

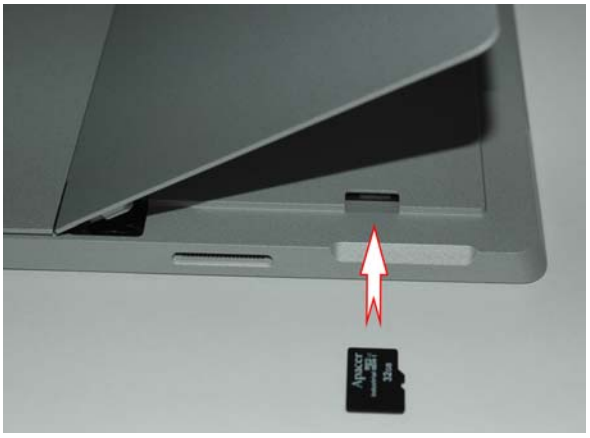


Figure 6-1: Inserting the microSD card in the tablet computer that is included in the Freestyle^{3D} kit

- Insert the formatted microSD card with the notched edge in the direction as illustrated until it clicks into place.
- Confirm the direction of the microSD card. If you forcibly insert it in a wrong direction, the microSD card, the card slot or data on the card can be damaged.

6.4.4 Ejecting the microSD card

To remove a microSD card from the tablet computer, carefully hold it with a fingernail and slide it out of the microSD card slot.

6.5 Freestyle3D Status LEDs

A blue and a red status LED are integrated in the Start/Stop button upon Freestyle3D. They sign the following statuses:

Connect Freestyle3D to the computer	Red and blue LED will light up. After the device is detected by the software, the blue LED will turn off.
Ready to capture	Blue LED will light up.
Not ready to capture	Red LED will light up.
While capturing	Blue LED will flash.
Tracking lost: resume tracking	Red LED will flash. After tracking resumes, the red LED will be turned off, and the blue LED will flash again.

Chapter 7: Navigation

This chapter will provide preliminary steps and basic operations and will guide you step-by-step from setting up your sensor to capturing your first scan.

7.1 Project Selector

After the first start, SCENE Capture, SCENE Process, and SCENE show their **Home** screen, which includes the **Project Selector**.

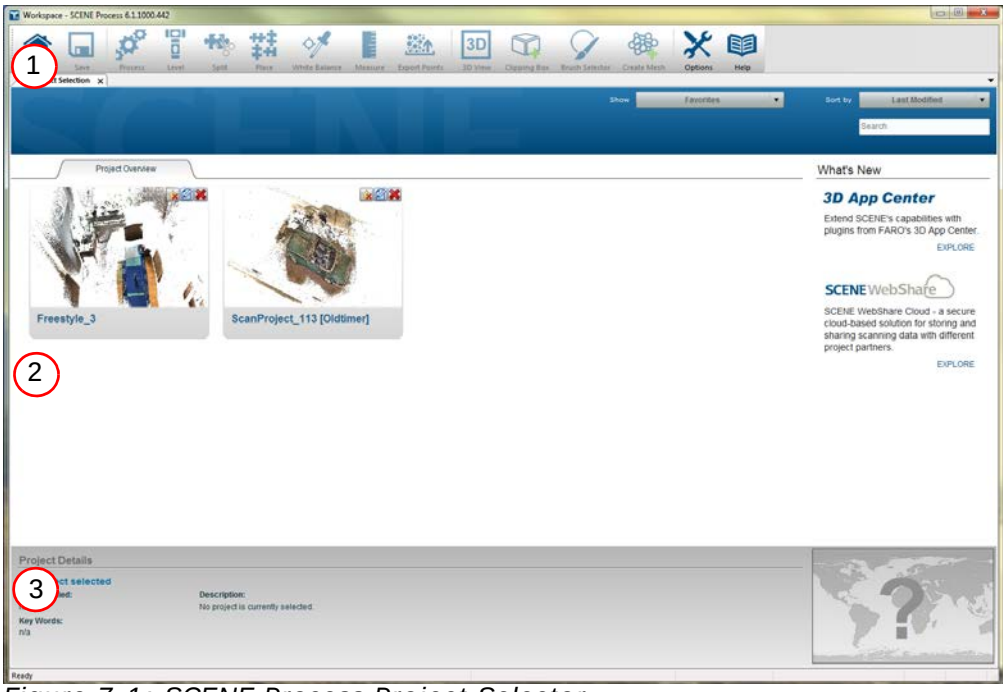


Figure 7-1: SCENE Process Project Selector

① Toolbar - provides a quick and easy way to access common menu features with the mouse or, on tablet computers, by tapping.

② *Project Selector* - open an existing scan project by double-clicking/ double-tapping on its preview picture.

③ Project information - If the mouse pointer or, on tablet computers your finger, moves over one of the available scan projects, more information related to this scan project is displayed here.

7.1.1 Project Selector

The **Project Selector** is a visual tool for managing and accessing scan projects in SCENE Capture, SCENE Process, and SCENE.

It provides a quick and convenient access to all your scan projects and project workspaces, and presents all the scan projects known to the software at that time.

	The **Project Selector** requires Adobe Flash Player. Adobe Flash Player can be installed during the installation process.

Project Previews Each **Project Preview** offers several icons in the top right corner.

Figure 7-2: Project Preview

Opening scan projects

To open a scan project, you can either double-click on the project's preview image, or you can click on the preview image and then click the appropriate workspace from the menu that appears.

Figure 7-3: Open projects

If SCENE WebShare data is available for a project, then SCENE WebShare appears in the menu. Choose this option to open a SCENE WebShare view of the project.

Add to Favorites 

Favorites are your most popular projects. You can add a project to your favorites by clicking the **Add to Favorites** button  . You can remove a project from the favorite list any time later. To show only favorites, simply select the Favorites option in the Filter drop-down menu.

Ignore Projects 

Ignored projects are hidden from the **Project Selector**. To remove projects from the Ignore List, select Ignore List from the Filter drop-down menu. All the hidden projects are displayed. Click the green cross  to remove a project from the ignore list.

	A hidden scan project is still available in the scan project folders on your computer. You can not delete a scan project in SCENE Capture or SCENE Process.

Edit Pro-ject Details 

Clicking the **Project Details** button  will bring up the screen shown in *Figure 7-4*.

Project information such as project name, project description or keywords can be monitored and changed here. Information like the project's location on your hard disk drive or the project's ID cannot be changed.

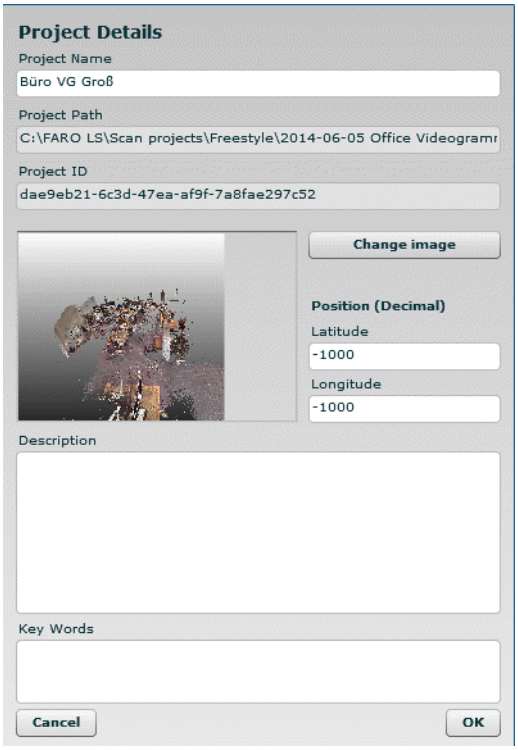


Figure 7-4: Project Details

Key Words

Key words can be defined for every project. These key words are utilized by the search for quick access to all your data.

Position

Add a position to your project to make the Google Earth View feature available.

The coordinates have to be entered in decimal notation. Here are some example coordinates:

Moscow:	Latitude: 55.758032	Longitude: 37.617188
Sydney:	Latitude: -33.870416	Longitude: 151.204834
Rio de Janeiro:	Latitude: -22.902743	Longitude: -43.214722
Seattle:	Latitude: 47.606163	Longitude: -122.332764

Google Earth View 

If positional information is provided for a project, the Google Earth View button becomes available in the project's preview. Clicking this button will open a Google Earth view of the project's location in your default web browser.

Filtering, Sorting, Searching

The **Project Selector** allows you to apply several filters and sorting mechanisms.

Projects can be filtered to show projects with SCENE WebShare data only, projects without SCENE WebShare data only, your favorite projects or ignored projects. Both methods can be combined to reduce or increase the number of projects shown by the project selector.

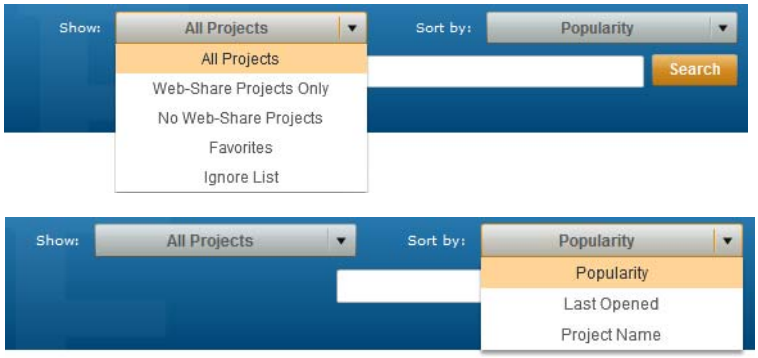


Figure 7-5: Sorting and filtering projects

The search field can be used to search for specific scan projects or key words and will refine the search results on-the-fly while you type.

7.2 Project Workspace

Once you have opened a scan project, this window appears. It is made up of the following areas:

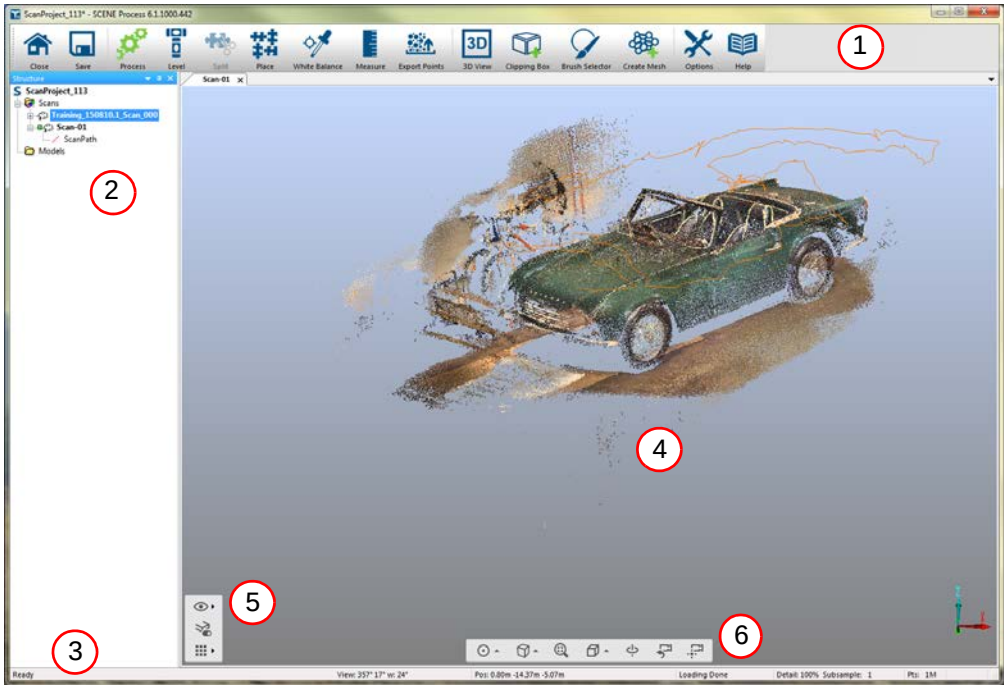


Figure 7-6: Composition of the Workspace window (SCENE Process)

① *Toolbar SCENE Capture* or *Toolbar SCENE Process* - provides a quick and easy way to access common menu features with the mouse or, on tablet computers, by tapping.

② *Context menus* - displays the structure of the Workspace, including all sub-folders and objects. Whether the Structure View stays visible or is folded away automatically may be controlled by the pin needle button at the top right of the Structure View.

③ **Status bar** - displays command and scan point data details, tool tips and responses to the last command executed.

④ **Scan and object views** - the visual presentation of the scan data and other objects.
The scans are displayed in 3D View.

SCENE Process and SCENE only:
Laser scans can be viewed in Planar View, Quick View and 3D View. See the SCENE User Manual for more details to this views.
The scan and object views are displayed as unanchored windows, but if you open the 3D View of the entire scan project by clicking or tapping the 3D button in the toolbar, a second tab will open.

Presentation mode All menus and toolbars can be minimized to provide maximum space on the screen for scan data. This feature is controlled by using Ctrl-F11 or Alt-ENTER as short cut command.

7.2.1 Toolbar SCENE Capture

Figure 7-7: SCENE Capture Toolbar

1. Home. If a scan project is opened, you will be asked if you want to save the scan project. Afterwards, the scan project will be closed and the **Project Selector** will be shown.
2. Saves the scan project.
3. *Calibration status (SCENE Capture)* and *Calibrate*
4. *Device White Balance*
5. *Capture (SCENE Capture and SCENE)*
6. *Processing options*
7. *Measure distances*
8. Opens the *Export point clouds of the scan project* dialog.
9. Options menu: *Default Scan Options* , *Capture options* and *Processing options*
10. Help - shows the User Manual (pdf file).

    Close the PDF by swiping from the top to the bottom of the pdf document.

    Switch to the software by swiping from the left to the right of the pdf document.

7.2.2 Toolbar SCENE Process

Figure 7-8: SCENE Process Toolbar, part 1

1. Home. If a scan project is opened, you will be asked if you want to save the scan project. Afterwards, the scan project will be closed and the **Project Selector** will be shown.
2. Saves the scan project.
3. *Processing options*
4. *Level (SCENE Process and SCENE)* a scan
5. Opens the *Split Scan* feature

⑥ Opens the *Place Scans (SCENE Process and SCENE)* feature
⑦ *White Balance (SCENE Process and SCENE)*
⑧ *Measure distances*
⑨ Opens the *Export point clouds of the scan project* dialog

Figure 7-9: SCENE Process Toolbar, part 2

⑩ Shows the 3D View of the entire scan project
⑪ *Tailor a Point Cloud View with the Clipping Box*
⑫ Brush Selector - select scan points by marking them with the brush
⑬ Export a selection as a mesh
⑭ Options menu: *Default Scan Options* and *Processing options*
⑮ Help - shows the User Manual (pdf file).

Close the PDF by swiping from the top to the bottom of the pdf document.

Switch to the software by swiping from the left to the right of the pdf document.

Figure 7-10: SCENE Toolbar

① *Calibration status (SCENE Capture)*
② *Device White Balance*
③ *Capture (SCENE Capture and SCENE)*
④ *Processing options*
⑤ *Exploring Scan Data and Objects* a scan
⑥ Opens the *Split Scan* feature
⑦ Opens the *Place Scans (SCENE Process and SCENE)* feature
⑧ *White Balance (SCENE Process and SCENE)*
⑨ Opens the *Export point clouds of the scan project* dialog
⑩ Options menu: *Default Scan Options* , *Capture options* and *Processing options*
⑪ Help - shows the User Manual (pdf file)

7.2.4 Workspace Structure

All objects in the workspace are arranged in a hierarchy so that they are easier to find. This is similar to a file system, where the files are placed in folders, which can also be nested hierarchically..

	Each of those folders has a context menu, that is the menu which opens when right clicking on the folders name.

7.2.5 Structure View

In the Structure View, you can see the hierarchy of the objects.

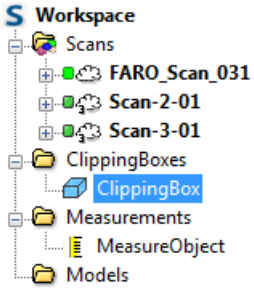


Figure 7-11: Structure View

Scans folder

This folder might have several scan subfolders depending on the structure of your scan project.

Cluster folders

The Scans folder may contain folders which again contain scans. Such a folder is called Cluster. A Cluster again may contain other Cluster folders.

Scan

Scan is also essentially a folder which, apart from scan points, can also contain additional information, like objects, but no further scans. Since you could have dozends of Scan folders in your project, every Scan folder has its individual number.

In front of a scan's name, different symbols may appear:

	Freestyle3D: Not processed completely
	Freestyle3D: Recording finished. Some single frames unloaded because of low memory.
	Freestyle3D: Processing done
	Freestyle3D: Reduced quality because of low machine performance
	Processing done, a point cloud has been generated.
	Capturing
	Replay
	Optimize Scans
	Color Smoothing
	Stray Point Filtering
	Point Cloud Creation
	Marker detection

ClippingBoxes Clipping Boxes allow slicing the point cloud and clipping away specific areas which enables you to display or hide certain points of the point cloud.

Measurements Contains the measurement objects.

Models Contains CAD models, for example, imported VRML models.

Rearrange objects You can rearrange the objects within the hierarchy. To do this, select an object and using drag & drop, move it to the folder in which you require it to be located.

If you use the left mouse button, the properties of the object will not change. Especially the local coordinates will not change.

If you use the right mouse button, an additional context menu opens with which you can decide what should happen with the object.

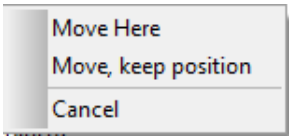


Figure 7-12: Structure View: Drag & drop object with the right mouse button

Here you can not only choose between copy and move, but also select that the object should keep its global position.

Layers Apart from this hierarchy, the objects are also assigned to layers. Layers are used to group objects independently of their hierarchy and to control the visibility of these object groups. For example, in your CAD model, you can place the interior walls of a building on a separate layer. If you then make this layer invisible, you very easily obtain an impression of the available floor space in the building. The visibility settings are explained in the SCENE User Manual.

You can give most objects their own names, which may only contain letters, numbers, the point "." and the underscore "_". Scans cannot be renamed. The References folder should not be renamed because it is used for registering the scans.

7.3 Navigation Toolbar (3D View only)

In the 3D View, you can position yourself at arbitrary positions in space and have a look at the scan points and CAD models. The mouse is used to define the turning movements you want to perform, and with the keyboard you define the actual movement in space.

Several navigation modes are available.

Figure 7-1: Navigation Toolbar

① *View Modes*
② *Camera Modes*
③ *View All*
④ *Predefined Views*

⑤ *Center of Rotation*
⑥ *Last Camera Position*
⑦ *Align Camera on Point*

7.4 Context menus

The objects listed in the Structure View as well as the scans and objects displayed in the views feature so-called context menus which offer more possibilities.

You can open these context menus by right clicking the scan's view, or right clicking the object.

	The following paragraphs describe the context menus which are specially made for Freestyle3D scans. The general context menus can be found in the SCENE User Manual.

7.4.1 Scan properties

In the Structure View, right click the scan's name, then click **Properties**.

The Properties dialog consists of several tabs.

Preview

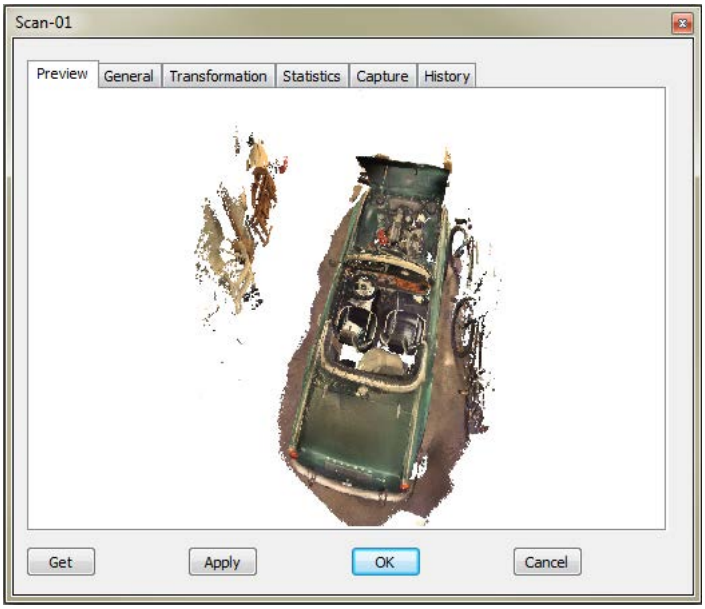


Figure 7-2: Scan properties - Preview

The **Preview** tab shows a 3D View of the scan as it looked when it was saved.

General

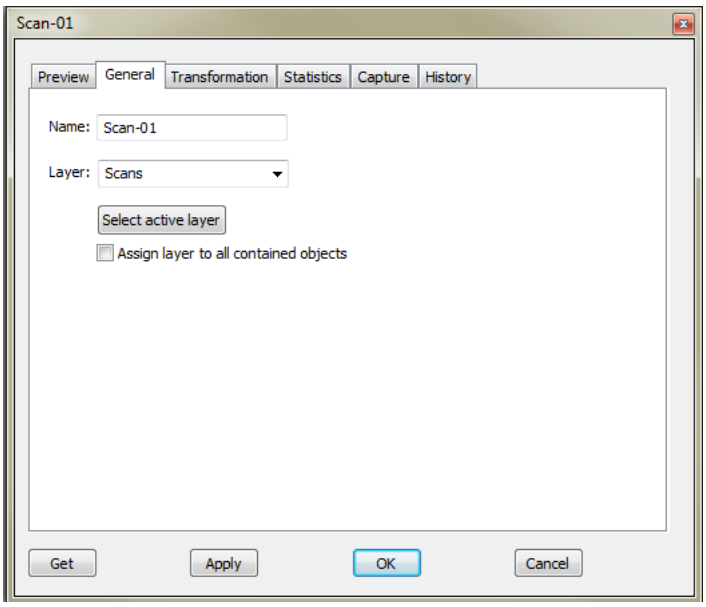


Figure 7-3: Scan properties - General

Name

Name of the scan. Scans cannot be renamed.

Layer

The representation layer in which the scan is located.

Select active layer

Enters the currently active representation layer.

Assign layer to all contained objects

All the objects of the scan take on the representation layer of the scan.

Transformation

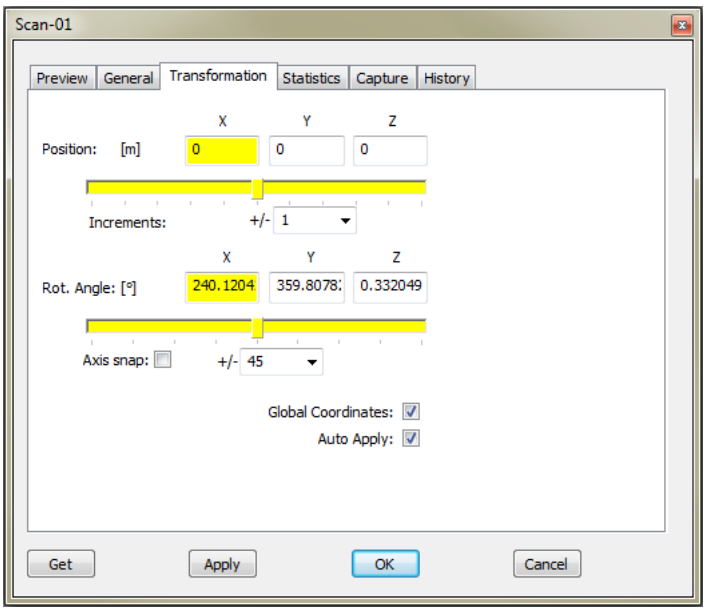


Figure 7-4: Scan properties - Transformation

Position

The translation portion of the transformation.

X - To key in a translation in the x direction.

Y - To key in a translation in the y direction.

Z - To key in a translation in the z direction.

Scroll bar

Set the transformation using the mouse. The direction of the transformation will be the x, y or z coordinate that is highlighted in yellow.

Each tick increments by

Set the increment for the scroll bar.

Rotation Angle

The angle of rotation if the rotation axis is split along the coordinate axes.

X - The angle of rotation around the x axis.

Y - The angle of rotation around the y axis.

Z - The angle of rotation around the z axis.

Scroll bar

Set a new angle of rotation.

To change a value, you can either enter the required value directly into the appropriate field, or you first select the field and then use the corresponding slider to change the value step by step. You can set the increment using the drop-down box. If you hit the edge with the slider, simply reselect the field and the slider will return to the center without you losing your previous changes.

Axis snap

If checked, you can change the rotation for the current axis independently from the others. This is achieved by changing the order in which the rotations are applied.

Global Coordinates

If selected, coordinates are displayed in the global coordinate system; otherwise they are displayed in the coordinate system of the scanner.

Auto Apply

If selected, new settings are applied and visible immediately; you do not need to click on the **Apply** button after changing the settings.

Statistics

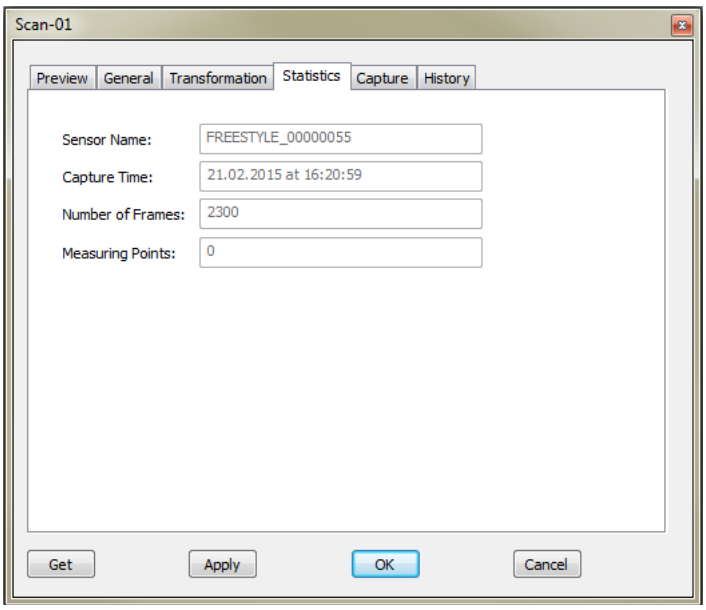


Figure 7-5: Scan properties - Statistics

Sensor Name

Shows the internal name of your sensor. You might need this name when you have to contact FARO customer service.

Capture Time

Shows date and starting time.

Number of Frames

The number of frames the scan consists of.

Measuring Points

The number of measuring points, if you did some measurements in this scan.

Capture

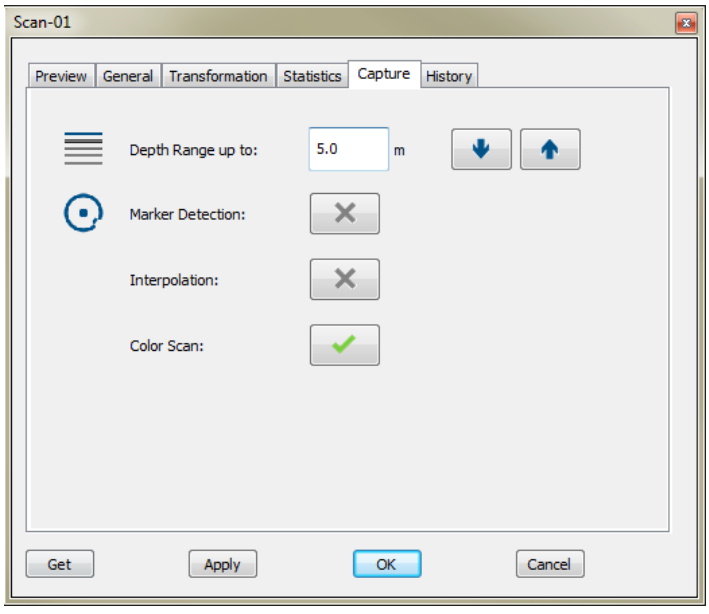


Figure 7-6: Scan properties - Capture

The Capture dialog corresponds to the *Default Scan Options* dialog in the Options menu of SCENE Capture.

If you weren't the one who made the scans, you can here check the settings which were made for each scan.

Editing options

The Capture dialog allows to modify settings.

If a scan is already processed and the user changes a value, the "processing state" of the scan is reset. The scan should then be processed again.

This may be a useful feature to test different processing options for a scan.

History

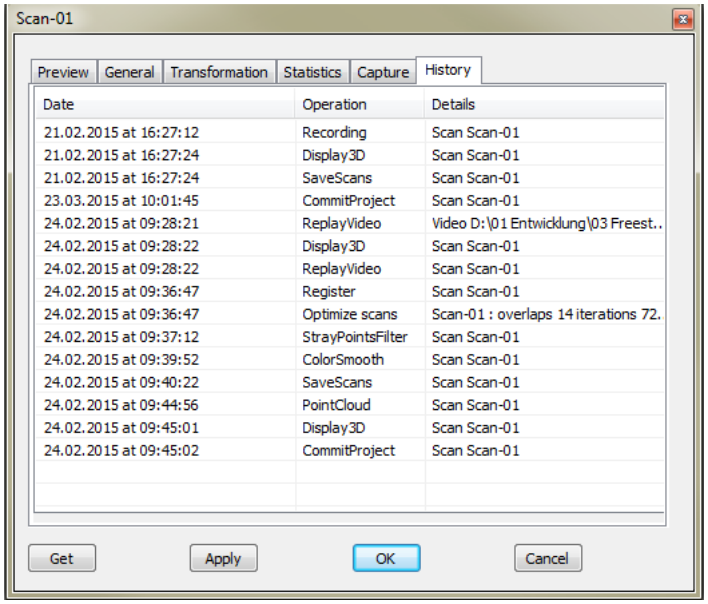


Figure 7-7: Scan properties - History

Provides the capture date and time, a short description of the step that has been performed, and the name of the scan.

7.5 About Scans and Point Clouds

New to the 3D scanner world? Here is a short introduction on ...

7.5.1 Scans

Scans are the files as they are captured by the scanner with their millions of data records that include position and color for single scan points. Scans consist of scan points that were captured from a single scanning session.

7.5.2 Point Clouds

Point clouds are an alternative representation of the scans and have to be created from the single scans. Point clouds are organized in a spatial data structure that facilitates fast visualization of scan points and automated point loading based on point visibility. They may facilitate and accelerate the processing of the scan points.

Chapter 8: Capture

This chapter will give you a brief description on how to set the capturing parameters in order to capture your first scans.

8.1 Environmental Conditions

- For applications requiring the highest degree of accuracy such as reverse engineering, and starting with the sensor at lower temperatures, turn the sensor on and warm it up until the internal temperature stabilizes.
- If the temperature of the sensor is above or below the specified range, capturing is still possible but the temperature may have an impact on the measuring accuracy.
- Strong dust formation, fog, rain or snowfall will result in bad measurements. Avoid scanning under these conditions.
- Avoid capturing objects against direct sunlight. This will result in limited scan data in this area.
- Objects or surfaces may have an increased range noise if they are directly illuminated by bright sunshine.
- Keep in mind that the tablet computer (or your own tablet/notebook) may be not as ruggedized as the sensor and may become damaged under certain environmental conditions.
- When capturing outdoors or in dirty surroundings, protect both the sensor and the tablet computer from liquids and humidity, but also from dust and dirt which may damage the electronic components and the sealings.
- Temperatures lower than 0°C and higher than +40°C may influence the performance of both devices.

8.2 How to use markers

Usually, neither Freestyle3D nor the software requires artifical references, so-called targets, to produce well-placed scans. But there might be situations where you need these references. For Freestyle3D, the marker plates would be of help. A set of marker plates is included in the Freestyle3D kit, if you need more of them, you can buy them as an accessory.

During capturing, markers help to improve the result.

During processing, markers help to close loops.

Figure 8-1: Marker plates

Rules

- The marker plates are numbered. Do not use two or more marker plates with the same number.
- Do not place on curvy surfaces.
- Do not move until the scan project is finished. Especially outdoors, you can place little weights, for example pebbles, on the corners of the marker plates. The weights shall not cover the pattern on the marker plate.
- The pattern shall be easily and clearly visible.
- Do not position symmetrically.
- Place in different distances to the object. Avoid a linear alignment.
- Ideally, a marker plate should be captured at least twice in a scan.

To use the marker plates in your scan project, you have to select the marker detection in the *Default Scan Options*.

8.3 Typical workflow for a scan project

1. Create a new scan project: *Set the name of the scan project*. Otherwise, a scan project with the name **Freestyle** is created.
2. Plug the sensor to your tablet computer.
3. *Color camera calibration*.
4. *Start capturing*. As long as you do not close the scan project, every new scan will be saved to this scan project.
5. *Start processing*.
6. *Place Scans (SCENE Process and SCENE)*.
7. Scan point inspection and analysis.
8. Create the comprehensive project point cloud.

8.4 Typical workflow for a Freestyle^{3D} scan project

1. Create a new scan project: *Set the name of the scan project*. Otherwise, a scan project with the name **Freestyle** is created.

2. Plug Freestyle3D to your tablet computer.
3. *Calibrate* Freestyle3D (recommended).
4. *Device White Balance* Freestyle3D (recommended).
5. *Start capturing*. As long as you do not close the scan project, every new scan will be saved to this scan project.

   By default, the scan project is saved to the microSD card.
6. *Import a Scan Project (SCENE Process)* from the microSD card to your workstation.
7. *Start processing*.
8. *Place Scans (SCENE Process and SCENE)*.
9. Scan point inspection and analysis.
10. Create the comprehensive project point cloud.

8.5 Set the name of the scan project

To have your scans and scan projects well arranged, it makes sense to define a project location and name.

You can change this **Project Base Name** in **Options** ▸ **Capture**.

If you want to start right away, forget about that and *Start capturing*. The software will then create a scan project called **Freestyle**.

The resulting project will then be saved to the selected **Saving Location**.

8.6 Add sensor scans to an existing project

Add scans

You can add scans of a sensor scan project to a laser scanner project as well as to another sensor‘s scan project.

1. Open SCENE.
2. Open the scan project.
3. Capture the scans as described in the following chapters.

Your new scans will automatically be added to the scan project.

Import scans

You can import a sensor‘s scan project to a laser scanner project.

1. Open SCENE.
2. Open the scan project.
3. Select **Import**, then click **Import Projects**.
4. In your file system browser, select the file to be imported.

Your Freestyle3D scans will be added to the project.

8.7 Capture (SCENE Capture and SCENE)

8.7.1 Default Scan Options

The **Default Scan Options** tab provides some additional settings which are not essential for the capturing process, but maybe important for the processing and evaluation of your scan project. These options are used during capturing and post processing.

	If you need to modify one of the settings later in SCENE Process, you can do that in the *Scan properties* dialog. After that, you'll have to *Start processing* again.

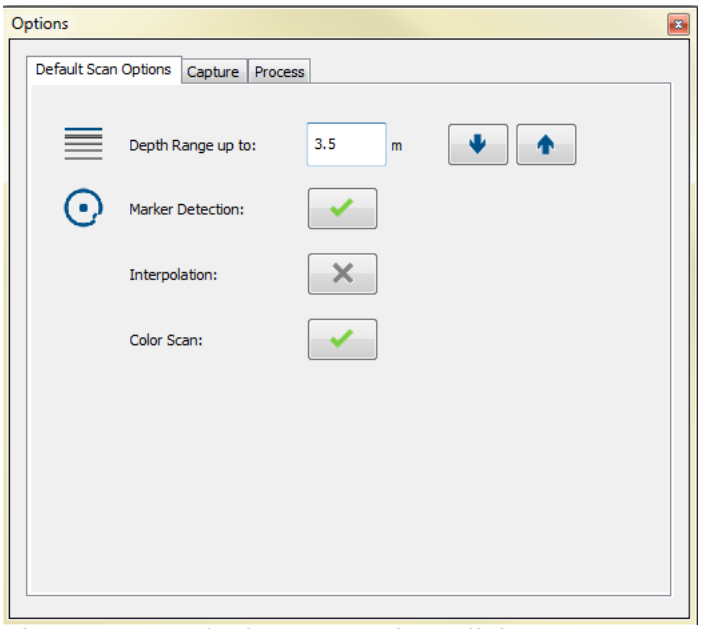


Figure 8-2: Default Scan Options dialog

1. Open SCENE Capture, or SCENE.
2. Click or tap the **Options** button in the toolbar, then click the **Default Scan Options** tab.

Depth Range

If you know in advance that your scan scenery will not exceed a limited range, set this range

- by clicking or tapping the up or down arrow, or
- by entering a value.

The scan points outsides this range will be cut off.

	For Freestyle^{3D} and Freestyle^{3D} X, you can not set values smaller than 50 cm. The reason is that Freestyle^{3D} and Freestyle^{3D} X have a blind angle in which capturing is not possible.

Marker Detection

You can use the markers on the calibration plate to verify measurements, or you can use the little marker plates which are available as accessory. You can also use them as reference points when placing your scans. For this, activate **Marker Detection,** place the calibration plate into the scene and scan it together with the objects. SCENE Capture will detect the markers and saves the information together with the scan project.

Interpolation

Select interpolation to create dense scans for Freestyle^{3D}.

See chapter *"Interpolation" on page 38* for detailed information.

Color Scan By default, color scans are generated. But, if you do not need the color, you can deactivate this option. The color information will then be dropped.

8.7.2 Capture options

The **Capture** tab offers some settings which may be useful during capturing. These options have no effect for the post processing.

1. Open SCENE Capture, or SCENE.
2. Click or tap the **Options** button in the toolbar, then click the **Capture** tab.

	• The Flash feature is only available for Freestyle3D. • If required, you can change the Follow Camera and the Flash settings while capturing.

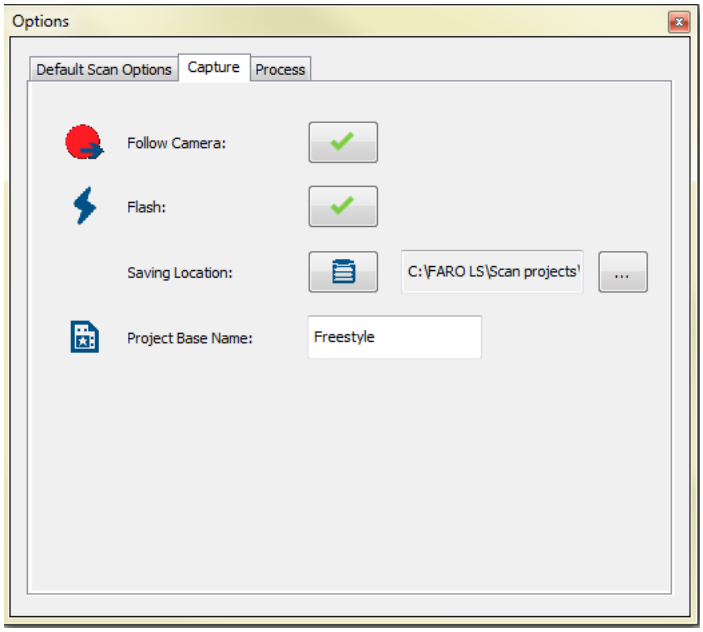


Figure 8-3: Capture dialog

Follow Camera

The 3D View corresponds to the direction of view the sensor has. The view point is set approximately 1 meter behind the device.

When Follow Camera is deactivated, the Point Cloud View does not show the device's movement.

Flash If you need the flash-light while capturing, select by clicking the button.

WARNING	
	Strobe light The flash-light is a strobe light and can be hazardous to persons who may be susceptible to epileptic seizures. In case of doubt, switch the flash-light to OFF.

On: Flash-light is always switched on.

Off: Flash-light is not switched on.

Auto: Flash-light is switched on if the camera detects that the light is not sufficient. As soon as the light situation gets better, the flash-light is switched off again.

Saving location

By default, your scan project is saved to the microSD card.

To choose another location, click the button. Now, you can choose any other location to save the scan project.

Project Base Name

The default setting is FREESTYLE. To enter a new scan project name, mark the default setting and overwrite it. The name may not include spaces and some special characters. If you try to enter one, the software will display a message.

8.7.3 Interpolation

Select **Interpolation** to create dense scans. Scan data will be intensified and small point gaps will be closed.

	Interpolation improves the look of a scan, but may cause inaccuracies like for example rounded corners. Fine structures may occur bolder, or, on the contrary, are invisible. If your object or scene shows fine structures, or if you plan to measure in the scan, you should not use interpolation.

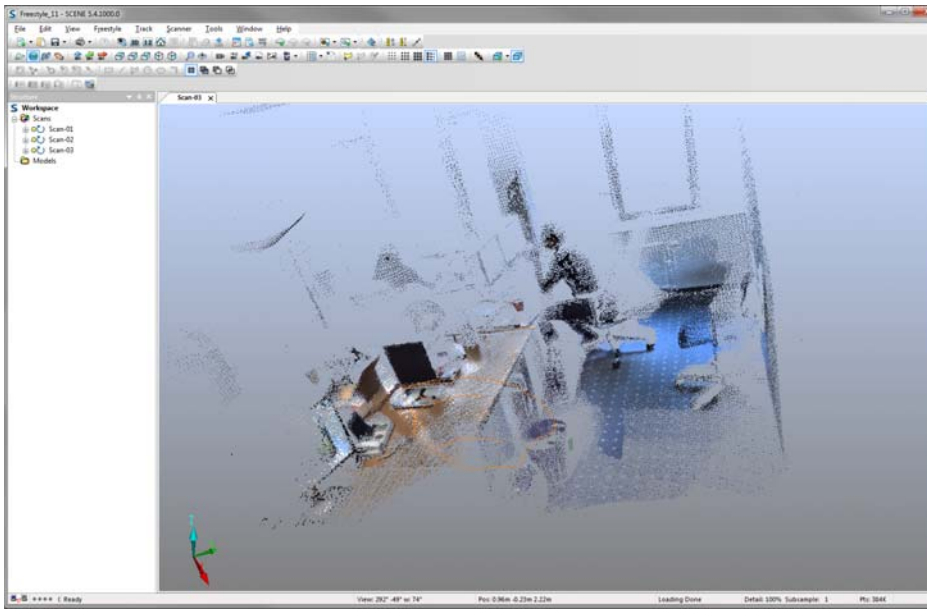


Figure 8-4: Scan with deactivated interpolation

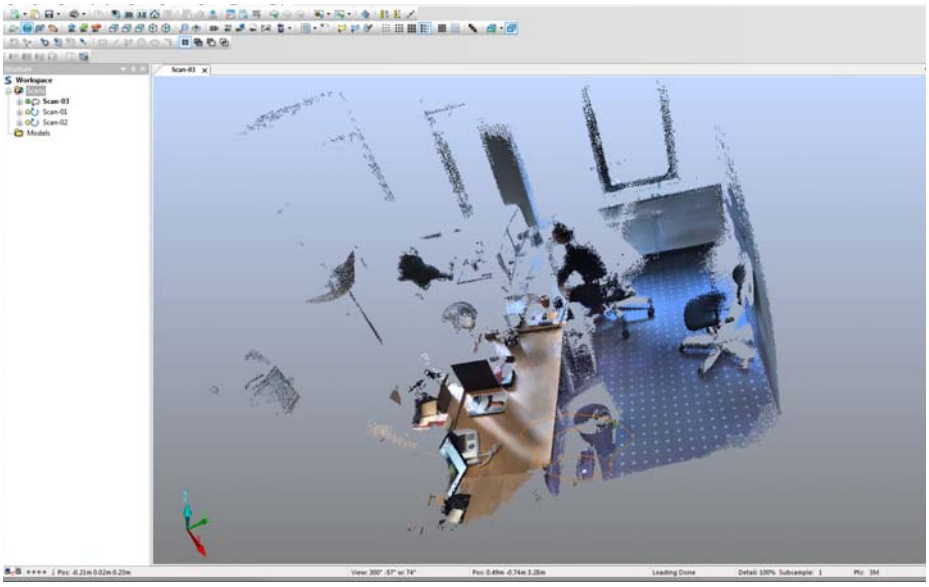


Figure 8-5: Scan with activated interpolation

8.7.4 How to capture

Scanning with a sensor is quite simple, but there are some rules which are important to know.

- Make sure that the object of interest is within the specified maximum range and that it is not closer than the minimum range of the sensor.
- Objects or surfaces may have an increased range noise if they are directly illuminated by bright sunshine.
- Move the sensor slowly and constantly, avoid jerky movements. Fast and jerky movements may lead to inaccurate data or tracking will get lost.
- Avoid
  - capturing objects against direct sunlight. This will result in limited scan data in this area.
  - having only plain-colored surfaces in the device field of view.
  - having only shiny surfaces in the device field of view, like for example metal rails, or high-gloss lacquer.
  - having only highly absorbing surfaces in the device field of view, like for example black furniture.
- Try to move the device in circles or loops. This helps to proceed loop-closing.
- Try to finish a scan at the place where you began. This helps to proceed loop-closing.
- Objects shall not move while they are captured.
- If the number of features is low or badly distributed, try to move the sensor's field of vision to areas with more structures.
- If the lighting conditions are bad, use the auto flashlight to get better results.
- Watch the display during capturing. As long as the captured object "is green", the point density will be high. If the object "is yellow", the point density will be at a lower extent.
- If you are not able to scan dark areas, treat these with developer spray.

- If you are not able to scan shiny areas, treat these with anti-glare spray.

8.7.5 Start capturing

WARNING	
	**Eye injuries caused by laser beams** Although the sensor is classified as a laser class 1 device, it might be dangerous if the laser beams point to someone‘s eyes. Be careful when scanning people or animals. Do not aim to your or someone else's eyes from a close-up distance.

NOTICE	
	**Freestyle^{3D}: Damage to electric or electronic components** In certain situations, you would be statically charged. As soon as you touch the metal parts of Freestyle^{3D}, high voltage will discharge to the device and cause serious damages. Always hold Freestyle^{3D} by its handle. Do not touch the metal rings around the glass covers on the lower side of Freestyle^{3D}.

	**Freestyle^{3D}: Inaccurate scans** Always hold Freestyle^{3D} by its handle. Do not grab the device by one of its arms. Since Freestyle^{3D} is a high-precision measuring device, even the slightest bending of the device will result in inaccuracies or even errors.

1. Start capturing by
   - pressing the button on top of Freestyle^{3D}, or
   - by tapping or clicking the  button in the toolbar.

   After a few seconds, a split window shows up with the 3D Point Cloud View on the left and the 2D Video View on the right, as well as a progress dialog.

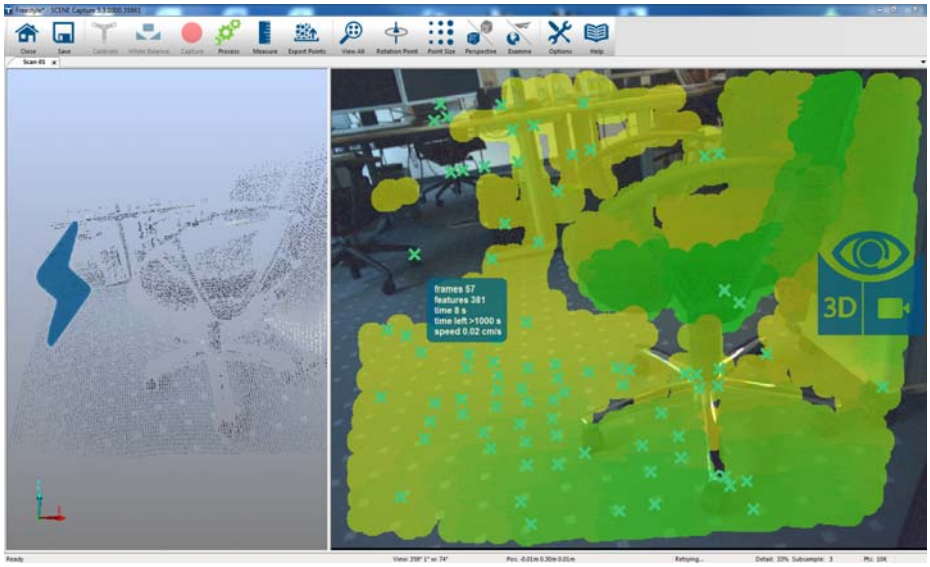


Figure 8-6: Screens while capturing: Point Cloud View and Video View

Freestyle3D only: On the left side, the flashlight button is shown. Tap it to switch the flashlight to automatic, on or off.

On the right side, the 3D camera button is shown. Tap it to toggle between 3D Point Cloud View on the left and the 2D Video View on the right, or only 3D Point Cloud View, or only 2D Video View.

Point Cloud View Shows captured points in a 3D View. It will build up in real-time.

Video View Shows the video camera's view which is supplemented by several colored attributes which support you while capturing.

Crosses

The crosses symbolize recognized features which are important later on, when you process the scan. If the number of features gets below a certain threshold, tracking is no longer possible and is lost. Always make sure to have enough features in the field of view.

Colored shades

Regions in the Video View that have a low density are colored yellow.

Regions with a sufficient density are colored green.

In addition to that, regions for which no 3D data is captured at the moment are not colored. To get a good quality scan, try to scan until everything you want to scan is shown in green color.

8.7.6 Quality indicators

	Too much light or less light.	Warning sign.	Modify light conditions, e.g. by switching lamp on/off.
	Less contrast.	Warning sign.	Areas with less or no contrast, usually when capturing large planes, like white walls.

	Picture gets blurry.	Warning sign.	Areas with less or no features.
	Movement too fast.	Warning sign.	Move device slowly and constantly.
	Scan got lost.	Warning sign.	Try to resume capturing. Check in *Tracking lost: resume tracking* how it works.
	No 3D data.	Warning sign.	• Insufficient 2D or 3D structure, capturing could not be initialized. • Invalid device calibration.
	Initialize scan.	Info sign.	Try to keep the scanner steady and wait until the sign disappears.

8.7.7 Tracking lost: resume tracking

If tracking was lost, you can resume it.

As soon as the tracking was lost, the view changes: the Point Cloud View disappears, and you will now see a smaller window which shows the moment where tracking was lost.

If the loudspeakers of your computer are switched on, you will hear an acoustic signal.

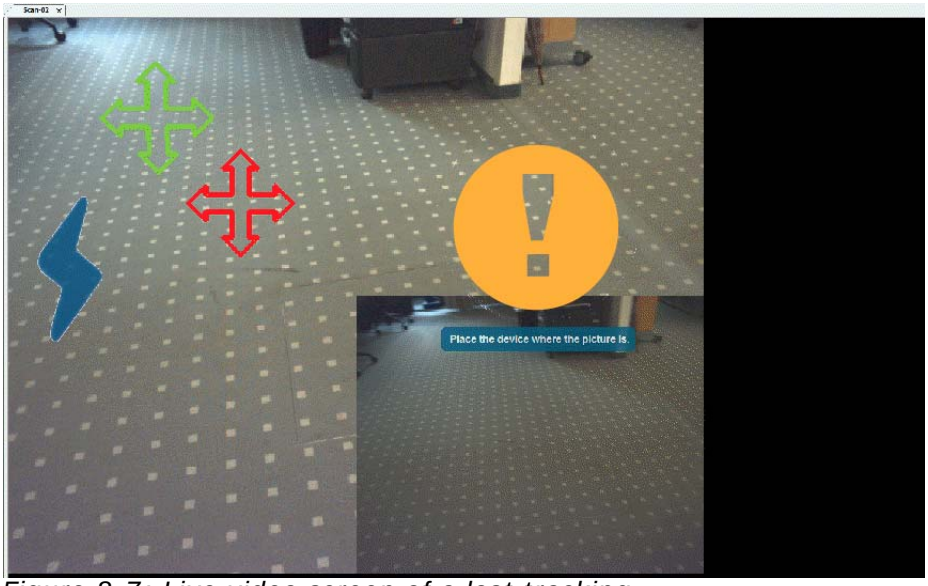


Figure 8-7: Live video screen of a lost tracking

⇨ Move the sensor so that the video view and the view in the small window match. Then, a green and red cross-shaped icon will appear in the live video picture.

⇨ Try to move the sensor so that the red and green crosses in the live video picture match.

Tracking should then resume automatically.

	In certain situations, it might be a problem to resume tracking. SCENE Capture counts the time, and, after about 30 seconds, automatically stops capturing and starts with a new scan. When you process your scan project later on, you can decide if the aborted scan could be useful or not.

8.7.8 Low storage space

While you are capturing, SCENE Capture checks whether there is sufficient storage space on the media you specified in **Options**  .

As soon as the storage space gets low, a warning icon is displayed.

If this icon is shown, finish the scan as intended. You do not need to stop the capturing immediately. SCENE Capture will then finalize and save the scan project.

8.7.9 Stop capturing

1. Stop capturing by
   - pressing the button on top of Freestyle3D, or
   - by tapping or clicking the  button in the toolbar.

Once a scan is completed, you will get the following folder structure in the project's workspace:

- Scans: Contains all captured scans.
- Scan (named according to the scan name specified in the settings): Contains all the frames, and other objects of a single scan.

In the scan‘s properties, more information is displayed, like some statistics and the history. *For more information, see “Scan properties” on page 27.*

8.7.10 Your first results

⇨ Double-click or double-tap on a scan‘s name in the project‘s workspace. The 3D View will be shown.

⇨ Have a look at your scan and check it. You can rotate the object since rotation mode is set by default. Click or tap on the 3D View and move the scan.

	SCENE Capture does not process and display all the captured data. So, the scans may appear in a lower quality. As soon as the scan project was processed, you will see the real quality.

Automatic levelling

Freestyle3D uses the build in sensors to level scans automatically. The z-direction is “up” for all scans.

8.7.11 Transferring the scan project (SCENE Capture)

SCENE Capture provides an Export process which works via microSD card and which is used to transfer scan projects from a tablet computer to a workstation.

By default, the software saves the scan project to the microSD card. So, if you finished scanning, close SCENE Capture. After doing that, you can

release the microSD card from the tablet computer and continue with processing the scan project on your workstation and with SCENE Process.

See "Import a Scan Project (SCENE Process)" on page 45.

Chapter 9: Import a Scan Project (SCENE Process)

After you inserted the microSD card into the computer, you can import a scan project automatically.

Import and open a scan project

1. Open SCENE Process.
2. Insert the microSD card into the computer. You may need an adapter to do this.

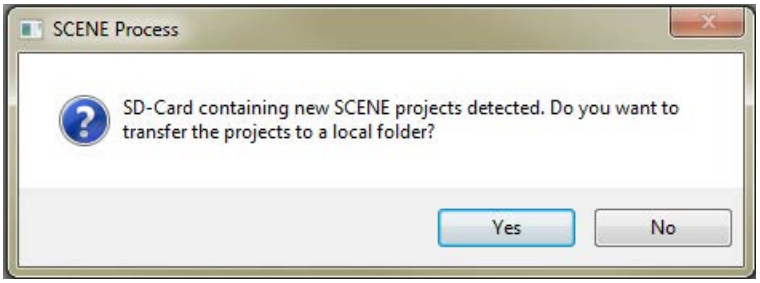


Figure 9-1: Import message

A message appears asking if you want to start an automatic data transfer.

3. Click **Yes**.
4. SCENE Process imports the scan project. This may take several minutes.
5. In the **Project Selector** window, navigate to your project.

Double-click on the project preview of the scan project.

Chapter 10: Process the Scan Project

This chapter will give you a description on how to process a scan project. Advanced functions are described briefly since those functions need at least basic experience with the SCENE software.

	For more information on visibility settings and point clouds see the SCENE User Manual.

10.1 Processing options

Processing is executed with the scans which are selected in the Structure View. If you do not select scans, the scan project will be processed.

If you did not do any processing of your current scans before, **Process** will execute the steps **Replay**, **Optimize Scans**, **Color smoothing**, and **Stray point filtering** one after another. Afterwards, the point cloud is created automatically. This may take a while, do not interrupt it.

If you executed one of the single steps before, **Process** will execute the missing ones.

There is a possibility to influence which steps are executed: the **Options** ▸ **Process** dialog.

	Only those functions will be executed which are activated in the **Process** tab.

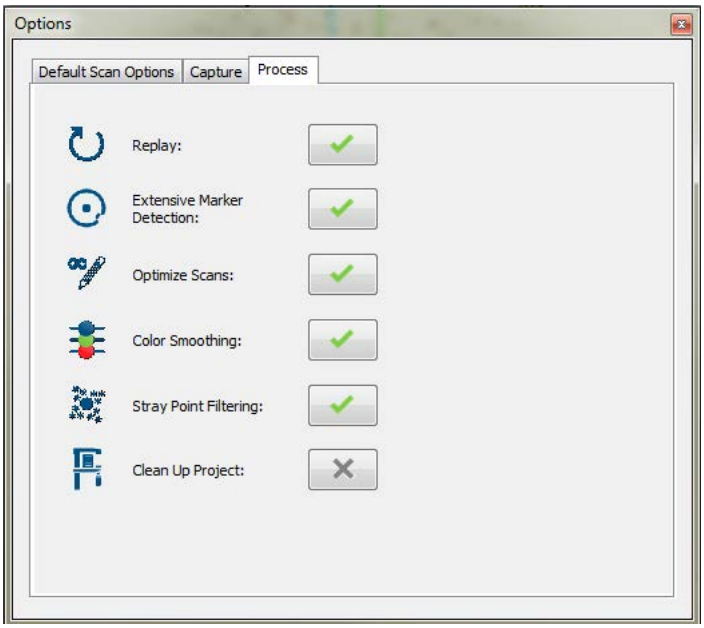


Figure 10-1: Process dialog

1. Click or tap the **Options** button in the toolbar, then click the **Process** tab.
2. Activate the processing steps which shall be performed.
3. Leave the dialog by clicking the button in the upper right corner.

10.1.1 Replay

If scans did already pass some processing steps, **Replay** turns the scan process back to the beginning.

Processing is now executed with higher precision than it was done during capturing. More scan points are created.

Some capturing options are used for **Replay** again. These are:

- Depth range
- Detect marker

Replay as a single function

In the Structure View, right click the scan, then click **Operations** ▸ **Replay**.

10.1.2 Extensive Marker Detection

SCENE Process provides a further possibility to detect the markers you have placed in the scene.

While the marker detection in SCENE Capture checks if there are markers in the live scene, this marker detection now searches for marker images in your scans. This search is somewhat time consuming, but more precise.

10.1.3 Optimize Scans

Optimize Scans adjusts all frames of a scan to minimize the overall displacements errors. The function searches for loops in the scan and tries to close those loops.

Loop closing is necessary because small errors from frame to frame may accumulate over time, resulting in gaps if you return to the same position again.

Optimize Scans as a single function

In the Structure View, right click the scan, then click **Operations** ▸ **Registration** ▸ **Optimize Scans**.

You can supplement this by a precise manual registration. *See "Placing the scans (SCENE Process and SCENE)" on page 76.*

10.1.4 Color Smoothing

Averages the color of scan points in overlapping areas within the selected scan, and adjusts color effects caused by different lighting situations.

Color smoothing as a single function

In the Structure View, right click the scan, then click **Operations** ▸ **Color/ Pictures** ▸ **Color Smoothing**.

10.1.5 Stray Point Filtering

Removes stray points, creating a cleaner overall look. SCENE Process checks all scans in your scan projects to find the scan points which fit best.

Stray Point Filtering as a single function

In the Structure View, right click the scan, then click **Operations** ▸ **Filter** ▸ **Stray Point Filtering**.

Clean Up Project / Wipe Project History

As a project grows over time, numerous revisions may accumulate in the scan project history. To reduce the number of revisions and the amount of stored data when an important milestone has been reached and the

individual steps are no longer needed, you can delete all revisions, and save a new revision.

In **SCENE Process** this option is named **Clean Up Project** and in **SCENE** this option is named **Wipe Project History.**

	The **Clean Up Project/Wipe Project History** feature is meant to be used after a scan project is finalized. Do not use it during the process because of the following reasons: • The scan project history is deleted. All information about the history of a project will be lost. You will no longer be able to revert the project to a previous revision afterwards. • The video camera files are deleted. It is not longer possible to process the scan project.

1. Click the **Clean Up Project/Wipe Project History** button. After confirming a warning message, the **Share Changes** dialog opens.
2. If required, modify the entry.
3. Click the **Ok** button. The software will then start to create a new revision.

	If revision history is critical, you should use the *Export* features to export the scan project. Exporting the scan project will perform a cleanup and compact function but stores the results in a new scan project. The revisions of the original project will be kept.

10.2 Start processing

After checking the processing steps, you can continue.

1. In the Structure View, select **Scans** to process the entire scan project. Select one of the scans to process this single scan.
2. Click or tap the **Process** button  in the toolbar to start processing. During processing, the **Process** button looks like that:  .

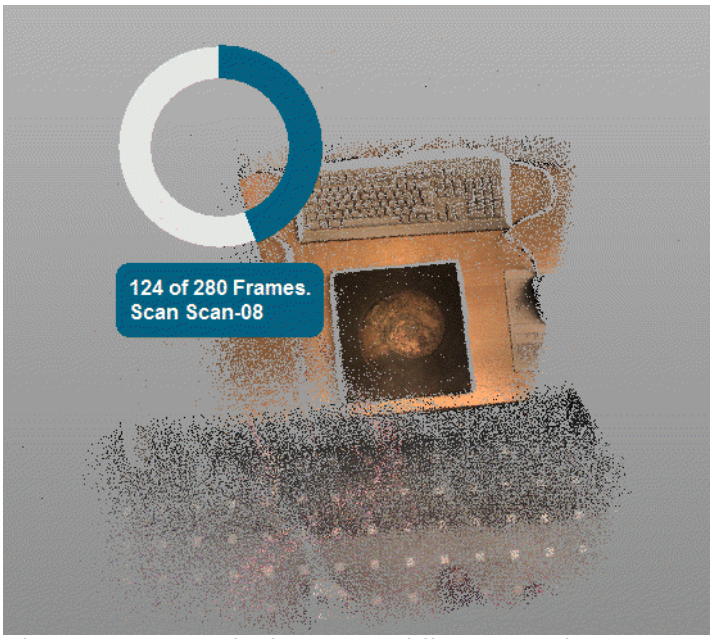


Figure 10-2: Typical screen while processing

3. Click or tap the **Process** button  in the toolbar to stop processing.

The **Process** button is shown in yellow color  , if not all processing steps were performed, that is, after you deactivated some of them in the **Process** tab.

As soon as processing is finished for all scans of the project, the **Process** button is shown in green color  .

10.3 Modifying the scan‘s view

SCENE Process shows all scans and point clouds in a 3D View.

In the 3D View, you can position yourself at arbitrary positions in space and have a look at the scan points.

The mouse is used to define the turning movements you want to perform, and with the keyboard you define the actual movement in space.

All these features are described in chapter *3D View*.

Chapter 11: Exploring Scan Data and Objects

This chapter describes the 3D View and its settings.

	For more information, see the SCENE User Manual.

11.1 3D View

The 3D View is set up with the field of view corrected, so that it appears very close to reality.

In the view, you take a position as an observer in the room and look in a certain direction to observe the scanned area with a freely selectable scale. You cannot move freely in the room as an observer. Line of sight and scale are freely adjustable. You will see the scan points of the scanned area all around you.

	On systems with NVIDIA Quadro graphics processors, the rendering performance in the 3D View might be slow or intermitted. In order to improve the rendering performance, start the NVIDIA Control Panel application (available in the Windows Control Panel) and select the global preset **3D App - Game Development** from the **Global Settings** tab.

11.1.1 Move the 3D View with your mouse

Change the scale

To change the scale, use the scroll wheel of your mouse. If you turn the wheel towards you, you increase the scale; the displayed area becomes smaller. This is similar to using a telephoto lens on a camera. If you turn the wheel away from you, you decrease the scale. The displayed area becomes larger, similar to using a wide-angle lens.

Adjust the line of sight

You can adjust the line of sight by holding the left mouse button down and moving the scan points in the direction required.

Move the 3D View

You can move the 3D View by holding the scroll wheel down, and moving the scan points in the direction required.

Move and scale

You can move and scale the 3D View by holding the left and the right mouse button down.

Moving the mouse towards you will decrease the scale. Moving the mouse sidewards will rotate the 3D View.

Fly to point

Double click or double tap on a scan point to fly to a location. SCENE Capture will then zoom into the scene and close to the selected scan point. The **Fly to point** feature is available in all navigation modes (Examine and Fly).

11.1.2 Move the 3D View with the keyboard

Key(s)	Function
Ctrl + **O**	Open Workspace
Ctrl + **N**	Create new scan project
Ctrl + **F**	Find and locate objects in workspace

3D View (general)	
B	Toggle between Walk- and Fly mode
Space	Toggle between Fly mode and Examine mode
Ctrl-Key (hold down)	Temporarily use Examine mode when another navigation mode is active
Middle mouse button (hold Down)	Temporarily use pan mode
Shift + X	Fly to point
Q, **E**	Roll camera left, right
Page Up / R **Page Down / F**	Move up Move down
+ / **-**	Zoom in or out
Shift + middle mouse button (click):	Set the rotation point
P	Toggle between perspective camera and orthogonal camera
V	Remove camera rolling
C	Toggle Clear View
T	Align camera to surface normal
X	Move Camera to 3D point
Alt + **P**	Save screenshot of current 3D View
Backspace	Go back to previous camera position
1, **2**, **3, 4**	Point size 1, 2, 3, and adaptive point size (4)
Ctrl + **A**	Select all points (only the points of scan point clouds or the project point cloud)
Ctrl + **D**	Dismiss the current scan point selection (only for point selections of the scan point cloud or the project point cloud)
Ctrl + **F2**	Create new viewpoint
F2	Go to next viewpoint
Shift + **F2**	Go to previous viewpoint
3D View (fly mode)	
Arrow Keys **W**, **A**, **S**, **D** **8**, **4**, **3**, **6** (on numeric key pad)	Move camera forward, left, backwards, right
I, **J**, **K**, **L**	Rotate camera upwards, left, downwards, right
3D View (examine mode)	
Arrow Keys **W**, **A**, **S**, **D** **8**, **4**, **3**, **6** (on numeric key pad)	Move camera backwards (object away), right (objects left), forward (objects closer), left (objects right)
I, **J**, **K**, **L**	Rotate camera downwards (move towards top view of object), counter clockwise (object clockwise), upwards (move towards bottom view of object), clockwise (object counter clockwise)

11.2 Level (SCENE Process and SCENE)

Level helps to level the scans during placement. It is a bit similar to an inclinometer, but it needs your assistance to define what is „down“ in a scan.

	• **Level** is only available when a 3D View of a scan is opened. • **Level** always works top down. For example, if you have a room ceiling as a reference, you have to select a view in which the ceiling is shown in topdown view.

1. Open a scan which you know contains a horizontal plane.
2. Click the **Level** button in the toolbar, or,
   In the Structure View, right click the scan, then click **Operations** ▸ **Registration** ▸ **Level**.

While working with Leveling, the **Level** button looks like this: . Click the button to abort the function.

In this example, we have the floor which can be used as a horizontal reference.

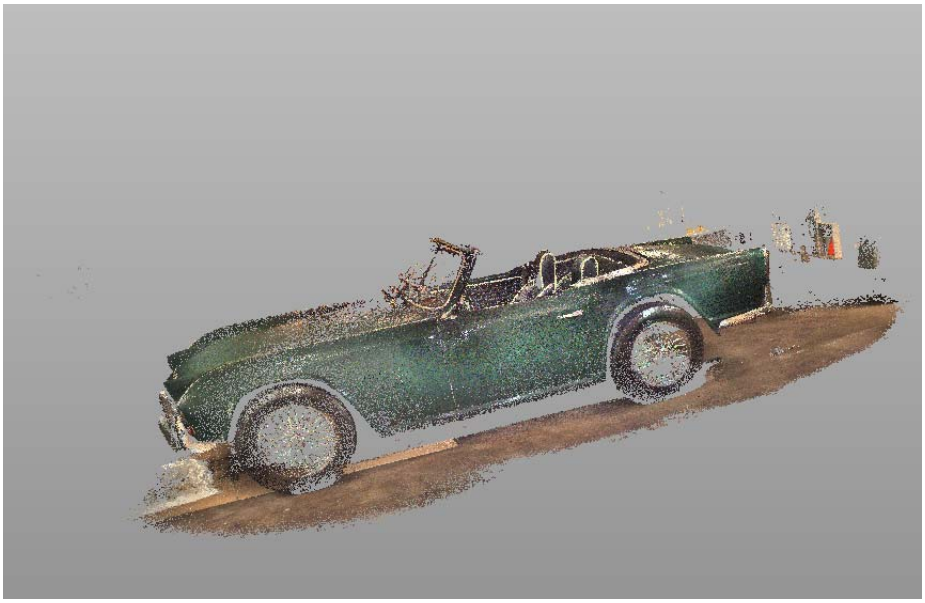


Figure 11-1: Pick a scan point for leveling

3. Pick a scan point of the plane.

This plane is used to level the scan.

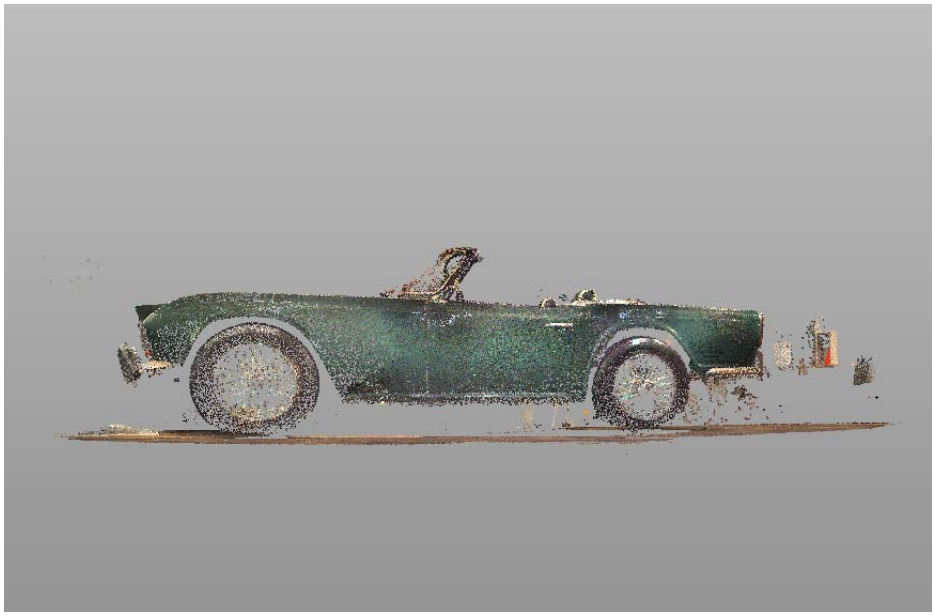


Figure 11-2: Leveled scan

1. Click or tap the **Level** button in the toolbar to close the function. You can also press the **Esc** key, if available.

11.3 White Balance (SCENE Process and SCENE)

Scans may appear with biased colors when they were captured under non-optimal conditions.

The **White Balance** function offers the possibility to select a small scan area which you know that, in reality, has a white color.

The software will adjust all colors of the scan according to this setting.

	White balance only works with point clouds.

1. Click the **White Balance** button , or,

   In the Structure View, right-click the scan, then click

   Operations ▸ Color/Pictures ▸ White balancing .

   While working with **White Balance**, the button looks like this: . Click the button to abort the function.
2. Click a scan point which should be displayed in white color. If the currently shown view is not suitable, you can rotate the scan by pressing the **Ctrl** key and clicking the scan.

   The software will now use a sphere-shaped selection around the selected scan point to adjust the colors.

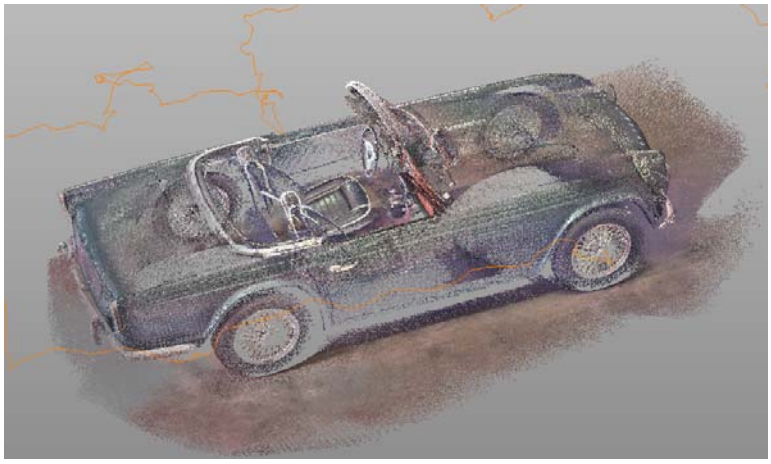


Figure 11-3: Scan before using White Balance

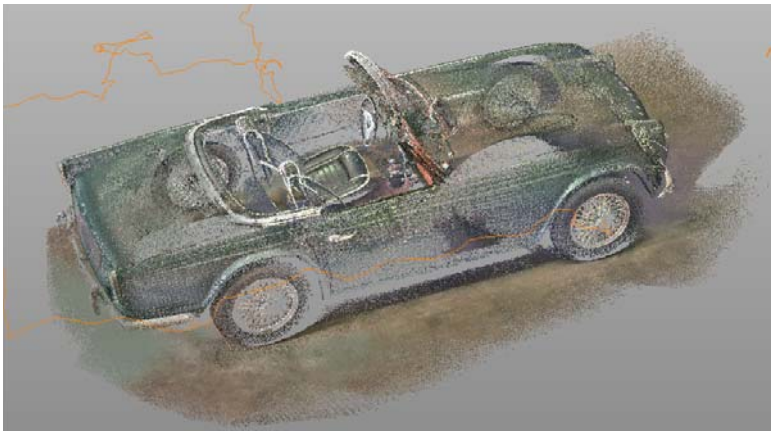


Figure 11-4: Scan after using White Balance

The software will ask you whether you are satisfied with the result. If you do not like the result, click the **No** button, and the settings will be undone.

3. Click or tap the **White Balance** button in the toolbar to close the function. You can also press the **Esc** key, if available.

11.4 Measure distances

With renovations, you are often confronted with the question of whether there is still enough space in the building for the intended machinery. Since you can only rely on the CAD model of the building to a certain extent, you will probably have to examine and take measurements of the critical places on site. Using scanned reality, you can easily address queries at your computer, such as: What is the clearance height of this gate? How great is the distance between these supports?

There are two different approaches for measuring distances:

- between scan points,
- between markers on the calibration plate, or markers on the marker plates.

	• In SCENE Capture, measurements are not saved with the scan project. They disappear when you close the scan's view. • If you work with a tablet computer, use the pen to pick measurement points.

To start a measurement between two or more scan points, click the **Measure** button in the toolbar.

While working with Measure, the **Measure** button looks like this: . Click the button to abort the function.

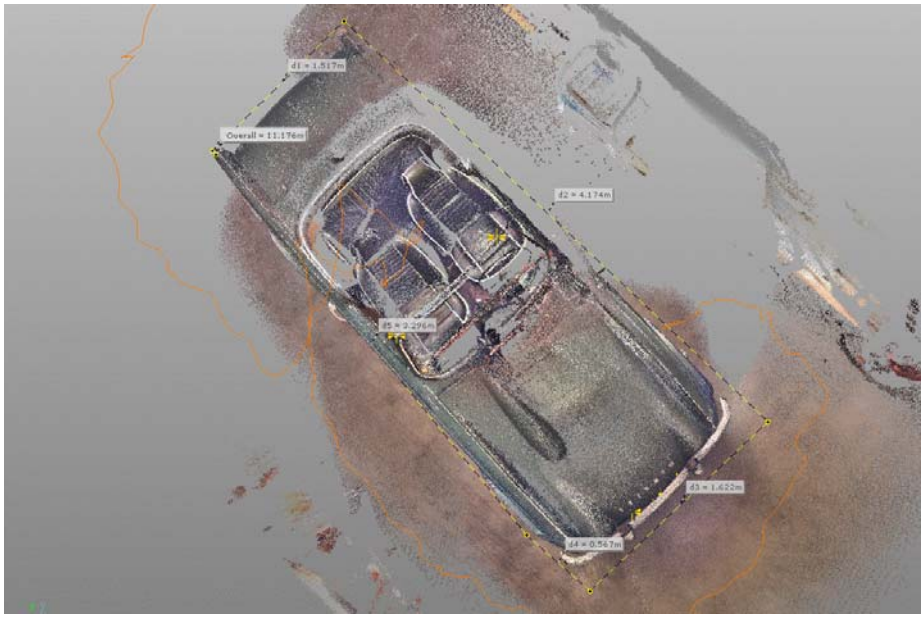


Figure 11-5: Point-to-point measurement

Select measure points

1. Select valid scan points with the tablet's pen, or by clicking them with the left mouse button. If you need to rotate the scan, press the **CTRL** key to switch to the rotation function, then click and rotate the scan. Release the **CTRL** key to continue the measurement.
2. Select the last measure point and finalize the measurement with a double-tap of the pen, or double-click of the mouse.

- To cancel the current measurement, click the **Measure** button or press the **Esc** key.
- To leave the measurement process, cclick the **Measure** button or press the **Esc** key.

A new point-to-point measurement is added to the **Measurements** folder of the Workspace.

	Point-to-point measurements may be susceptible to single noisy scan points.

A yellow-dashed line is drawn between the measure points.

Two blue-dashed lines which stand in a 90 degrees angle over the yellow-dashed line, are added to show the horizontal and the vertical length.

Labels show the overall distance and the length of each measure segment.

11.5 Verify measurements (Freestyle3D)

There may be situations in which you have to prove that your virtual measurements are as precise than real measurements.

You can use the Calibration Plate to verify your virtual measurements.

Figure 11-6: Line marks on the Calibration Plate

1. Take the Calibration Plate and measure the distance between the two line marks with a tape measure or similar.
2. Place the Calibration Plate into the scene. If you do already know which object is of interest, place the calibration plate close to that object.
3. Check, that the Calibration Plate is clearly viewable from different perspectives.
4. Scan the scene.
5. Click the **Measure** button  in the toolbar.
6. Measure between the center points of those markers which are situated between the line marks. The result of this virtual measurement should be very close to your measurement on the real Calibration Plate.

11.6 Brush Selector

The brush selection can be used similar to brush tools known from 2D image processing programs. It works with scan- or project point clouds only.

The brush works in three dimensional spaces, meaning that you can use the mouse to literally paint points which are going to be selected.

The brush has the shape of a sphere. A transparent red circle will highlight the area where the selection sphere is currently located.

1. Click the left mouse button to define the starting point of the selection, hold the button down in order to paint the points.

2. Moving the cursor around while having the brush selector tool activated will highlight the scan points that are currently within the selection sphere.
3. Use the mouse wheel to modify the radius of the sphere.
4. Hold the shift key to modify the sphere radius more quickly.

Chapter 12: Tailor a Point Cloud View with the Clipping Box

Clipping boxes provide an easy access to areas of interest of a 3D point cloud. They allow slicing the point cloud and clipping away specific areas which enables you to display or hide certain points of the 3D point cloud.

There are two types of Clipping Boxes:

- Clipping boxes with the points outside of the box hidden. Only the points inside the box are displayed.
- Clipping boxes with the points outside the box displayed, points inside the box are hidden.

Clipping boxes may also be used to select scan points in the 3D View in order to perform certain operations on these points.

- Clipping boxes can be applied to the points of point clouds, not to the points of scans. In such a case, create point clouds by clicking **Process** (*"Processing options" on page 47*).
- If your scan project contains more than one scan, place those scans first, then use the Clipping Boxes for the entire scan project.

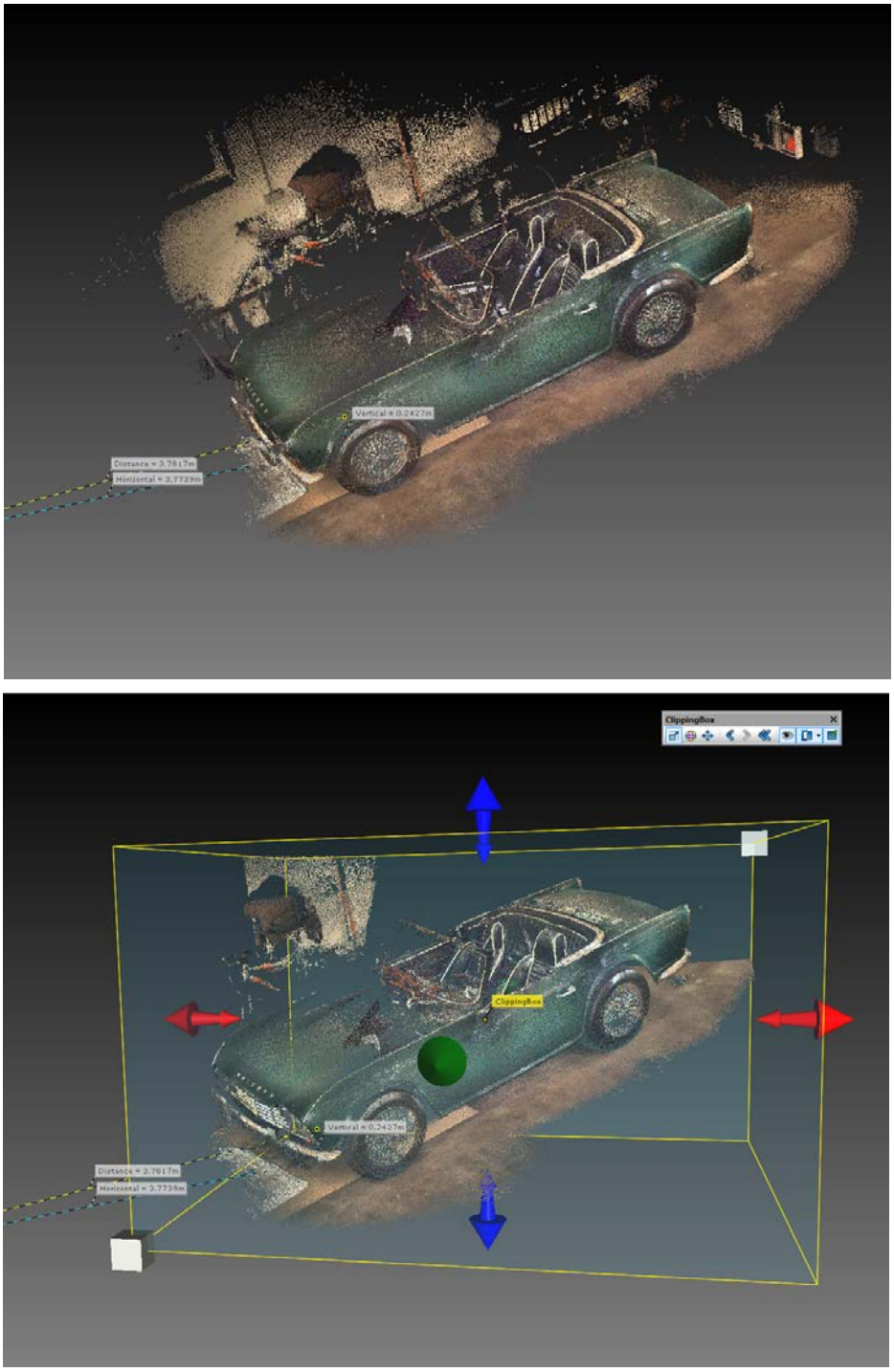


Figure 12-1: 3D View without (upper picture) and with Clipping Box (lower picture)

12.1 Creating a Clipping Box

1. Open a 3D View and navigate to the area of interest.
2. Click the **Create a new Clipping Box** button in the Clipping Box toolbar. A Clipping Box will be created close to the center of the current view. The created Clipping Box will be scaled so that it covers roughly two thirds of the screen.

The created Clipping Boxes are saved to the workspace for later use and will be added to a folder **ClippingBoxes** in the **Structure View**. Those folders are added as follows:

- New Clipping Boxes are local, which means, they will be placed below the object the 3D View is opened on.
- If the overall project 3D View gets opened, created Clipping Boxes will be global.
- In scan projects imported from earlier SCENE versions, Clipping Boxes will stay global.

Operations started from a 3D View which operates with Clipping Boxes will use only the Clipping Boxes visible in that 3D View.

Once created, you can reposition and resize a Clipping Box.

	• Once created, the rotation point of the view will be set to the center of the Clipping Box. • Creating Clipping Boxes does not delete any points from the point cloud. The points outside or within the Clipping Box are simply hidden and may be displayed again at any time.

12.2 Manipulating a Clipping Box

You may change the transformation of a Clipping Box by rotating, moving or changing its size.

For this, click the Clipping Box in the 3D View, or click its name in the **Structure View**. A floating tool bar will appear which provides the manipulation functionality.

Figure 12-2: Clipping Box toolbar

12.2.1 Scale button

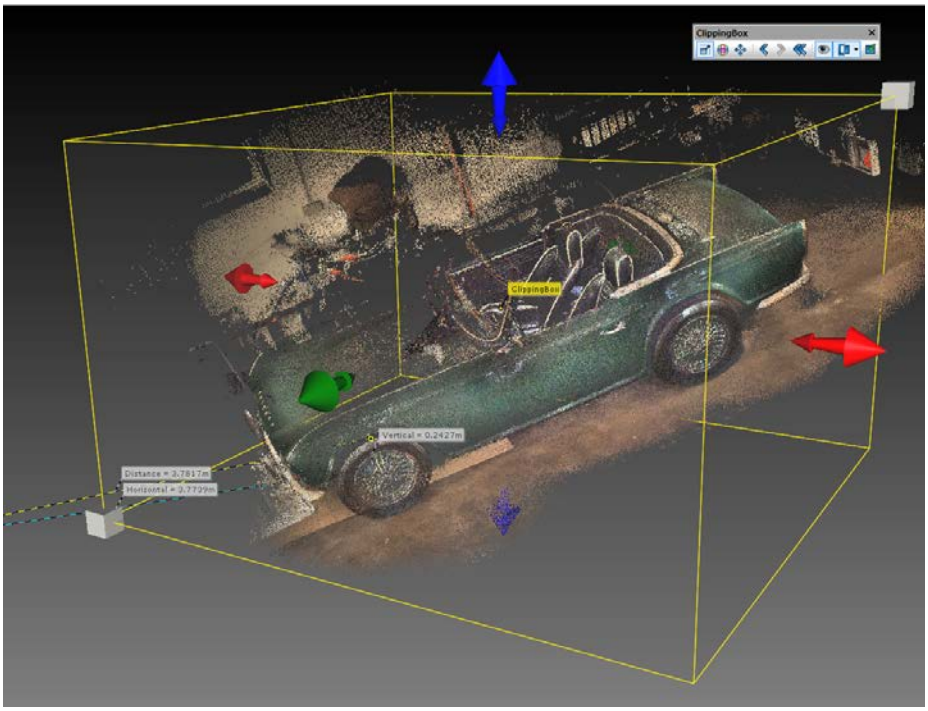


Figure 12-3: Resizing a Clipping Box

1. Select the **Scale** button from the Clipping Box toolbar to **resize** the Clipping Box. Handles will appear on the Clipping Box allowing you to resize it.
2. Drag one of the red, blue or green handlers to resize the Clipping Box. The corresponding face of the box will move.
3. Drag the grey cubes at the corners to resize the Clipping Box proportionally.

When dragging one of the handlers, the length of the movement will be indicated in the view as shown in the picture below.

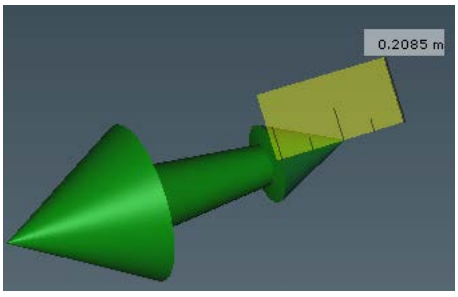


Figure 12-4: Length of movement

12.2.2 Rotate button

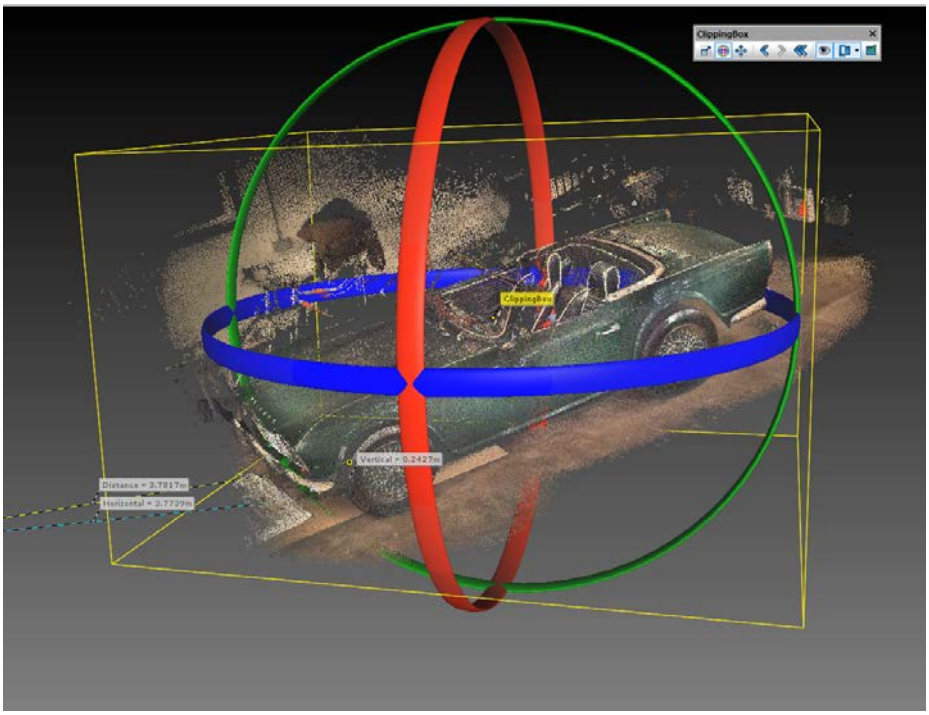


Figure 12-5: Rotating a Clipping Box

1. Select the **Rotate** button from the Clipping Box toolbar to **rotate** the Clipping Box. Handles will appear on the Clipping Box allowing you to rotate it around different axes.
2. Drag one of the red, blue or green handlers and rotate the Clipping Box along the corresponding axis.

12.2.3 Move button

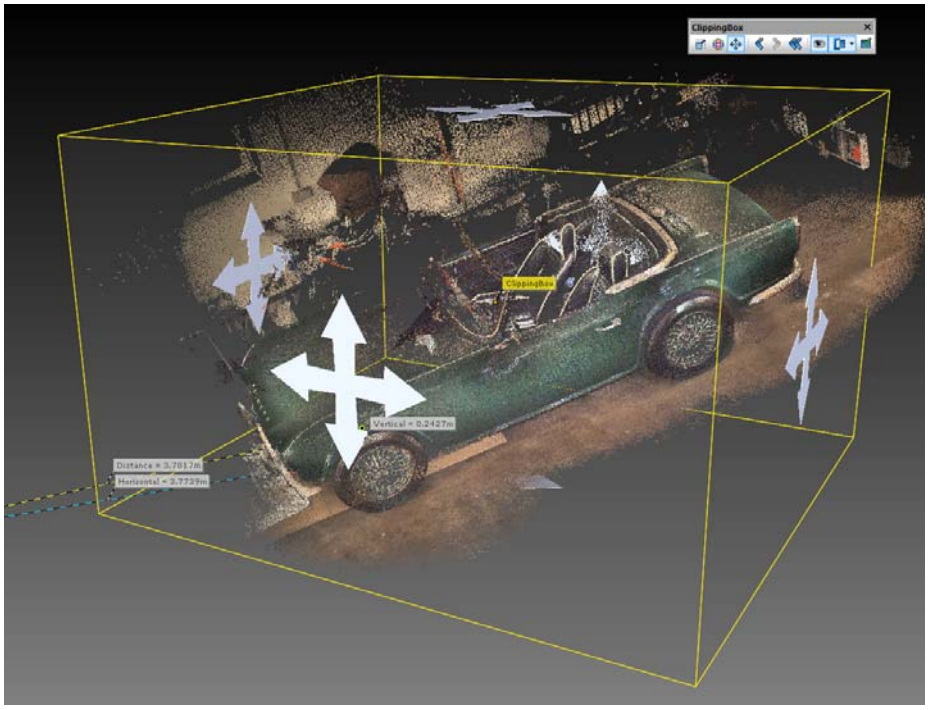


Figure 12-6: Moving a Clipping Box

1. Select the **Move** button from the Clipping Box toolbar to **move** the Clipping Box. Handles will appear on the Clipping Box allowing you to change the position of the box.
2. Drag one of the handlers (white arrows) and move the Clipping Box within two dimensions. The dimensions depend on the used handler. You may also use the keys 2, 4, 6 or 8 on the number pad instead.

	• Change the size of the handlers with the num pad "+" key (increase size) and "-" key (decrease size).
	• You may undo (and reapply) your transformation changes with the following buttons of the Clipping Box toolbar:
	  • Undo the last transformation change with .
	  • Redo the last transformation change with .
	• Restore the initial transformation of the Clipping Box with .

12.3 Hiding and Displaying Points by Means of Clipping Boxes

12.3.1 Hide button

You may select which points are displayed or not with the **Hide** button of the Clipping Box toolbar.

Hide exterior: Hide the points outsides the selected Clipping Box (this is the default setting).

Hide interior: Hide the points insides the selected Clipping Box.
This does not have an effect on the visible objects in the 3D View.

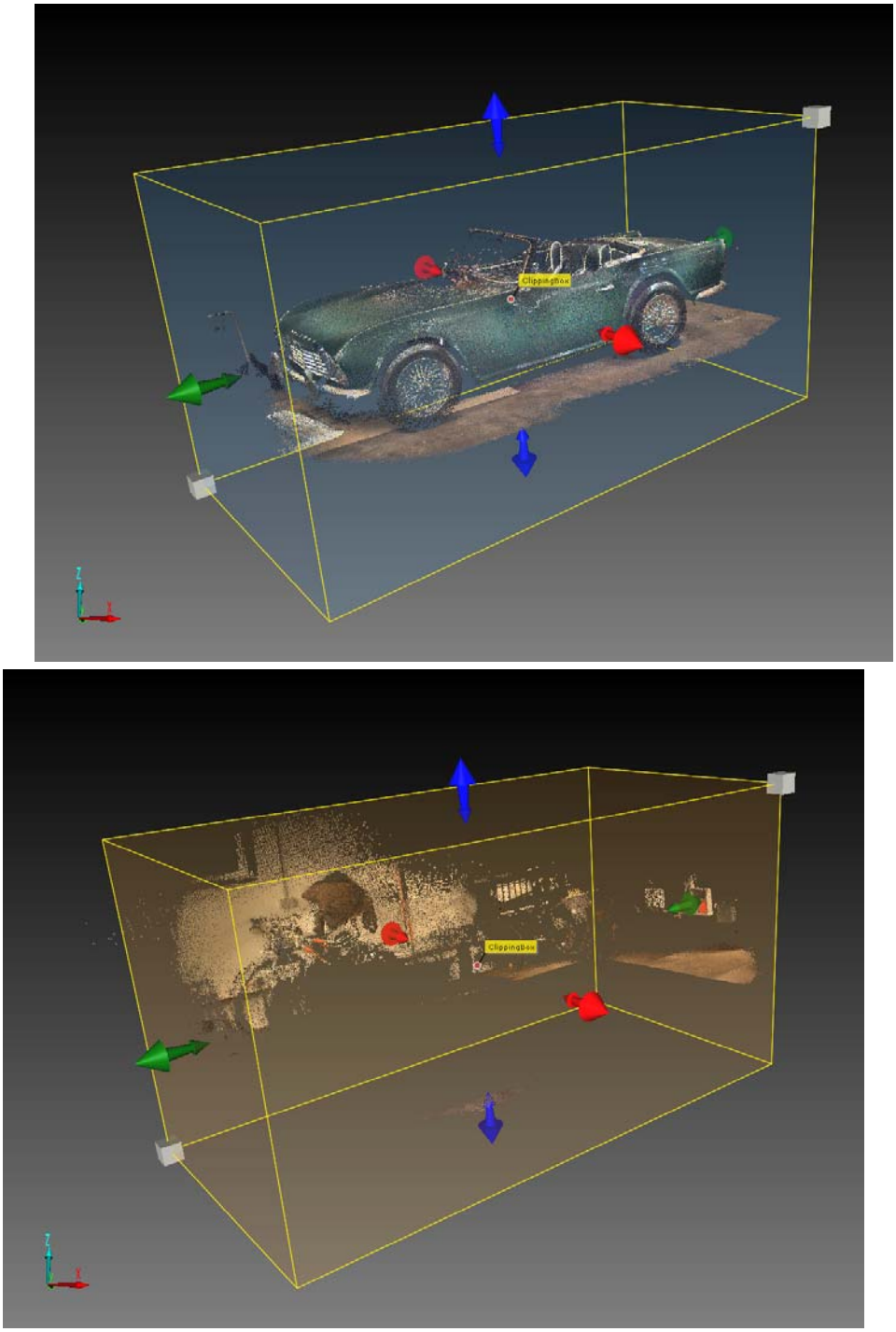


Figure 12-7: Exterior hidden (upper picture) and interior hidden (lower picture)

Depending on this setting the boundaries of the Clipping Box as well as the icon in the **Structure View** will be displayed in different colors:

- transparent blue when the exterior is hidden.
- transparent orange when the interior is hidden,

This setting will be saved in the Clipping Box properties for later use and may also be changed in the properties dialog.

12.4 Deleting Points by Means of Clipping Boxes

You may delete points of all active Clipping Boxes.

1. Execute **Hide exterior** or **Hide interior** to the Clipping Boxes.
2. Right-click an active Clipping Box, then select
   - **Delete visible points of all active clipping boxes**: All visible points of all active Clipping Boxes will be deleted, no matter if they are insides or outsides the Clipping Boxes.
   - **Delete invisible points of all active clipping boxes**: All invisible points of all active Clipping Boxes will be deleted, no matter if they are insides or outsides the Clipping Boxes.

12.5 Enabling / Disabling Clipping

12.5.1 Enable/Disable clipping button

You may enable or disable clipping of the selected Clipping Box with the **Enable / Disable clipping** button of the Clipping Box toolbar. When disabled, the points hidden by this box will be displayed again; the color of the Clipping Box boundaries and its icon in the **Structure View** change to grey.

Figure 12-8: Disabled Clipping Box

This setting will be saved in the Clipping Box properties for later use and may also be changed in the properties dialog.

12.5.2 Toggle application of Clipping Boxes button

You may also enable or disable clipping of all available Clipping Boxes globally with the **Toggle application of Clipping Boxes** button of the 3D View toolbar. This setting will not be saved in the properties of the individual Clipping Boxes.

12.6 Working with Multiple Clipping Boxes

You can combine the point visibility settings of several Clipping Boxes. For this, the following rules apply:

- Adding a Clipping Box with **hide exterior** enabled to already available and active Clipping Boxes:
  - The points inside this box will always be added to the currently visible points, even if this box intersects with boxes that have their interior hidden.
  - The points outside this box will not be hidden. In that case the clipping settings of the already available Clipping Boxes have the precedence.
- Adding a Clipping Box with **hide interior** enabled to already available Clipping Boxes:
  - This will cut out the points that are inside of this box from the points that are visible at that time, even if this box intersects with boxes that have their exterior hidden (and their interior displayed).
  - The points outside this box will not be displayed. In that case the clipping settings of the already available Clipping Boxes have the precedence.

The order of creation of the Clipping Boxes thus matters and has an effect on which points are displayed or not.

Example: We want to show the motor of the car. For this, we use a scan in which the hood is opened:

Figure 12-9: Example: Complete point cloud

Now you add the first Clipping Box around the car that has its exterior hidden (Clipping Box 1).

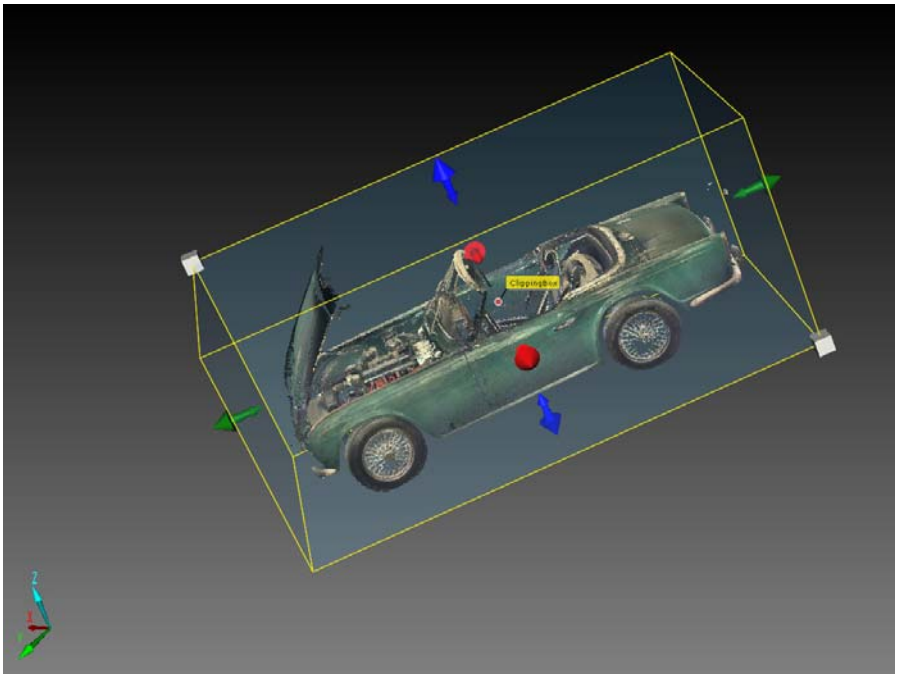


Figure 12-10: Example: First Clipping Box with hide exterior added

All the points outside the Clipping Box are now hidden, only its interior is displayed. Now you would like to remove the hood because it would disturb the view. So you add a new Clipping Box with hide interior enabled (Clipping Box 2).

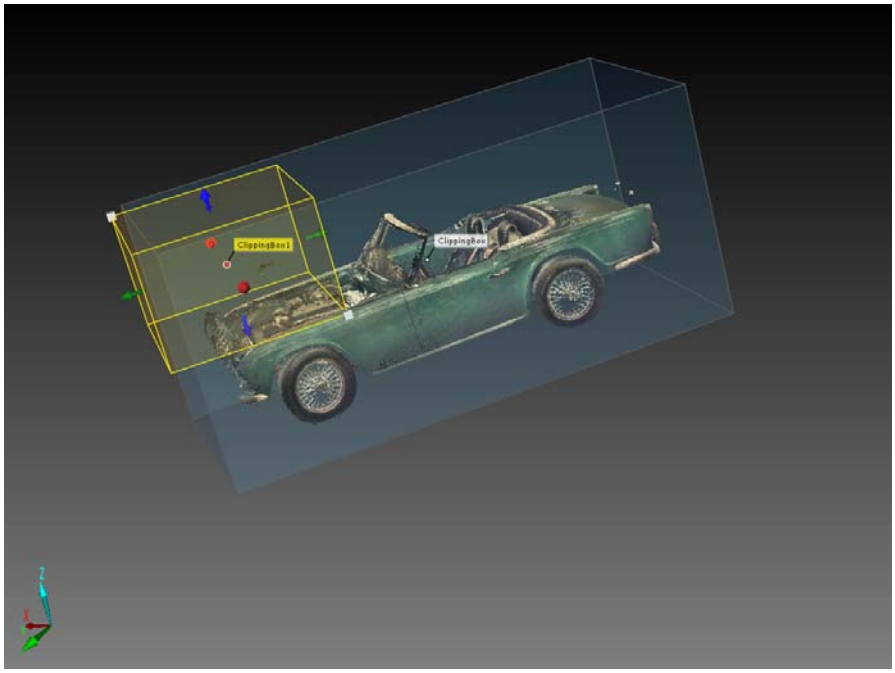


Figure 12-11: Example: Second Clipping Box with hide exterior added

The points within Clipping Box 2 are now hidden. But now you would like to hide the points of the two front fenders. So you add two new Clipping Boxes but this time with hide interior enabled (Clipping Boxes 3 and 4).

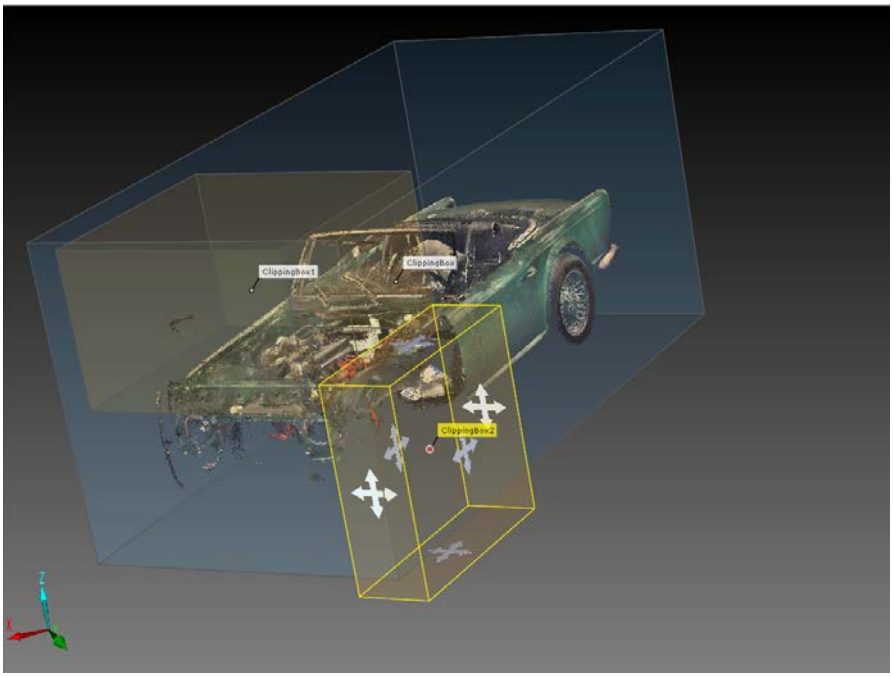


Figure 12-12: Example: Clipping box 3 with hide interior added

The points in the overlapping areas between Clipping Boxes 1 and Clipping Boxes 3 and 4 are now removed from the scene.

Figure 12-13: Example: Result with hidden Clipping Boxes

If you would like to have one or more of the available Clipping Boxes not being regarded in the current scene, you may disable them or delete them from the workspace.

12.7 Toggling Visibility of Clipping Boxes

Clipping box visibility button

Toggle the visibility of a Clipping Box

- With the **Clipping box visibility** button in the Clipping Box toolbar,
- in its context menu,
- or in its properties dialog.

Disabling the visibility of a Clipping Box will only hide its boundaries; the Clipping Box is still active (if clipping is enabled) and it still has effect on the visibility of the points in the 3D View.

12.8 Creating Multiple Clipping Boxes Along an Axis of an Existing Clipping Box

You can create multiple Clipping Boxes along one of the three axes of an already available Clipping Box which also serves as a template for the new Clipping Boxes. This allows slicing the point cloud into specific areas of interest and can be a useful feature, for example to divide a building into its several floors.

Do the following to create multiple Clipping Boxes along an axis of an already available Clipping Box:

1. Open the 3D View.
2. Navigate to the Clipping Box which should serve as the template.
3. Check if this Clipping Box has the clipping mode **Hide Exterior**. If not, select **Hide Exterior** .

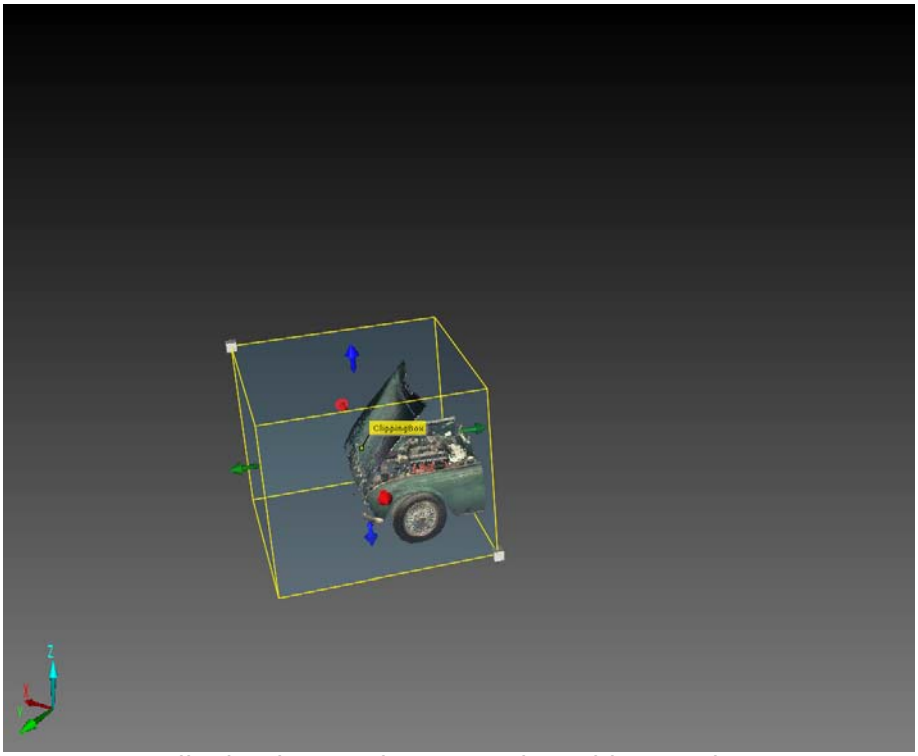


Figure 12-14: Clipping boxes along an axis - Hide Exterior

4. Right-click this Clipping Box, then click **Create Clipping Boxes Along an Axis**. Two new Clipping Boxes will be displayed according to the default settings.

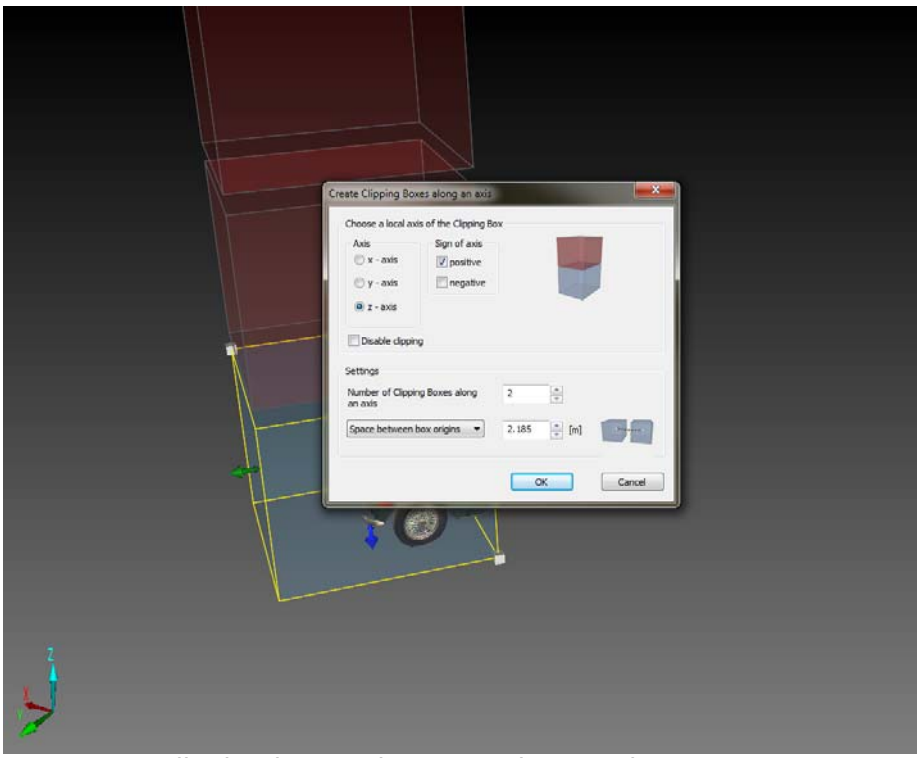


Figure 12-15: Clipping boxes along an axis - Preview

5. Make your settings in the appearing dialog: In our example, we would like to have each one Clipping Box for the front part, for the middle part, and for the rear part of the car.

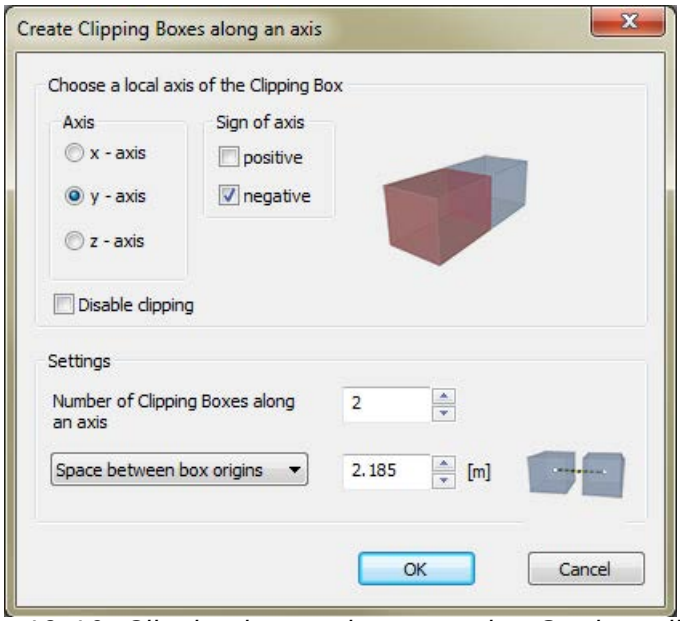


Figure 12-16: Clipping boxes along an axis - Settings dialog

Axis

Select the axis of the existing Clipping Box along which the new Clipping Boxes will be generated. A preview of the new Clipping Boxes will be available in the current 3D View.

Disable Clipping

Disable clipping in the preview.

Sign of Axis

Select the direction of the axis in which the Clipping Boxes will be created.

Settings

Number of Clipping Boxes along axis

Define the number of Clipping Boxes to be created.

Space between boxes / Space between box origins

The distance between the Clipping Boxes. There are two ways to define the distance, either between the origins of the Clipping Boxes or between the adjacent faces of the Clipping Boxes.

6. Click **OK** to create the Clipping Boxes with the selected settings.

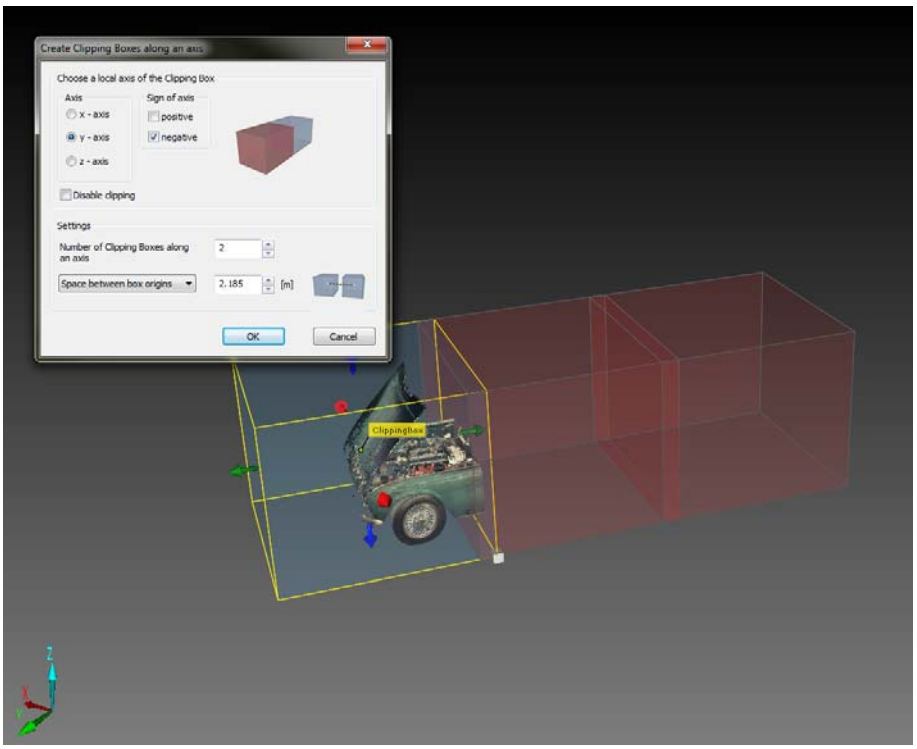


Figure 12-17: Clipping boxes along an axis - preview

The initial Clipping Box will be moved to the new Clipping Box folder and will be renamed according to the folder's name. The other Clipping Boxes will get the name of the folder and an enumeration. The Clipping Boxes will be surrounded by the so-called **Clipping Box container**.

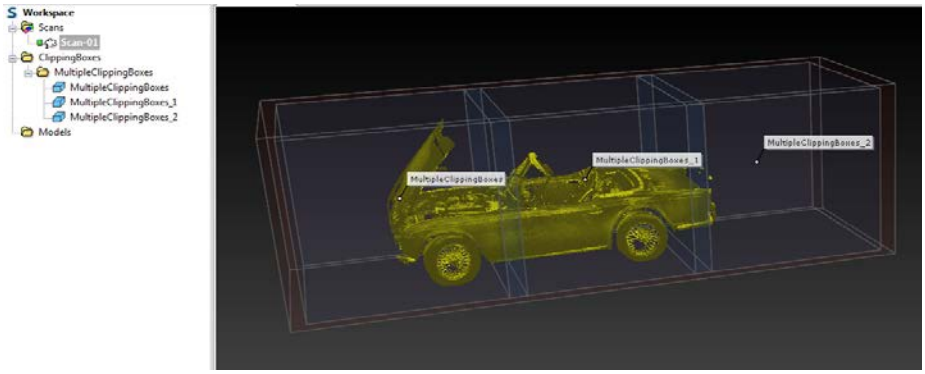


Figure 12-18: Clipping boxes along an axis, with Clipping Box container

Working with Clipping Box Containers

A Clipping Box container contains all the Clipping Boxes which were created along an axis of an existing Clipping Box. It has a transformation which consists of scale, rotation and translation.

You can rotate, move, or resize a Clipping Box container similar to a Clipping Box.

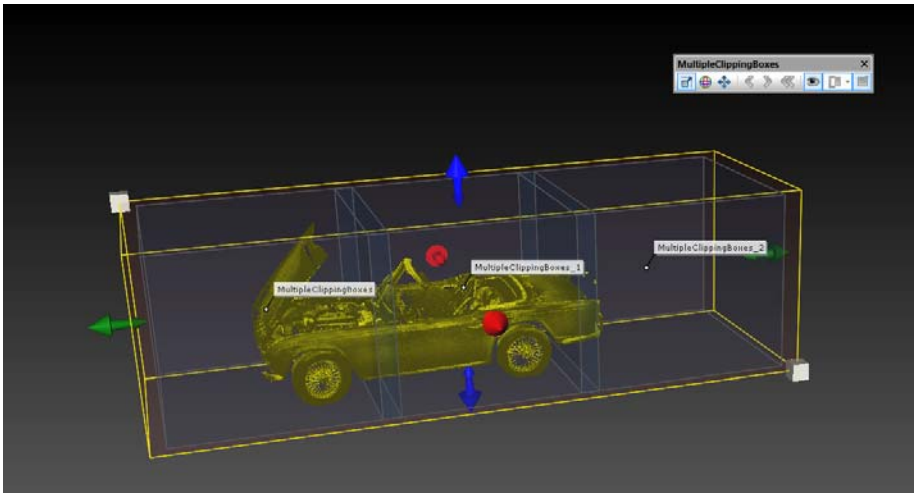


Figure 12-19: Clipping box container with resize handlers

These transformation changes will be proportionally applied to the Clipping Boxes within the container.

If required, you can change the size of the Clipping Boxes inside the Clipping Box container. It is no longer possible to rotate one of the Clipping Boxes, nor is it possible to move one of the Clipping Boxes to the outside of the Clipping Box container.

	• All Clipping Boxes within a Clipping Box container have constrained functionality:
	  • The single Clipping Boxes cannot be rotated individually.
	  • Their clipping mode cannot be changed.
	  • The single Clipping Boxes cannot leave the volume of the Clipping Box container.
	• Change the visibility of the Clipping Box container and the Clipping Boxes in the container with the **Clipping box visibility** button  in the Clipping Box toolbar or in its context menu.
	• Any tranformation of the Clipping Box container will transform the single Clipping Boxes.
	• The visibility state of the Clipping Box container is a global state and not view specific. This state will be saved with the workspace.

.

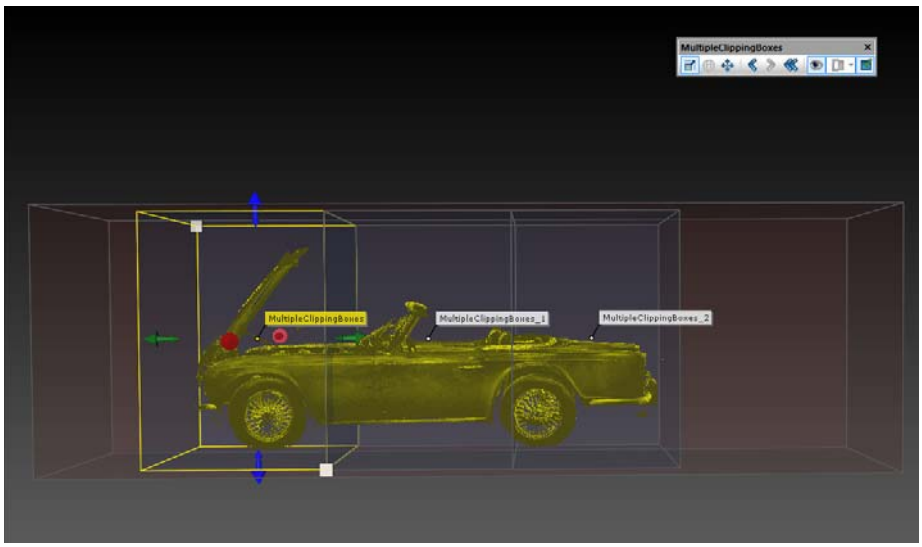


Figure 12-20: Resizing the Clipping Boxes inside the Clipping box container

12.9 Exporting Scan Points by Means of Clipping Boxes

You may also export 3D points into different file formats using the active Clipping Boxes.

1. Right-click the 3D View, or,

   right-click a Clipping Box.

2. Then, click **Import / Export ▸ Export 3D selection using active Clipping Boxes**.

SCENE Process will then create a 3D selection and export the selected points afterwards.

Additionally, you may export the points in a local coordinate system defined by one of the available Clipping Boxes. For this, select **Use Local Coordinates** in the export dialog and select the Clipping Box from the available list.

	• Only the points of point clouds will be exported. • The **Export** menu shows the **Color / grey** option as well as the **Full scan** option greyed out, because they don't make sense for a point cloud.

Chapter 13: Place Scans (SCENE Process and SCENE)

This chapter explains how to place scans by selecting corresponding scan points. The process of placing scans is also known as **Registration**.

Scan points are captured and saved in a coordinate system which is relative to the scanner. If you have two or more scans taken at different locations in a room, right after scanning they will only know their own scan coordinate systems. But of course in reality the origins of these scan coordinate systems have been at different positions in the room, and therefore it is necessary to determine the spatial relationship between them. This is called placing the scan, and the step from the scan coordinate system into the overall coordinate system is called transformation.

The basic principle behind scan placement is very simple: so called **target objects** are identified for which not only the scan based coordinates can be determined, but for which also their coordinates in a more general overall coordinate system are known. If there are at least 3 target objects in a scan (scan reference object), it is mathematically sufficient to calculate the transformation, that is, the exact position and orientation of the scan. Then, not only the selected target objects, but all scan points get their coordinates in the overall coordinate system.

- If you‘re using clusters, you can place scans within those clusters. You can not place clusters with clusters. To do this, select the SCENE placement features.
- It is possible to place sensor scans and laser scans.
- For more information for other possibilities on how to place scans, see the SCENE User Manual.

13.1 Markers as target objects to place scans

You can use the Calibration Plate and its markers, or the marker plates to get specific target objects for placement.

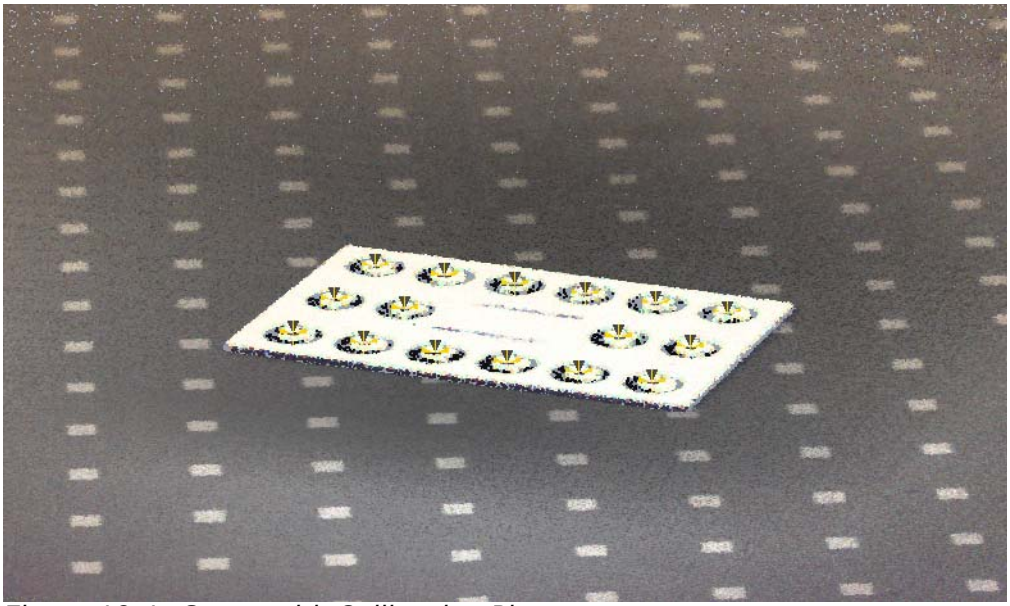


Figure 13-1: Scene with Calibration Plate

1. Place the Calibration Plate or the marker plates into the scene.

2. Check, that the plates are clearly viewable from different perspectives.
3. Scan the scene.
4. Transfer the scan project and use SCENE Process to place the scans.

13.2 Placing the scans (SCENE Process and SCENE)

1. Click the scan folder.
   If your scan project contains clusters, the scans inside the clusters will not be displayed. In this case, click the cluster's name to get its scans displayed.

2. Click the **Place scans** button in the toolbar.
   The **Place Scans** overview window shows up in a new tab:

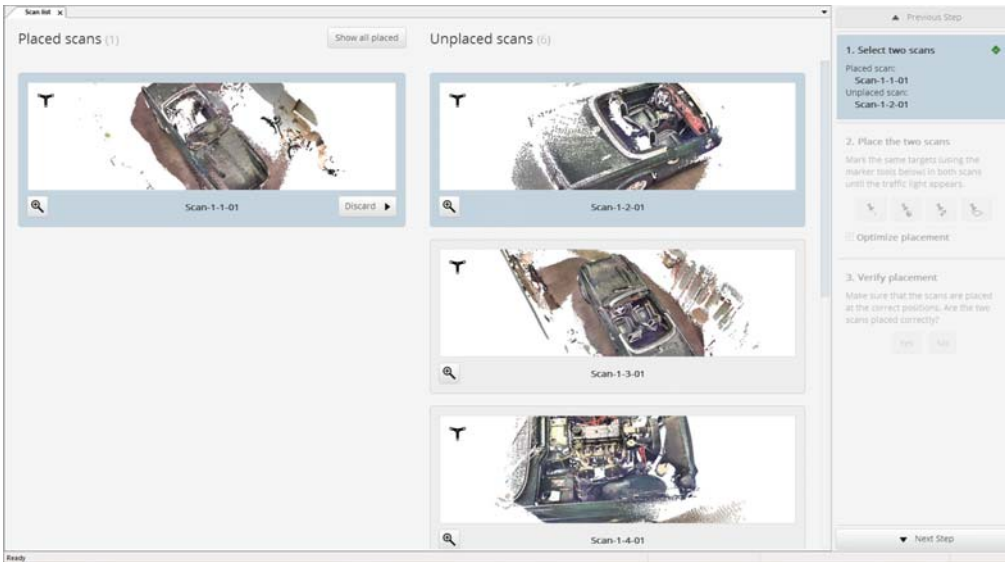


Figure 13-1: Place Scans, start page

The left column contains the **Preview** pictures of the first scan which could be used for placement. Later on, it will contain the **Preview** pictures of all the placed scans.

The middle column contains the Preview pictures of all scans which belong to the scan project, or to a cluster, and which have not been placed yet.

The right column is called **Task Panel**. It will guide you through the placement. A small red icon in the upper right side of a box signs that this step is not finished yet. As soon as it is finished, the square is displayed in a green color.

In the **Preview** pictures, a symbol in the upper left corner shows if the scan was made with a sensor or with a laser scanner. Click the **Zoom** button to see the preview enlarged.

How to use the Task Panel

Follow the numbered steps. You can switch between the steps by

- clicking the next or previous step, or
- using the **Previous Step / Next Step** buttons.

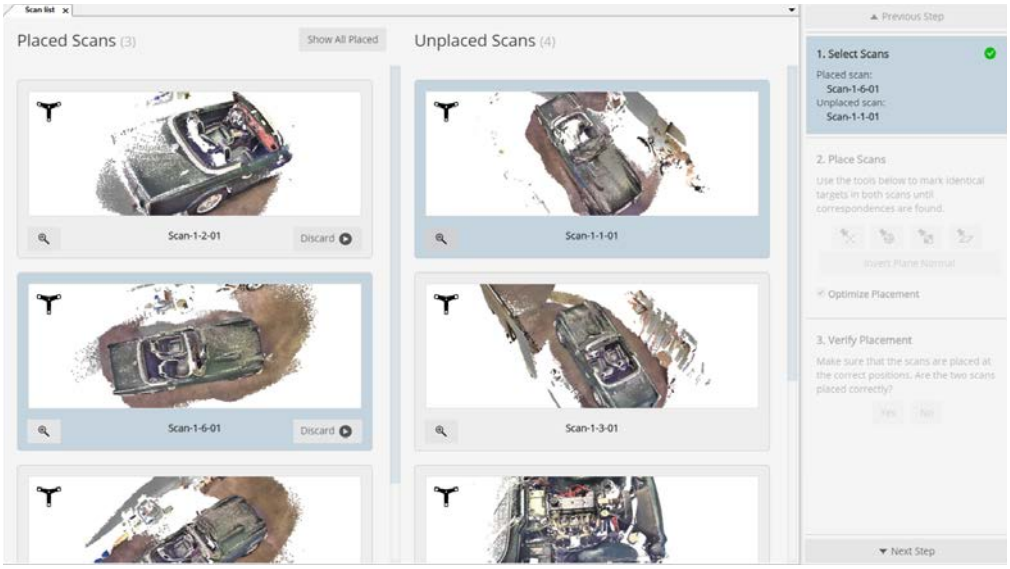


Figure 13-1: Place Scans, select two scans

3. The scan which is first in alphabetical order is automatically listed in the left column.
4. If you wish to start with a different scan, click the **Discard** button. Then, find the first of two scans which shall be placed. Select it by clicking on its preview. The scan preview will be moved to the left column.
5. Find the second of two scans which shall be placed. Select it by clicking on its preview. The scan will stay in its position, but is highlighted.

Figure 13-1: Place Scans, mark points

6. Switch to step 2. The so-called **Correspondence Split View** is displayed which shows each one scan in a window. Freestyle3D scans are displayed in **3D View**. Laser scans are displayed in the so-called **Quick View**, that is, you always see the scanned area from the scanner position. You cannot leave this position. However, you can of course change your field of view and scale.
7. Select one of the marker tools and use it to pick corresponding scan points or planes in both scans. This scan point or plane is now used as a

target and is displayed with a yellow mark. There is no need for a specific order, just switch between the scans and pick target objects.

8. You can delete a target object. Right click on its mark, then click **Delete**.
9. For planes, you can invert the Plane Normal: click the plane. It is active if its grid is shown. Then, click the **Invert Plane Normal** button.
10. If you need change your point of view, use the **3D Navigation** buttons. Select one of the functions, move the scan, and continue picking by selecting a marking tool.
    By default, the scans can be rotated around a pre-defined rotation point. If this is okay for you, simply click, move the scan, and continue picking.

Figure 13-1: Place Scans, correspondences

11. While you are marking corresponding target objects, SCENE Process is doing its part of the job. After SCENE Process detects sufficient pairs of corresponding target objects, it will display the correspondences by adding a colored and numbered label. Labels of corresponding target objects have the same color. The thin frame around the label symbolizes the quality of the correspondence:
    - Green: good quality
    - Yellow: compromised quality
    - Red: seriously compromised quality

    The quality of the overall correspondences is displayed with a traffic-light on the lower right side:
    - Green: good quality
    - Yellow: compromised quality
    - Red: seriously compromised quality

    Beneath the traffic light, the number of found correspondences is displayed.

	If one of the matching target objects appear to be mismatched, you can try the following: • Pick more target objects, if possible. • Check the picked target objects for correctness. Sometimes, it is difficult to see the actual position of a target object in a 3D picture.

12. Since these correspondences would be sufficient to place the scans, you could switch to step 3.
    You could as well mark some additional target objects. The more, the better.
13. Switch to step 3. Placement will start immediately.

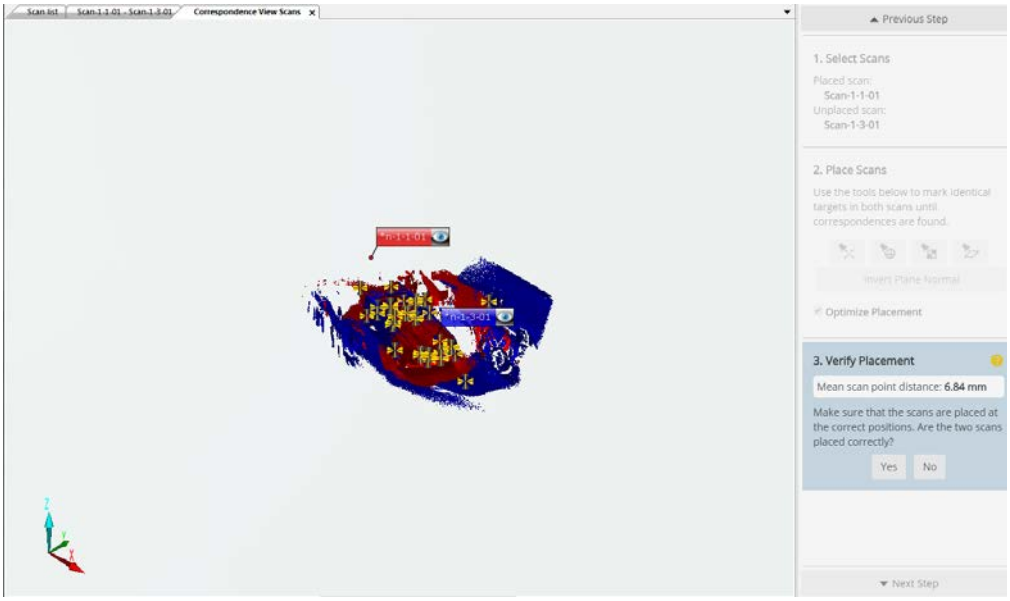


Figure 13-1: Place Scans, Correspondence View

14. After placement is finished, a **Correspondence View** of the two placed scans is displayed. By default, the result is displayed in isometric view. You can change to another view by clicking one of the View buttons in the **3D Navigation**.
15. Verify the placement results.
16. Click the **Yes** button to continue with a new scan pair.

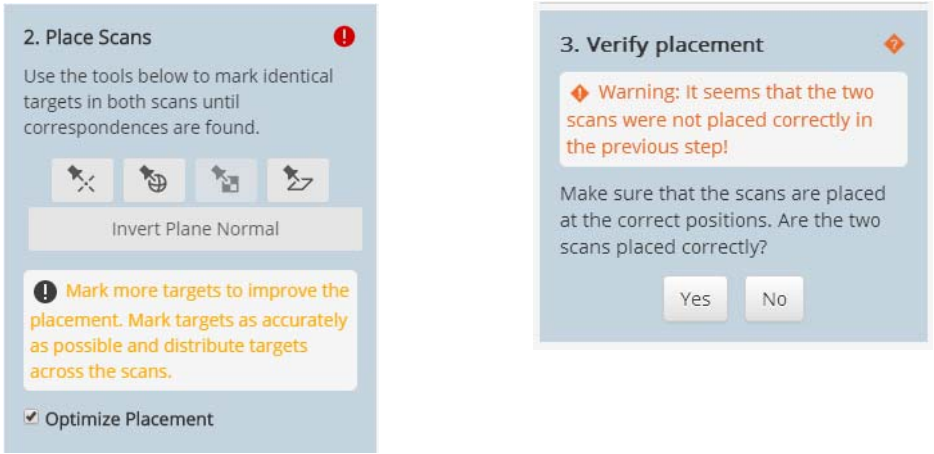


Figure 13-1: Messages

17. Place Scans, help and warning message
18. Click the **No** button if you are not satisfied. SCENE Process switches back to step 2 and displays a help text. You can then mark more corresponding target objects and start placement a second time.
    If you switch to step 3 before you have marked a sufficient number of target object pairs, a warning message will be displayed.

19. If placement was successful, click the **Yes** button to continue with a new scan pair.

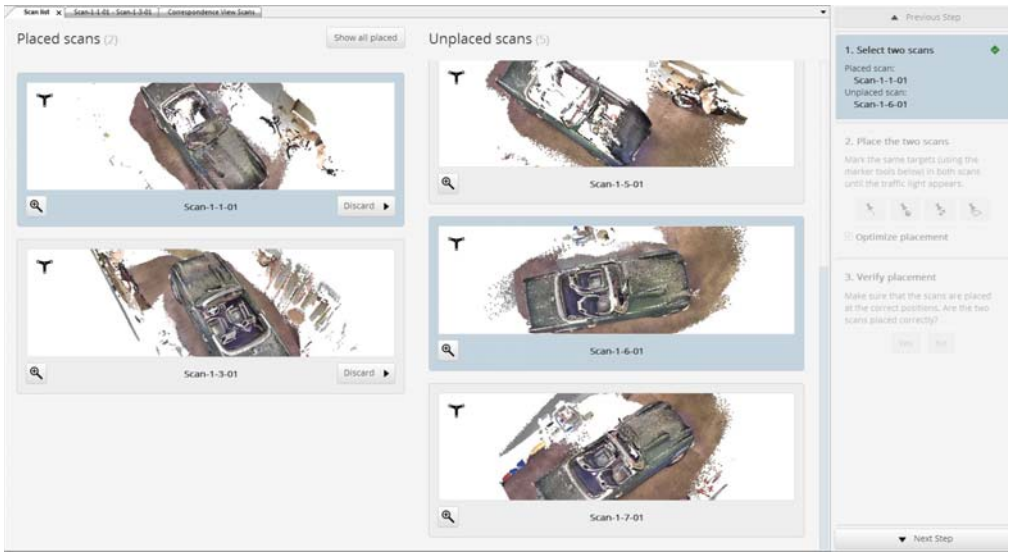


Figure 13-1: Place Scans: Overview Window after placement

20. The **Overview Window** will be displayed again, now showing the two placed scans in the left column.
21. After this placement is finished, you can continue with picking more target object pairs: Select one of the scans in the left column, and one of the unplaced in the middle column.
22. Proceed like before.
23. Finally, the **Overview Window** will look like that:

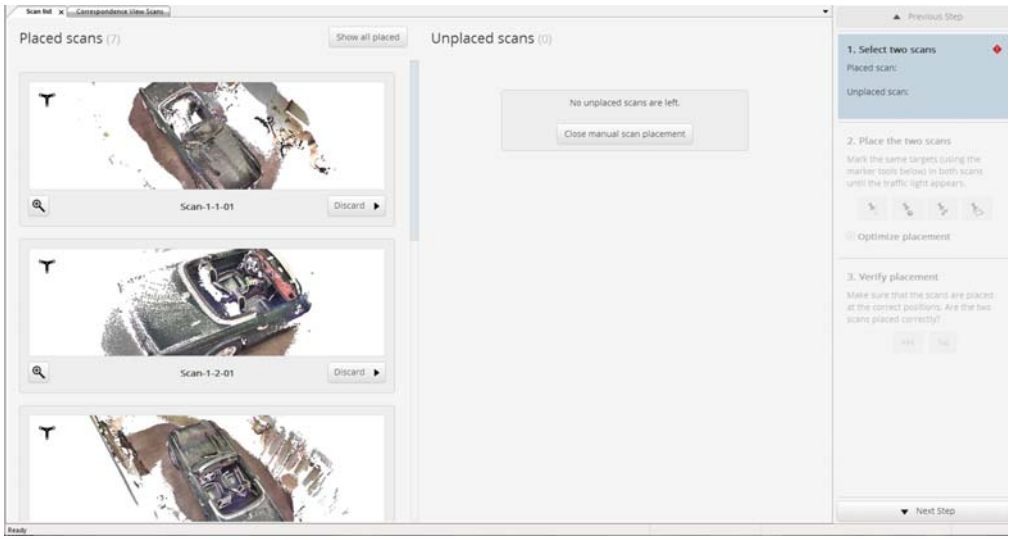


Figure 13-1: Place Scans: Overview Window after having placed all scans

24. Click the **Show all placed** button to see the result in the Correspondence View:

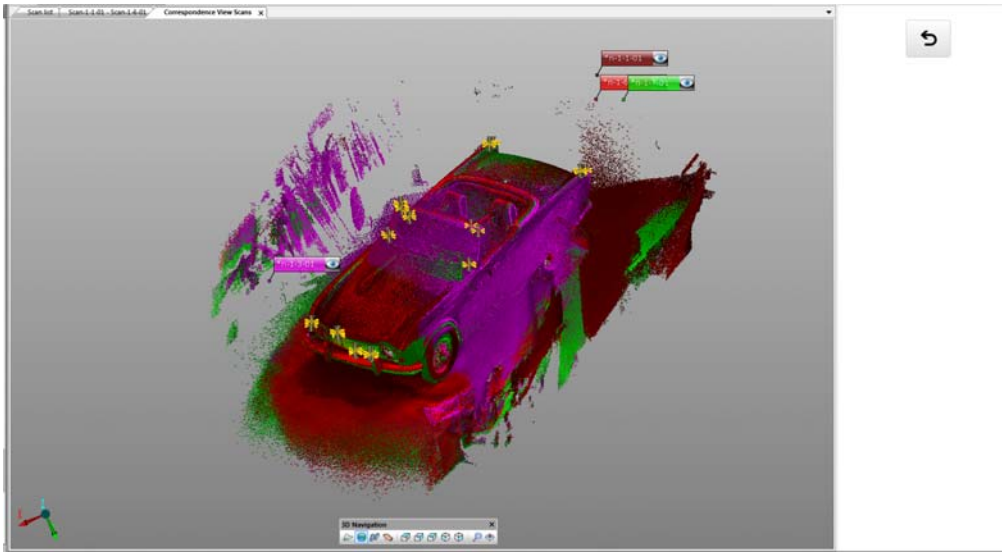


Figure 13-1: Place Scans: Correspondence View

25. Click the **Return** button to return to the Overview page.
26. Click the **Close manual scan placement** button to close the **Place Scans** tab, or,

    click the **Place scans** button in the toolbar to only close the **Place Scans** tab.

Chapter 14: Split Scan

Each scan consists of multiple so-called frames that are placed against each other. Those placements can fail, for example, the first set of frames is placed correctly, then some frames failed, and the remaining frames up to the end are placed correctly again.

To be able to use such a partially misplaced scan, you can split it into several parts. Ideally, you will receive some well-placed frame sets and one or more misplaced frame sets.

Afterwards, you can place these new parts together and leave the bad frames out.

	Split Scan does not work with Point Clouds. If you try Split Scan on a Point Cloud, the Point Cloud will be reverted to a scan. After the splitting is finished, Point Clouds of the splitted scans will be built. This may take some time.

1. Click or tap the **Split Scan** button in the toolbar, or,
   in the Structure View, right click the scan, then select **Operations** ▸ **Split Scan.**

Figure 14-1: Split Scan, start page

The scan will be shown in **3D View** as usual. In addition, the so-called Scan Path is displayed. The Scan Path is an orange line that symbolizes the trace on which Freestyle3D was moved while scanning. The Scan Path position of the current frame is shown by a small yellow ball.

Below the 3D View, the **Split Scan** dialog is displayed:

Frame No: Each scan consists of a number of frames.

Slider and ← → buttons

Select the frame at which the scan shall be splitted.

Split Scan button

Click to split the scan at this frame.

Delete button

After starting Split Scan, one long **Delete** button is displayed which you can use to delete the selected scan.

As soon you have started to cut the selected scans into new scans, a new **Delete** button will appear for each of the new scans.

In case you want to delete one of the scan parts, click the **Delete** button of the scan part.

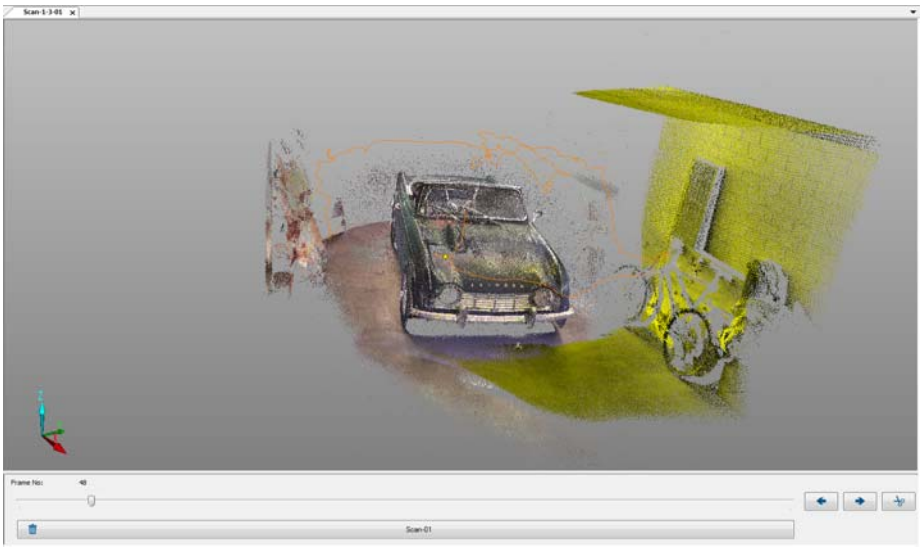


Figure 14-2: Split Scan, select frame

2. Use the slider or the ← → buttons to select the frame at which the splitting shall take place. The yellow ball is moved along the Scan Trace.

   The frames which are marked with a yellow shade will appear in the new scan.

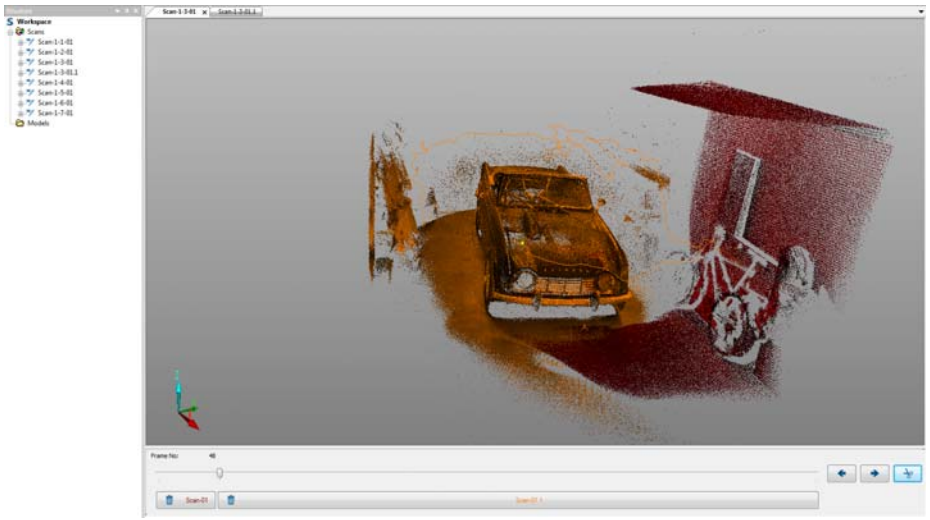


Figure 14-3: Split Scan, scan after clicking the Split Scan button

3. Click the **Split Scan** button.
   - The two scan parts are then displayed in different colors, so you can easily control whether the splitting is correct.
   - A second **Delete** button is displayed.
   - The Structure View shows a new scan. Its name is derived from its original scan, and a number is added. If you split the original scan in several parts, the number added to each scan name will be incremented.

4. In the Structure View, double-click the new scan.

Figure 14-4: Split Scan, selection is moved into a new scan

If the scan needs more customization, select another frame and repeat the process.

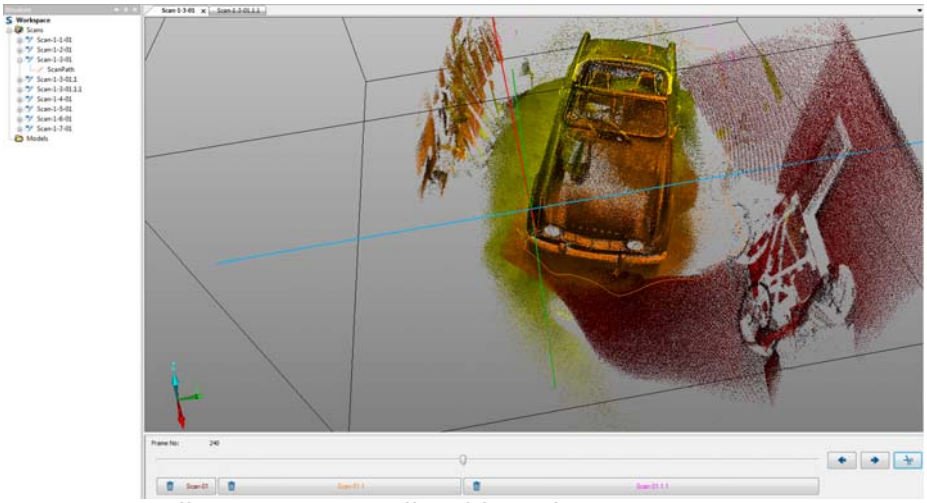


Figure 14-5: Split Scan: Scan splitted into three parts

Click or tap the **Split Scan** button  to close the feature.

As soon as you open the original scan again, you will see that it has changed.

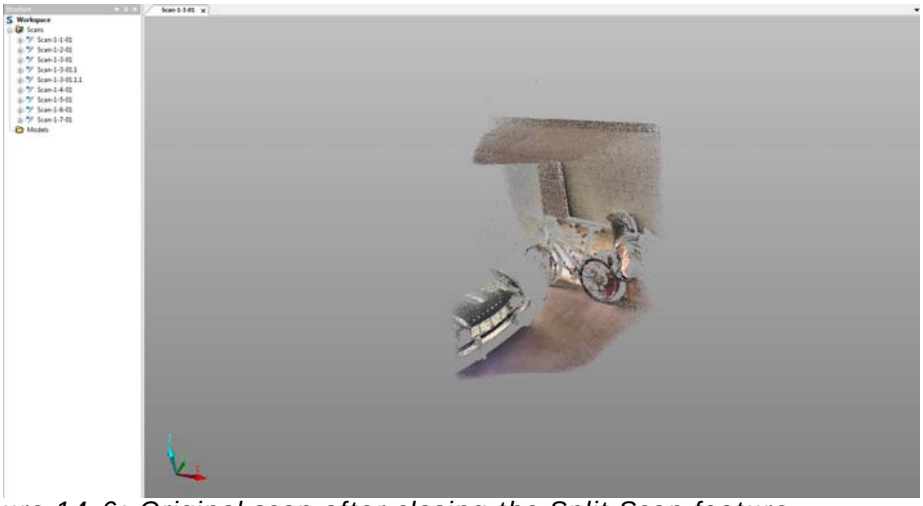


Figure 14-6: Original scan after closing the Split Scan feature

The original scan now consists of those frames which were not split off.

Chapter 15: Meshing

From scan points to triangles

When an object is scanned, the scan points represent individual spots on the surface of the object. If you want to reconstruct the surface itself, you can create a mesh which takes the scan points as a basis and approximates the surfaces within certain limits. This approximation is done with a set of triangles.

Depending on the curvature of the real surface and the required approximation quality, the number of triangles can vary between a few and a huge number.

Making Your Mesh Water-Tight

To print a 3D model with a 3D printer, the 3D model needs to have closed edges creating a solid volume. A commonly used term for this is „water-tight“. If you were to fill your geometry with water would nothing leak out?

15.1 Creating a Mesh in the 3D View

Figure 15-1: Meshing Object

There are two methods to create a mesh:

- **Mesh Selection**: You can make a freehand selection of scan points.

  1. Create a 3D selection as described in *Creating a Mesh in the 3D View*

  2. Click the little arrow in the Mesh button to open the drop-down menu, there click Mesh Selection. The **Create Mesh - Settings** dialog is shown. You can also right-click the selection, then click Selection - Mesh Selection.

- **Mesh Clipping Boxes:** You can use one or more clipping boxes to select the object to be meshed.

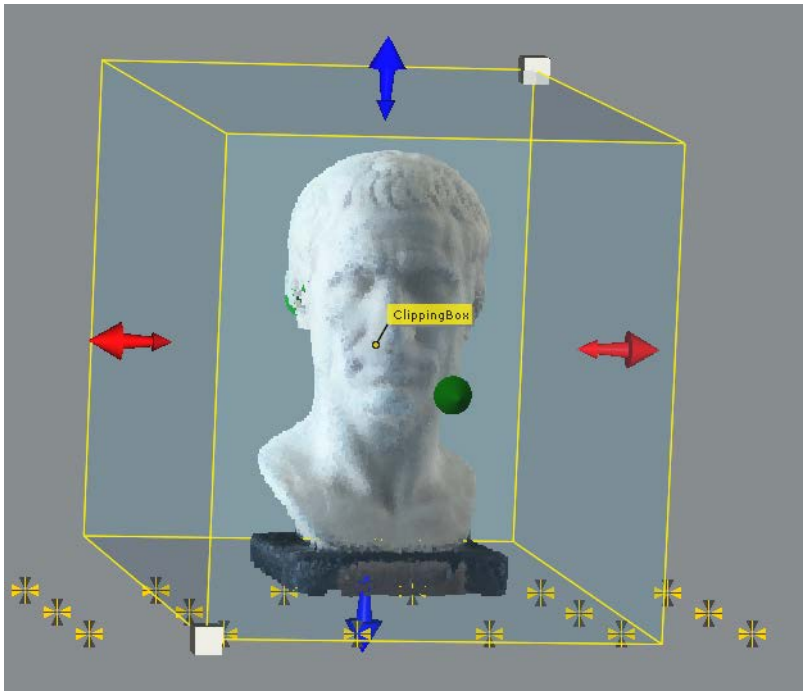


Figure 15-2: Object selected with a Clipping BoxMesh with clipping box

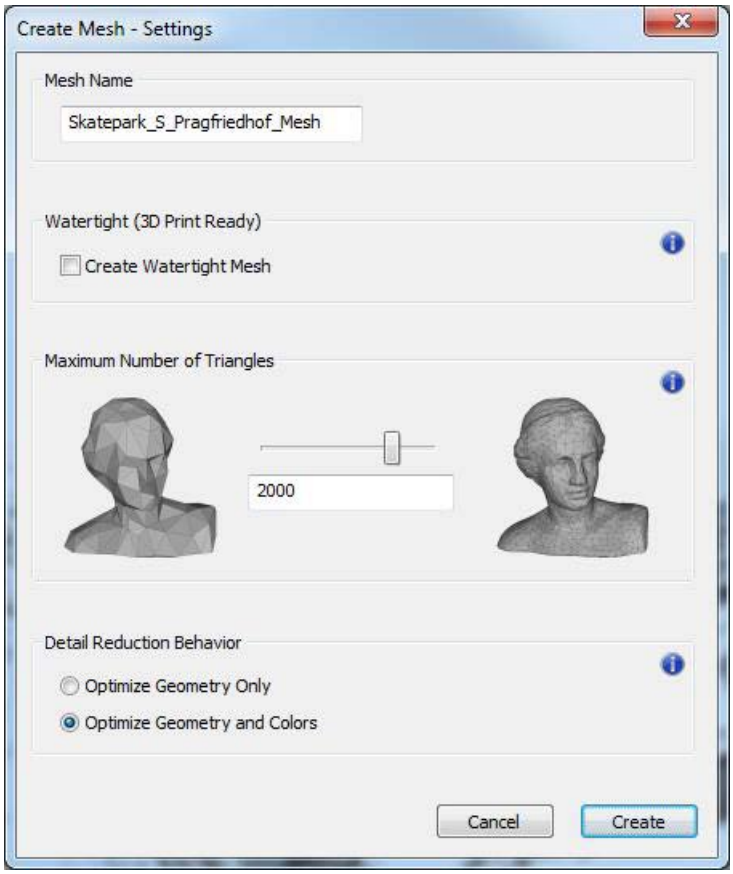
Meshing a Selection

1. Create a 3D selection as described in *Selecting Scan Points (3D View, Planar View, Quick View)*

2. Click the little arrow in the Mesh button to open the drop-down menu, there click Mesh Selection. The **Create Mesh - Settings** dialog is shown. You can also right-click the selection, then click Selection - Mesh Selection

Mesh Clipping Boxes

Settings



Create a Mesh

This dialog provides the following options:

Mesh Name

Specify a name for the mesh.

(Watertight)3D Print Ready

Select this check box if the mesh shall be used for 3D printing. The mesh will then be generated „watertight“, which means, it has a solid surface.

Maximum Number of Triangles

This setting controls the level of detail of the resulting mesh. More triangles create more detailed meshes, and larger files.

Detail Reduction Behavior

For optimal geometric precision select the option, Optimize Geometry Only.

For optimal color detail but slightly reduced geometric precision, select Optimize Geometry and Colors.

Clicking on the Create button starts the mesh creation. The created mesh will be added to the structure view and displayed in the opened 3D view. It is also possible to open a 3D view on the mesh through the context menu.

15.2 Export

1. Right-click the mesh, then click **Export**. The **Export** dialog is shown.
2. Select the file format in which you want the meshed object to be exported. Available file formats are: .stl, .ply, .obj, and .wrl.
3. Click **OK** to start the export.

Chapter 16: Export

16.1 General

In order to use scan points from the scans in other applications such as CAD systems, SCENE Process provides the possibility to export scan points in various data formats and write them to a file. You can then import this file into the desired application.

16.2 Export point clouds of the scan project

You may export the point clouds into different file formats in order to use them in other applications such as CAD systems.

The following formats are available: E57, VRML, DXF, XYZ ASCII, XYZ binary, XYZ binary, IGES, PTS, and Pointools POD.

There are three possibilities:

- ⇨ Click or tap the **Export Points**  button to export all point clouds of this scan project. A dialog will show up in which you can select the target file format. All Clipping Boxes will be applied.
- ⇨ In the Structure View, right click a scan's name, then click **Import / Export ▸ Export Scan Point Cloud - Unordered**.
- ⇨ In the Structure View, right click a cluster's name, then click **Import / Export ▸ Export Scan Point Clouds - unordered** to export all point clouds of this cluster. Exporting point clouds on a scan or cluster will only apply the Clipping Boxes below the scan or cluster, instead of all available Clipping Boxes.

	For information on exporting scan points, scans, and scan projects, see the SCENE User Manual.

16.3 Export to SCENE WebShare Cloud

Create Virtual Scans

Virtual scans are required to show Freestyle3D scans in a Panorama View or 3D View in WebShare Cloud.

Virtual scans are created from the point cloud data of already existing scans. After the virtual scans were created, they behave like scans which were captured with a laser scanner. You can open a Virtual Scan in Quick View, Planar View, and 3D View.

Figure 16-1: 3D View of a scan, the scan path is displayed

To create a virtual scan, do the following:

1. In the Structure View, right click the scan, then click **Operations** ▸ **Create Virtual Scans ...**

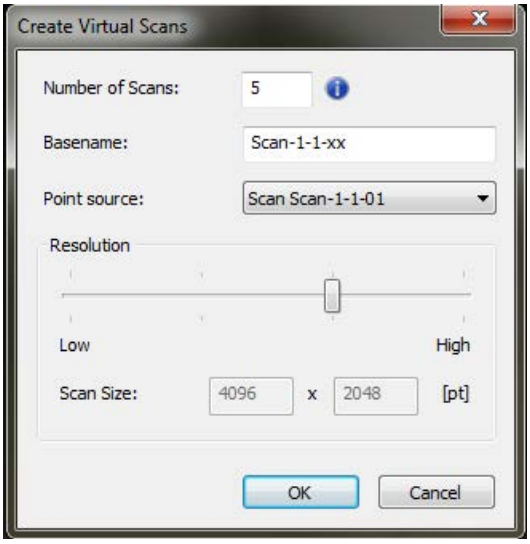


Figure 16-2: Create Virtual Scans dialog

Number of Scans

The number of virtual scans which will be taken from a scan. The virtual scans are taken along the scan path, leaving the beginning and the end out. The higher the number of virtual scans, the closer the distance.

Basename

Enter a name for the virtual scans.

Point source

Decide whether to use scan points from one scan, or all scans in the project.

Resolution

Set the resolution with the slider. The first number corresponds to the number of columns, the second number for the number of rows.

2. Click **OK** to start the creation of the virtual scans. A folder named VIRTUALSCANS will be created which contains the virtual scans.

After creation of the virtual scans, it is possible to view them in a 3D View.

Figure 16-3: 3D View of the VirtualScans folder with the positions of each virtual scan

⇨ Right click the VIRTUALSCANS folder, then click **View ▸ 3D View**.

In the 3D view, the positions of the newly created virtual scans are symbolized by a laser scanner icon.

Export the virtual scans

After you are done with creating all the virtual scans, you can continue with the usual **Export to WebShare Cloud** functions.

Chapter 17: On Site Calibration

Freestyle3D gets its calibration before shipping, but in some cases it may be necessary to user-calibrate it. Typically, this should be done on site, right before capturing.

Each Freestyle3D Kit includes a Calibration Plate. This Calibration Plate was used to calibrate the cameras insides Freestyle3D before shipping, that means, device and Calibration Plate belong together. The ID number printed on the Calibration Plate is saved internally in Freestyle3D.

Figure 17-1: Calibration plate

NOTICE

The Calibration Plate is made from carbon fibre, the markers are printed on it. Thus, it is quite rugged, but the printing may be scratched if you do not care. Ideally, stove the Calibration Plate at its place in the Freestyle3D transport case.

17.1 Calibration status (SCENE Capture)

Freestyle3D does not need any calibration, it is ready to capture.

One of the Freestyle3D sensors seem to have some measurement deviation. Re-Calibration should be done.

No Freestyle3D connected, or the computer was not able to detect it.

Try to

- unplug and plug the USB plug.
- use another USB3 port (if available).
- unplug the USB plug, restart the software, and try again.

The Calibration button is shown in red color when the calibration data went lost or is corrupt. It is not possible to correct this by performing a Re-calibration. In this case, contact FARO customer service.

17.2 Calibrate

Preparation

The plan is, to capture the Calibration Plate

- in an 90 degrees angle,
- from different distances.

1. Get the Calibration Plate and note the number which is written on its rear side. You will need that number lateron.
2. Place the Calibration Plate on a flat surface, for example, the floor.
3. The markers have to face upwards, none of them shall be covered by something.
4. Ensure that the Calibration plate is well illuminated. The illumination intensity should be at least 250 Lux (25 fc).
5. Ensure that the Calibration plate is not covered by hard shadows. This may happen easily, so try in advance if parts of your body, Freestyle^{3D}, or something else would produce a hard shadow on the Calibration Plate.

Figure 17-2: Unfavorable conditions

6. After Freestyle^{3D} has been connected to the computer and is initialized by the software, the calibration dialog is shown. Click or tap **Yes** to start calibration.
7. Alternatively, click or tap the **Calibration** button in the toolbar.

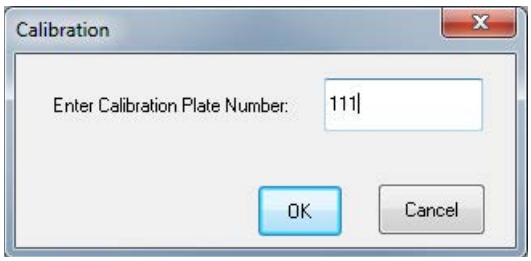


Figure 17-3: Calibration Plate Number dialog

8. In either case, you are now asked for the number on the Calibration plate. Enter the Calibration Plate‘s number and click or tap the **OK** button.
9. If this calibration is the first one with this Freestyle^{3D}, or if you enter a wrong number, a dialog is shown in which you can browse for the

calibration number file. It is saved on the green microSD card which came with the Freestyle3D kit. Select the file and click or tap the **OK** button.

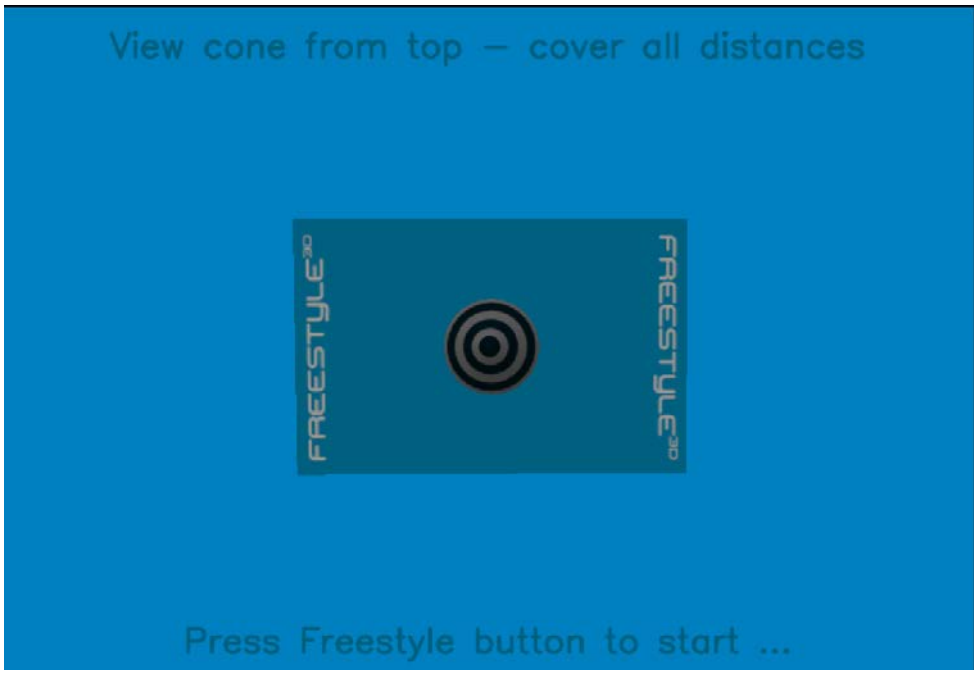


Figure 17-4: Start window

10. The start window of the calibration is displayed. Start calibration by pressing the Freestyle3D button.

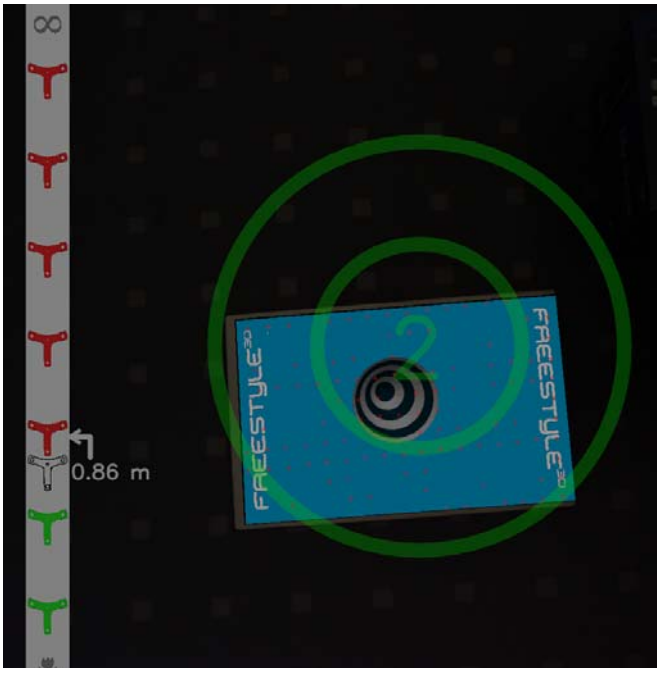


Figure 17-5: Video View with cone and Freestyle3D icon bar

11. Freestyle3D now starts to capture and the Video View is shown. A vertical bar with Freestyle3D icons is shown at the left, and in the middle, you can see a cone and two nested rings.

12. Hold Freestyle^{3D} centrically and horizontal over the Calibration Plate, and try to move the device until the rings around the cone are shown as centrical circles.
13. As soon as the position is okay, the rings are shown in green color and a countdown starts. As long as the position is not okay, the rings are shown in red color, and the reason is shown:
    - Wrong distance,
    - View is not horizontal, or
    - both.

    The position of the cone may slightly vary while calibrating. This is normal and does not influence the quality of the calibration.
14. Move Freestyle^{3D} slowly downwards until the lowest Freestyle^{3D} icons changes to a green color.
15. Now, move Freestyle^{3D} slowly upwards. Each of the Freestyle^{3D} icons has to change to a green color. An arrow shows which icon comes next.

As soon as all the Freestyle^{3D} icons are shown in green color, the status of the device is checked, and, if necessary, adjusted. After that, on-site calibration is finished.

17.2.1 Calibration data and report

The calibration data can be found in the FARO Freestyle directory on your computer.

Check \ProgramData\FARO\Freestyle.

Calibration report

The Calibration report is saved as a PDF file. You can find it in your scan project folder, in a folder called CALIBRATIONREPORTS. The Calibration report states whether the On site calibration was successful or not, and it shows some important data which may be necessary for verification.

Chapter 18: Color camera calibration

18.1 Calibration status (SCENE Capture)

The sensor does not need any calibration, it is ready to capture.

One of the sensors seem to have some measurement deviation. Re-Calibration should be done.

No sensor connected, or the computer was not able to detect it.

Try to

- unplug and plug the USB plug.
- use another USB port (if available).
- unplug the USB plug, restart the software, and try again.

The Calibration button is shown in red color when the calibration data went lost or is corrupt. It is not possible to correct this by performing a Re-calibration. In this case, contact FARO customer service.

18.2 Color camera calibration

All sensors except Freestyle3D support color camera calibration. Freestyle3D comes with a more sophisticated on-site calibration function.

Using a calibrated color camera improves tracking stability and accuracy of the results a little bit - but not much. Most of the sensors suffer from a misalignment of the color and depth system. This calibration function doesn't take care for this misalignment.

Click or tap the **Calibrate** button in the toolbar to start calibration.

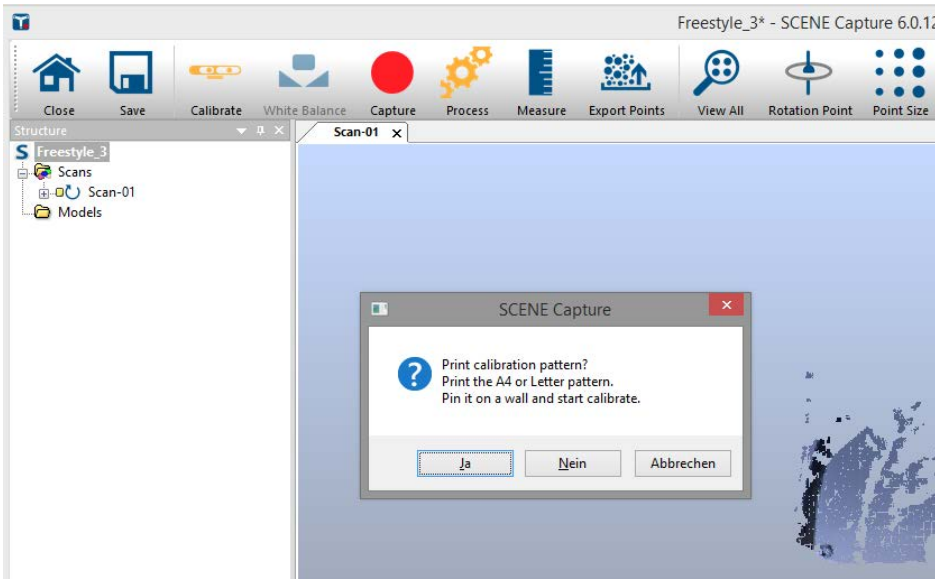


Figure 18-1: Print calibration pattern

Calibration patterns

SCENE Capture comes with calibration patterns used for the calibration.

- Click or tap the **Yes** button in the dialog to show the pattern in your PDF viewer and print the pattern.

- Click or tap the **No** button if you printed the pattern already.
- Click or tap the **Cancel** button to stop the calibration process.

1. Pin the calibration pattern on a wall, or on any other flat surface.
2. Start the calibration again.

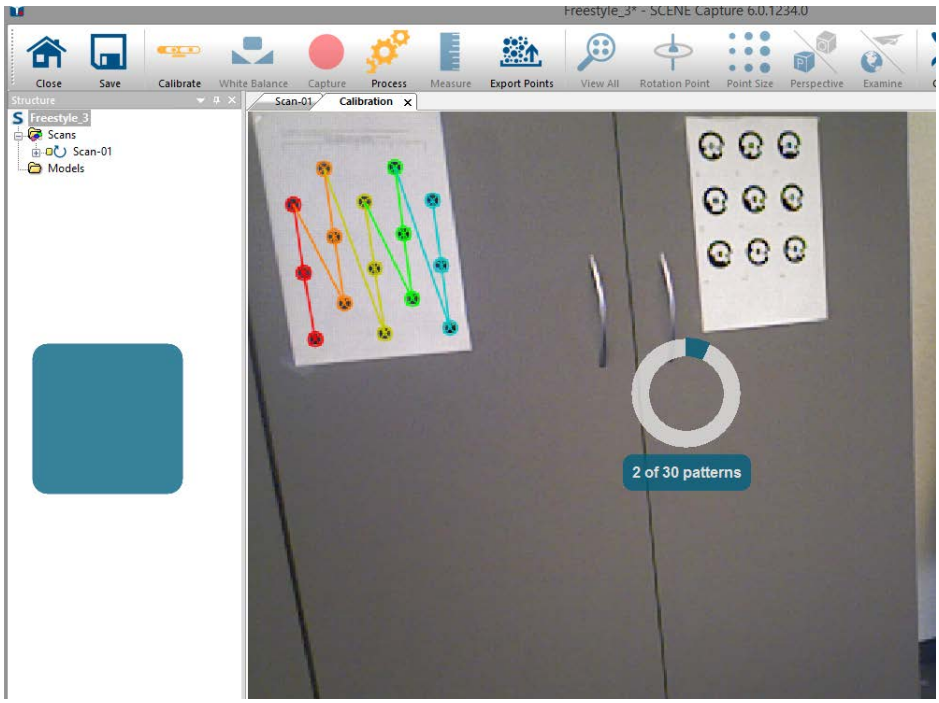


Figure 18-2: Live video with colored calibration pattern

A live video shows up.

- If SCENE Capture detects the calibration pattern, it renders the pattern in color. The pattern count in the progress indicator increases.
- When a pattern measurement is accepted, the pattern is rendered in gray.

3. Move the sensor into another position until the pattern is colored again.
   - Make sure that you move the sensor into different poses covering different angles and distances.
   - SCENE Capture uses 30 measurements of the pattern to calculate the calibration. A good distribution of the pattern poses guarantees a good calibration result.
4. Click or tap on the big blue rectangle on the left to stop the calibration.

	If SCENE Capture can't find the pattern in the video, the program seems to freeze. Searching takes some time and searching without result takes even longer. Therefore be patient.

After a successful calibration, the sensor icon turns into green.

The calibration result is stored on disk (<Program data>\FARO\Freestyle\Cameras). The file name pattern is <Sensor type>_<Serial number>.xml.

	Next time SCENE Capture detects the sensor, the calibration is picked up automatically. If you want to use the build-in calibration, delete or rename the file.

Chapter 19: Device White Balance

The White Balance function is used to adjust the color cameras in Freestyle3D.

1. Get the Calibration plate and place it close to you.
2. Press the Freestyle3D button.
3. Click or tap the **White Balance** button in the toolbar. While using the function, the button looks like that:
4. After Freestyle3D has been connected to the computer and is initialized by the software, the calibration dialog is shown. Click or tap **Yes** to start.

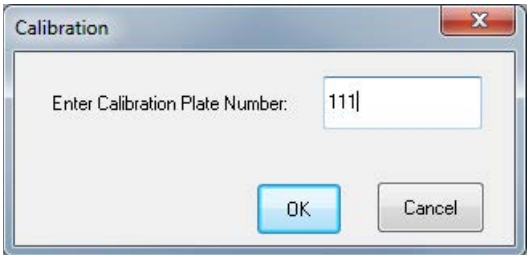


Figure 19-1: Calibration Plate Number dialog

5. In either case, you are now asked for the number on the Calibration plate. Enter the Calibration Plate‘s number and click the **OK** button.
6. If you enter a wrong number, a dialog is shown in which you can browse for the calibration number file. It is saved on the green microSD card which came with the Freestyle3D kit. Select the file and click or tap the **OK** button.
7. Try to locate the Calibration Plate with Freestyle3D.

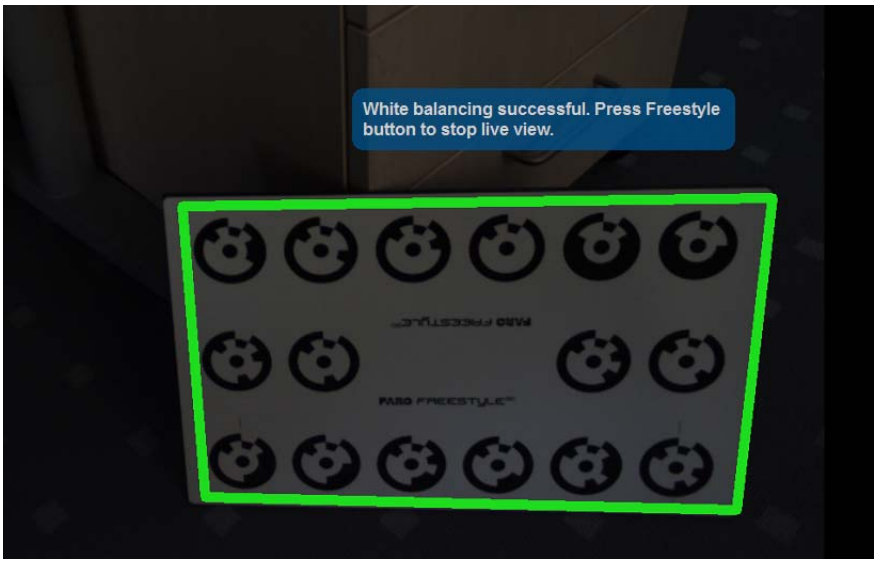


Figure 19-2: White Balance and Calibration Plate

8. In the Video View, a frame around the Calibration Plate is shown.
   - Frame is shown in red color: White Balance is not finished yet.
   - Frame is shown in green color: White balance is okay.

9. To check if the colors are captured correctly, move Freestyle^{3D} around and compare the colors displayed in the Video View with those the real scene has.
10. Press the Freestyle^{3D} button again to stop capturing. White Balance will be finished automatically.

Chapter 20: Maintenance

20.1 General

We recommended checking your sensor at least once a month. This enables you to spot trouble before it starts and helps providing you with an efficient measuring system.

A sensor is a precision instrument that contains many sensitive components, and it must be handled with care. Follow these procedures to prevent problems with your system:

- Check the cable for damage to outside insulation, connectors, and pins.
- Check the housing of the scanner for damage.
- Store the sensor in its transport case when it is not in use.

Freestyle3D only

To ensure a complete manufacturing recalibration of Freestyle3D, we recommend to ask for the yearly maintenance and certification service offered by FARO. Please contact your local FARO Customer Service team for more information.

20.2 Cleaning Instructions for Optics

NOTICE	
	Unnecessary damage or wear • To avoid unnecessary damage or wear, only clean the optics when the degree of contamination has an impact on the scan quality (that is, an increase in range noise or a decrease in scan range) and requires cleaning for proper functioning. • Major contamination and improper handling to clean optics may impact the scanning quality. Self-caused damages can result in a complete replacement of the part at the expense of the customer. • **Do not use cleaning fluid with alcohol or acetone**. The sealings could be dissolved. We recommend alcohol-free lens cleaner that can be found in most optical supply stores.

What's needed

- Tissues (if those in the transport case are no longer usable, we recommend tissues that can be found in optical supply stores)
- Additionally for greatly contaminated lenses:
- Mild neutral soap (optical supply store).
- Alcohol free cleaning fluid in spray bottle / dropping bottle.

Slightly contaminated optics

- Wipe the contaminated optics with the tissue.

Greatly contaminated optics

- Mist a tissue with the cleaning fluid (do not soak).
- Carefully wipe the contaminated optics with the tissue.

20.3 What should I do if my Tablet PC is not working properly?

The Microsoft tablet PC included in the Freestyle^{3D} kit has a one-year manufacturer's warranty. Please contact Microsoft Support to register your tablet or get registration information. Here is where you can find contact information.

- Support homepage: *http://www.microsoft.com/surface/en-us/support*. Select the language in bottom left corner.
- Global support contact list: *https://support.microsoft.com/dede/gp/customer-service-phone-numbers/en-us*

Once the tablet is registered, you can view the warranty terms online.

If your tablet PC is not working as expected, contact Microsoft directly.

1. Describe the issue.
2. Obtain a Return Material Authorization (RMA).
3. Print a shipping label.
4. Ship the tablet to the Microsoft Service Center for repair or replacement.

Chapter 21: Disposal

21.1 Disposal

At the end of its lifecycle, the sensor must not be disposed with your normal waste, but instead must be returned to a recycling facility for electric and electronic devices.

In case of doubt please contact your local government or local waste disposal operators.

By playing your part in ensuring the correct disposal of this product at the end of its useful working life, you will be safeguarding the environment, your own health and the health of other people.

21.2 Product Environmental Information

Applicable in the European Union and other European countries with separate collection systems.

The **European Directive 2012/19/EU on Waste Electrical and Electronic Equipment (the WEEE Directive)** stipulates that WEEE is now subject to regulations designed to prevent the disposal of such waste and to encourage design and treatment measures to minimize the amount of waste that is placed into the waste stream. The objective of the WEEE Directive is to preserve, protect and improve the quality of the environment, protect human health, and stimulate the practical use of natural resources. Specifically, the WEEE Directive requires that producers of electrical and electronic equipment be responsible for the collection, reuse, recycling and treatment of WEEE which the Producer places on the EU market after August 13, 2005.

FARO Technologies, Inc., as a producer of electrical and electronic equipment (EEE), has endeavored to meet these environmental responsibilities for managing WEEE. In so doing, FARO is providing the following to inform its customers about the WEEE collection process:

In order to avoid any potential dissemination of hazardous substances into the environment, FARO has labeled this product with the WEEE symbol (see below) in order to alert the end-user that it should be disposed of within the proper waste management system. That system will recycle, reuse, and dispose of materials from this product in an environmentally sound way.

The symbol represented below, and found on this FARO Technologies product, indicates that this product meets the European Directive **2012/19/EU** on Waste Electrical and Electronic Equipment. This symbol, only applicable in European Union countries, indicates that when this product reaches the end of its useful life it should not be disposed of with normal household or municipal waste, but in an established waste stream for WEEE.

Each EU Member State country has established a system for the collection, disposal, and recycling of WEEE. End-users in the EU should contact their local waste administration system for collection instructions concerning this product.

Refer to *www.faro.com* for further environmental information concerning this product.

Chapter 22: Technical Data

22.1 General

Type of device:	Hand-operated 3D laser scanner
Power supply voltage:	5 V (supplied via USB3.0)
Power consumption:	max. 5 W, USB3.0 powered
Operating temperature:	0°C - 40°C
IP Rating:	IP 52 *
Cable connector:	1.5m, not withdrawable from the scanner, USB3.0 interface
Weight:	0.98kg
Dimensions:	260 x 310 x 105mm
	see *"Freestyle^{3D} Dimensions" on page 111*

22.2 Performance Specifications

On page 109 the technical data is no longer assigned to the correct variants.

Resolution at 0.5m:	Lateral: 0.2mm-1mm distance
	Depth: 0.2mm
3D point accuracy/whole scan accuracy (1):	Freestyle^{3D}: ≤ 1.5mm
	Freestyle^{3D} X: ≤ 1mm
	Freestyle^{3D} Objects: 0.5mm at 0.3-0.5m distance
	1mm at >0.5m-0.8m distance
Typical lateral accuracy (2):	< 1mm
Single image point density:	Up to 45.0000 points/m^2 in 0.5m distance
	Up to 10.500 points/m^2 in 1m distance
Range:	Freestyle^{3D}, Freestyle^{3D} X: 3m – 10m
	Freestyle^{3D} Objects: 0.3m-0.8m
Typical noise (rms)	0.7mm at 0.5m distance
Freestyle^{3D}, Freestyle^{3D} X:	0.75mm at 1m distance
	2.5mm at 2m distance
Freestyle^{3D} Objects:	5mm at 3m distance
Typical noise (rms)	200um at 0.3m distance
Freestyle^{3D}, Freestyle^{3D} X:	400um at 0.5m distance
Freestyle^{3D} Objects:	800um at 0.8m distance

Typical field of view (HxW):	45° x 56° at 0.5m distance 45° x 59° at 1m distance 49° x 54° at 2m distance 49° x 52° at 3m distance
Calibration:	Optional user calibration with supplied calibration plate
Light source:	In-built LED flash

22.3 Laser (Optical transmitter)

Eye safety:	Laser class 1
Laser power:	max. 800mW total
Pulse duration:	<= 10ms
Wave length:	798-821nm

22.4 Cameras

Recorded 3D points (3):	Up to 88,000 points/s, point cloud density increases with time
Best points filter (4):	Noise reduction of typically 40% when scanning the same object from different distances
Exposure time:	0.02ms - 10 ms (autoexposure)
Texture color:	24bit
Lighting conditions (5):	Up to 10.000 Lux

(1) Measured on a 1m reference scale, in 1m distance, for a lateral scanner movement of 1m, using targets for distance measurement

(2) Measured in 0.5m-3m distance

(3) Point density depends on scanned surface and lighting conditions

(4) Noise reduction for equal scan times at 0.5m, 1m, 2m and 3m distance from object

(5) Limited range and point density in sunlight

* Dust protection 5.
Water protection 2: Protection against dripping water whilst device in standard idle position with sensor side facing downward

22.5 Type of microSD card

You can use SD, SDHC or SDXC cards. Memory cards with a size up to 64 GB have been verified to operate with the scanner. We recommend using memory cards with a capacity of 4 GB or more.

22.6 Freestyle3D Dimensions

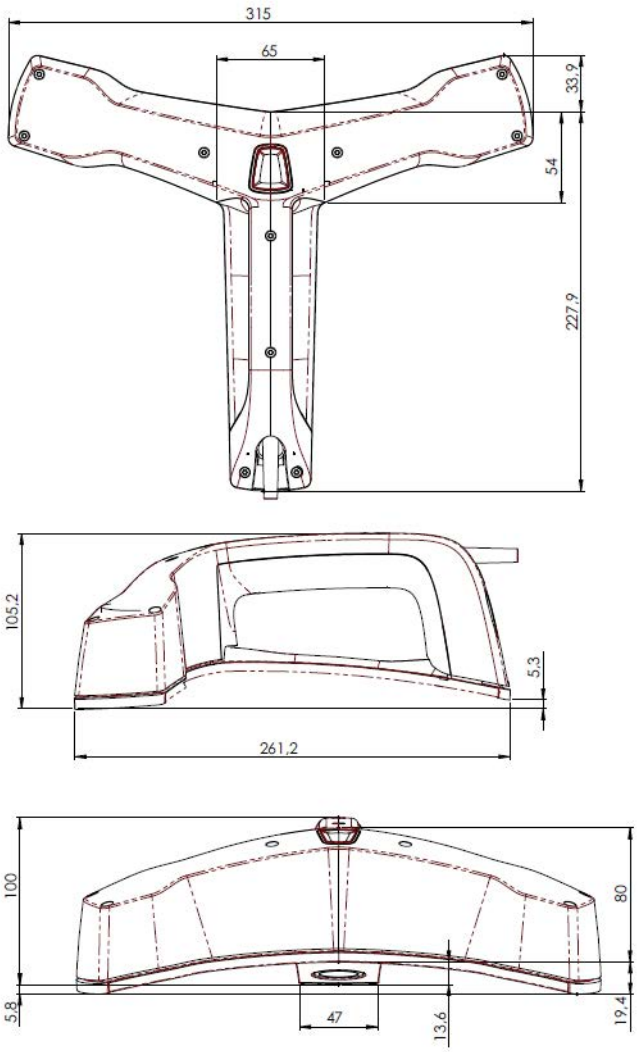


Figure 22-1: Freestyle3D Dimensions

Chapter 23: Supported sensors

SCENE Capture supports a variety of sensors. The setup comes with all drivers and installs them if selected. The accuracy of the sensors is unknown except for Freestyle3D Objects.

SCENE Capture supports one sensor at the same time only. The sensor icon in the toolbar changes depending on the sensor type. If the sensor has an individual calibration, the icon is green. If a default calibration is used, the icon is yellow.

SCENE Capture searches for a sensor plugged in at start up. If the user plugs in a sensor when SCENE Capture is started already, the sensor will be detected and initialized.

Identifying a sensor takes some time. A progress indicator shows up.

Sensor	Description	Remarks
	Freestyle3D Objects ,Freestyle3D X, Freestyle3D	The FARO Freestyle3D family is supported best by SCENE Capture. Freestyle3D uses sophisticated optical models and algorithms to compute accurate depth data perfectly aligned to the color data. Use these sensors for professional applications.
	ASUS Xtion, Primesense Carmine 1.09, Primesense Carmine 1.08	The ASUS Xtion and the Primesense Carmine sensors generate dense depth data. The built-in calibrations are pretty good. Use these sensors for documentation purposes when accuracy doesn't matter much. **Installation and setup** SCENE Capture comes with all necessary drivers for USB 2 and 3, to be used with Windows 7, 8 and 10. The drivers are installed by the SCENE Capture setup. The setup copies the installation file and the drivers into the <Install Path of SCENE Capture>\PrimesenseDriver. Use the program dpinst-amd64.exe to install the driver manually.
	Kinect for XBOX, Kinect for Windows	The old Kinect sensors generate dense depth data. They use Primesense technology. Use these sensors for documentation purposes when accuracy doesn't matter much. SCENE Capture uses the Microsoft Kinect 1.8 SDK to drive the Kinects. The sensors run with USB 2 and 3 ports, to be used with Windows 7, 8 and 10. **Installation and setup** The setup copies the installation file and the drivers into the <Install Path of SCENE Capture>\MicrosoftDriver. Use the program KinectSDK-v1.8-Setup.exe to install the SDK and driver manually.

Sensor	Description	Remarks
	Orbbec3D Astra, Orbbec3D Astra S	The Astra sensors generate dense depth data. The build-in calibrations are OK, but show visible misalignments between color and depth system. Use these sensors for documentation purposes when accuracy doesn't matter much. SCENE Capture comes with all necessary drivers for USB 2 and 3, to be used with Windows 7, 8 and 10. The drivers are installed by the SCENE Capture setup. **Installation and setup** The setup copies the installation file and the drivers into the <Install Path of SCENE Capture>\AstraDriver. Use the program astra-win32-driver-4.3.0.2.exe to install the driver manually.
	Kinect One	The Kinect One is a time of flight sensor developed by Microsoft. The sensor comes with the XBOX One. The build-in calibrations are OK, but show visible misalignments between color and depth system. There are also some issues caused by the measurement principle. **Installation and setup** SCENE Capture uses the Microsoft Kinect 2.0 SDK to drive the Kinect One. The sensor runs with USB 3 ports on Windows 8 and 10. You need a break-out cable to use the sensor with a Windows machine. The setup copies the installation file and the drivers into the <Install Path of SCENE Capture>\MicrosoftDriver folder. Use the program KinectSDK-v2.0_1409-Setup.exe to install the SDK and driver manually. **Note** SCENE Capture has problems detecting the sensor sometimes. You have to unplug and plug-in the sensor several times. We try to resolve the issue in one of the next versions.

Sensor	Description	Remarks
	Intel R200	The Intel R200 is a rear sensor manufactured by Intel. The sensor uses photogrammetry techniques in infrared images to generate depth data. The build-in calibrations are OK, but show visible misalignments between color and depth system. There are some issues caused by the measurement principle. SCENE Capture limits the range of the sensor to 0.7 – 2.0 meter. **Installation and setup** SCENE Capture uses Intel Realsense SDK to drive the sensor. The sensor runs with USB 3 ports on Windows 8 and 10. SCENE Capture installs the Intel Realsense SDK, but the driver installation needs a R200 plugged in. The setup copies the installation file and the drivers into the <Install Path of SCENE Capture>\IntelDriver folder. To install the R200 driver, plug in the sensor and run the intel_rs_dcm_r200_2.1.24.6664.exe program. Reboot your machine after the driver installation. **Note** If SCENE Capture can't detect the sensor even if everything is installed correctly, try to reboot.
	Intel F200	The Intel F200 is a front sensor manufactured by Creative Labs. The build-in calibrations are OK, but show visible misalignments between color and depth system. There are some issues caused by the measurement principle. SCENE Capture limits the range of the sensor to 0.3 – 1.2 meter. **Installation and setup** SCENE Capture uses Intel Realsense SDK to drive the sensor. The sensor runs with USB 3 ports on Windows 8 and 10. SCENE Capture installs the Intel Realsense SDK, but the driver installation needs a F200 plugged in. The setup copies the drivers into the <Install Path of SCENE Capture>\IntelDriver folder. To install the R200 driver, plug in the sensor and run the intel_rs_dcm_f200_1.4.27.41944.exe program. Reboot your machine after the driver installation. **Note** If SCENE Capture can't detect the sensor even if everything is installed correctly, try to reboot.

Sensor	Description	Remarks
	Intel SR 300	The Intel SR300 is a front sensor. It is the successor of the F200. The build-in calibrations are OK, but show visible misalignments between color and depth system. There are some issues caused by the measurement principle. SCENE Capture limits the range of the sensor to 0.3 – 1.2 meter. **Installation and setup** SCENE Capture uses Intel Realsense SDK to drive the sensor. The sensor runs with USB 3 ports on Windows 10 only. SCENE Capture installs the Intel Realsense SDK, but the driver installation needs a SR 300 plugged in. The setup copies the drivers into the <Install Path of SCENE Capture>\IntelDriver folder. To install the SR300 driver, plug in the sensor and run the intel_rs_dcm_sr300_3.0.24.59748.exe program. Reboot your machine after the driver installation.

Chapter 24: Technical Support

FARO Technologies, Inc. is committed to providing the best technical support to our customers.If you have any problem using one of our products, please follow these steps before contacting our Technical Support Team:

- Be sure to read the relevant sections of the documentation to find the help you need.
- Visit the FARO Customer Care area on the Web at *www.faro.com* to search our technical support database. This is available 24 hours a day 7 days a week.
- Document the problem you are experiencing. Be as specific as you can. The more information you have, the easier the issue will be to solve.
- If you still cannot resolve your issue, have your device's Serial Number available *before calling*.
- E-Mails or Faxes sent outside regular working hours usually are answered before 12:00 p.m. the next working day. Should our staff be on other calls, please leave a voice mail message; calls are always returned within 24 hours. Please remember to leave a detailed description of your question and your device's Serial Number. Do not forget to include your name, fax number, telephone number and extension so we can reach you promptly.

North America	Support Hours (Monday through Friday) 8:00 a.m. to 7:00 p.m. Eastern Standard Time (EST) e-Mail: support@faro.com Phone: +1 800 736 2771, +1 407 333 3182 (Worldwide) Mexico: 866-874-1154 Fax: +1 407-562-5294
Europe	Support Hours (Monday through Friday) 8:00 a.m. to 5:00 p.m. Central European Standard Time (CET) e-Mail: support@faroeurope.com Phone: +800 3276 7378, +49 7150 9797-400 (Worldwide) Fax: +800 3276 1737, +49 7150 9797-9400 (Worldwide)
Asia	Support Hours (Monday through Friday) 8:30 a.m. to 5:30 p.m. Singapore Standard Time (SST) e-Mail: supportap@faro.com Phone: +1 800 511 1360, +65 6511 1350 (Worldwide) Fax: +65 6543 0111

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China	Support Hours (Monday through Friday) 8:30 a.m. to 5:30 p.m. China Standard Time (CST) e-Mail: supportchina@faro.com Phone: +400.677.6826 Fax: +86 21 6494 8670
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Appendix B: FCC Equipment Authorization

FCC Equipment Authorization

Trade Name: FARO
Product Name: Freestyle3D, Freestyle3D X

These devices comply with Part 15 of the FCC Rules

Operation is subject to the following conditions:

1. The devices may not cause harmful interference, and
2. The devices must accept any interference received, including interference that may cause undesired operation.

Note:
This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is not likely to cause harmful interference.

Appendix A: CE Conformity

EC Declaration of Conformity

according to the Council Directive 93/68/EEC

FARO Scanner Production GmbH
Lingwiesenstraße 11/2
D-70825 Korntal-Münchingen Germany

Herewith we declare that the products

Freestyle3D Objects

are in conformity with the following directives and standards or normative documents:

EC-Directives	**2004/108/EC EMC Directive**
Standards	**EN 61010-1:2011** - Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use - Part 1: General requirements **EN 60825-1:2007** - Safety of laser products - Part 1: Equipment classification and requirements **EN 61326-1:2013-01** - Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements **EN 62471-1:2009-03** -Photobiological safety of lamps and lamp systems

Korntal-Münchingen, September 12th, 2016

Dr. Reinhard Becker
Director
R&D Scanner Production GmbH

This declaration certifies the conformity with the mentioned directives, but contains no assurance of properties. The safety notes detailed in the product documentation, which are provided, must be observed.

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