peel 3d™

User Manual

Version 1.2

TOC

Copyright

peel 3d version 1.2 SR1

Last modified in February 2019

General Information

This section contains general topics:

Welcome

Welcome to peel 3d contextual help and user manual.

This manual provides information regarding peel 3d software and scanner.

The *Contents* tab available through the sidebar, presents the table of contents. To access a topic, click on its title.

To search a particular topic or specific information in *Help*, use the *Search* tab available through the sidebar.

Icons used in the manual

Note: Information or explanation given for a better understanding.

Tips: Useful information or advice.

WARNING: Information given to prevent a potential problem or danger.

Example: Idea or fact used to explain a notion.

Contextual Help

Using the contextual help

The contextual help provides immediate assistance and information about the main features of peel 3d software and scanner.

In addition, the Content tab allows navigating in books and topics to find information concerning peel 3d.

To open or close the contextual help

- Click the  icon located at the upper right corner of the interface or
- Select **Help | Show contextual help** in the menu or
- Click F1

To find specific information

Click on  icon to access the whole help content.

Search tool

In the search tool, enter terms separated by spaces. The results will match all the terms in the query. Searches are case insensitive and will match exact terms and variations.

- Enter your query in the top right search box.
- Click  to see the search results.

Contents search

The *Contents* tab lets you explore and navigate to find specific information.

- Browse in books or entries by clicking on them to expand or collapse.
- Click on a topic to display its content.

System General Care

peel 3d products are made of optical precision parts and must be handled with care to avoid damaging their internal components and calibration system. They must be carried in their protective case at all times and must be stored in a dry, dust-free and room temperature environment. We recommend keeping all devices and accessories in the protective case when not is use.

Prior to starting a project, make sure the working environment is clutter-free and that cables are safely placed.

Always store the devices following these conditions:

- Storage temperature: 5 to 55 °C
- Operation temperature: 5 to 40 °C
- Humidity: 10 to 90 % non-condensing relative humidity

Never open any component of a peel 3d technology.

General use

- Always use the device in a clean and dry environment.
- Avoid direct lighting on the optical parts.
- Do not immerse the device.
- Do not drop the device and protect it against shocks.
- Do not introduce foreign bodies into the device.

Metal and plastic parts

To clean the device, use a soft cotton cloth with a small amount of water or a soapy solution.

Do not use solvent to clean the device.

Optical parts

- Spray dry air to remove any particles that may scratch the objectives and lights.
- Clean the objectives and lights with a damp cloth such as a non-abrasive optical towel or a microfiber cloth.

User calibration plate

The user calibration plate should remain in the protective case. Do not put any object on the case besides the custom foam insert. Do not touch the retro-reflective targets. In the case one target gets damaged, the whole user calibration plate must be replaced.

To clean dirty retro-reflective targets:

- Spot the target(s) that seem(s) to have some dust or dirt on it.
- Soak a cotton swab in a diluted soap solution (never use alcohol).
- Gently dab the targets (never rub the targets).
- Gently dry the targets by placing a microfiber towel or tissue on the targets (never rub the targets).

These recommendations also apply for optical reflectors cleaning.

Other materials

- Only use the sensor with the original power block supplied.
- Leave the protective caps on unused connectors.
- Do not fold cables with a curve radius lesser than 5 cm.
- Do not crush cables (do not step on them).

Service

Read the following terms and conditions before using this product.

Standard warranty

peel 3d standard warranty coverage period is one (1) year effective from the factory shipping date. This includes all parts and labor costs for product problems such as material or manufacturing defects.

Software update

Each year, peel 3d releases a software update. The customer is responsible for installing it. peel 3d is not liable for any device malfunction due to the installation of software on non-certified peel 3d computers. Refer to the System Requirements section for more details.

What is not covered

- Components, products or items not specifically listed herein.
- Unauthorized repairs performed by third parties, inaccessible products, theft.
- Damage caused by conditions beyond Administrator's control such as power surge, rust, corrosion, infestation, negligence, abuse, misuse or acts of God.

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Assistance

Getting help

Contextual Help

Should you have any questions or concerns regarding peel 3d software or scanner, refer to the contextual help (Help | Show Contextual Help). Information on the Help | About peel 3d.

Technical support

If you experience issues, contact the **Technical support team** (available during business hours).

You can also contact us online using the contact form or the live chat at **www.peel-3d.-com/pages/support** .

Diagnostic mode

This function is made available for the technical support team. It gathers information on the customer's active products in the case a system issue needs to be resolved. It is accessible from the **Configure | Diagnostic mode** after receiving the activation key from the Customer Support team.

Online Services

See peel 3d **Online Services** section.

Keyboard shortcuts

Keyboard shortcuts are available through the *Help* menu (**Help | Keyboard shortcuts**).

Functions	Keyboard shortcuts
Start / Stop acquisition	Space

Functions	Keyboard shortcuts
Delete	Del
Accept	Enter
Cancel	Escape
Full screen	F11
Photogrammetry Trigger	MediaPlayPause
Select all	Ctrl+A
Show only selected	Ctrl+E
Select next sibling node	Ctrl+R
File | New session	Ctrl+N
File | Open session	Ctrl+O
File | Save session	Ctrl+S
File | Save session as	Ctrl+Shift+S
File | Import | Positioning targets	Ctrl+T
File | Import | Mesh	Ctrl+M
Tools | Edit scan	Ctrl+Alt+E
Tools | Undo	Ctrl+Z
Tools | Redo	Ctrl+Y
Tools | Selection | Rectangle Selection	Ctrl+Alt+R
Tools | Selection | Free form selection	Ctrl+Alt+F
Tools | Selection | Brush selection	Ctrl+Alt+B
Tools | Selection | Connect	Ctrl+Alt+C
Tools | Selection | Similar curvature	Ctrl+Alt+S
Tools | Selection | Similar normal	Ctrl+Alt+N
Tools | Selection | Sudden change	Ctrl+Alt+H
Tools | Selection | Isolated patches	Ctrl+Alt+I
Tools | Selection | Curvature selection	Ctrl+Alt+U
Tools | Selection | Triangle picking	Ctrl+Alt+P
Tools | Selection | Boundary selection	Ctrl+Alt+O
Tools | Selection | Grow selection	Ctrl+Ins

Functions	Keyboard shortcuts
Tools | Selection | Shrink selection	Ctrl+Del
Tools | Selection | Select through	Ctrl+Alt+T
Tools | Selection | Select backface	Ctrl+Alt+K
Tools | Selection | Select only backface	Ctrl+Alt+L
Tools | Selection | Select all	Ctrl+A
Tools | Selection | Clear selection	Ctrl+D
Tools | Selection | Inverse selection	Ctrl+I
View | Predefined views | X+	Ctrl+1
View | Predefined views | X-	Ctrl+2
View | Predefined views | Y+	Ctrl+3
View | Predefined views | Y-	Ctrl+4
View | Predefined views | Z+	Ctrl+5
View | Predefined views | Z-	Ctrl+6
View | Predefined views | Isometric	Ctrl+7
View | Reset viewpoint	Ctrl+0
View | Fit to screen	Ctrl+9
View | Lock viewpoint	Ctrl+L
View | Lock zoom	Ctrl+W
Configure | Scanner | Calibration	Ctrl+Shift+D
Configure | Scanner | Configuration	Ctrl+Shift+C
Help | Show Contextual Help	F1

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Contact Us

Visit our website **www.peel-3d.com** and register your system to get access to technical documentation and upgrades.

Technical Support

Fill out the form on our support web page and someone from our team will get back to you shortly.

www.peel-3d.com/pages/support

You can also send us an email at this address:

support@peel-3d.com

Sales Support

sales@peel-3d.com

General Information

hello@peel-3d.com

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Getting Started

This section provides a general overview of necessary information user needs to know to use the software.

- System Requirements
- Software Installation
- Product Manager
- Online Services
- Software and License Updates

System Requirements

Minimum system requirements

Components	Requirements
Computer model	HP ZBook 15 (recommended)
Processor	Intel Core i7 (4+ cores) – 2.7 GHz or more
Operating system *	Windows 10 64 bits
Graphic card	NVIDIA card with 2GB memory or more OpenGL 4.3 and later
Memory	32 GB (minimum) or 64 GB (recommended)
Hard drive	At least 100 GB of free space or 200 GB (recommended)
Display	1920 x 1080
Connecting ports	1 × USB 2.0, USB 3.0 compatible

System performance improves with a more powerful computer.

Other considerations

The software takes advantage of modern computer architecture. Almost all of its operations are multithreaded to benefit from the multi-core processors of the computers.

Due to some constraints in Windows, there is a limit to the amount of memory that can be allocated to a single program, which is set to 1.6 GB in Windows 7 (32 bits). In a 64-bit operating system, the limit depends on the total amount of memory available in the computer. For example, a computer having 4 GB of RAM will have a 3.7 GB limit. If the limit exceeds, the software will display an error message prompting you to reduce the resolution or to increase the scan volume. The data of the current session will not be lost and will reappear when the volume changed back to a more reasonable setting. It is recommended to save the session at this point.

Software Installation

Download files online

peel 3d up-to-date file can be retrieved on the **website**. You can request access by using the *Web Access Request Form*.

- Log in to your account on the **website**.
- Click on *Products*.
- Check the “Select all” checkbox at the top left of the products table, to select all your products.
- Select the software and version you want to use at the bottom of your screen.
- Click the *Software Download* button and save the installer on your computer.
- Click the *Download all Licenses & Calibrations* button and save the “selected-product-s.zip” file on your computer.
- Launch the installer.

Software uninstallation

To uninstall the software, use the *Add and Remove Programs* in *Windows Control Panel*.

- In the *Start* Menu, click on *Control Panel*.
- Go to *Programs and Features*.
- Select peel 3d from the list and click *Uninstall*.
- Follow the instructions to complete the process.

The uninstallation tool allows keeping license and configuration files. If *Yes* is selected, configuration and license folders will not be removed.

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Product Manager

The *Product Manager* can be accessed to manage the configuration and license files of the scanner. It is available either through:

- peel 3d : **Configure | Product Manager**
- *Windows Start* menu: **All Programs | peel 3d | Product Manager**

The *Product Manager* lists all the products installed on the computer. More than one product can be installed on a computer, although only one can be activated per session.

If changes are made in the *Product Manager* while the software is running, a new session must be created.

To manually add a product to the *Product Manager*

- Click on the link *Add new product*.
- Enter the product serial number.
- Click *Browse* and select its configuration file (*.cst).
- Click *Browse* and select its license file (*.clf).

Product list

The *Product Manager* table gives information concerning the , the license and the calibration of the installed products as well as the active products .

To activate a product

Select the product to use from the *Installed* products and click on *Activate*.

To change or delete a product

- Select the product from the *Products* list.
- Click the *Change* button to change either the configuration file or the license file of the product.
- Click the *Delete* button to remove the product from the *Products* list.

Click the icon to force refreshing information for the current product.

License status

The product license status is shown in the *Device bar*, along with other information regarding the current session.

Status symbols in the *Product Manager*

The following table summarizes the different status symbols that can be encountered in the *Product Manager*:

Status symbols		Customer Care Plan expiration date column	License status	Calibration date column
✓	Up to date	Customer Care Plan is active for the product.	The license file is up to date.	The calibration file is up to date.
⊘	Invalid	Customer Care Plan is expired	The license file	N/A

Status symbols		Customer Care Plan expiration date column	License status	Calibration date column
		for the product.	is not valid.	
	Download	N/A	Download latest license file now.	Download latest calibration file now.
?	Not found	Customer Care Plan information not found.	License not found.	Calibration file not found.

The name of the product is displayed, in the *Product* column, if the serial number is found on the website. If the *Product Manager* is offline or if the serial number of a product cannot be found on the website, N/A is displayed.

Restore to factory default

The scanner calibration can be restored to its factory default accessing the *Product Manager*. This manipulation cannot be undone and should only be used when the sensor calibration process fails to optimize properly.

To restore the factory settings, click on the *Restore* button.

The button becomes available when a *.cst extension has changed. For example, when a scanner is recalibrated.

When using this function, a message appears informing a new scanner has been activated and a new session has been created with the original *.cst.

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Online Services

Overview

The *Online Services* are used to link the software with the **website**.It allows the users to directly access their product information, such as expiration dates, license expiration dates, last calibration dates, but also to ensure that the license files and software version installed on the computer are up to date.

Once the Online Services are activated, simple symbols are displayed in the *Product Manager* to provide a useful visual feedback to the user giving specific information about his products.

An available internet connection is required to use these services.

Online Services options

The *Online Services* options are located in the software general options accessible through **Configure | Options** menu.

Disconnected services

When the *Online Services* option is not activated, the *Product Manager* is not connected to *Customer Center*. Therefore, it only includes the license and configuration files that were previously installed on the computer. The users must manage their products through the **website**. It is also possible for the user to set the frequency which the software will check for available updates.

To activate the Online Services

Activation for non-registered users

- Click on the link available in the software options.
- A web page opens and a request form is loaded.
- Fill in the form and once it is completed, a registration approval email is sent within the next 24 hours.

Activation for registered users

- Enter email address and password used at registration .
- Check the *Remember Password* box (optional).
- Click OK.

Forgot your password?

- Click on the *Forgot your password?* link in the *Online Services* options to be redirected to the *Customer Center*.
- Click on *Forgot your password or need to change your password?* in the logon dialog.
- Enter your email address and click on *Reset/Change my password* to receive an email with the link to change your password.

Access to support website

Once the *Online Services* are activated, the **website** can be opened directly from the software (**Help | Customer Center**).

Online Services indicators

The main window displays a small indicator, at its bottom left, giving general information about products:

Indicator	Description
?	Not connected to the Online Services. No log-in information has been provided and/or the online services haven't been enabled with the check box in the options. Clicking on this icon

Indicator	Description
	will open the Options window.
	Not connected to the Internet.
	A software update is available. Click on this icon to initiate the download of the new version.
	Most recent calibration and/or license file(s) is/are available. At least one of the connected sensors (license and/or configuration file) is not up to date. Click on this icon to open the **Product manager**.
	The software is connected to the Online Services and the software version, as well as the entire license and calibration files are up to date.

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Software and License Updates

The **Online Services** portal gives access to different updates:

- **Software**
- **Calibration file**
- **License file**

> **To carry out an update, the computer must be connected to the Internet.**

Software update

peel 3d software should be updated each time a service release or a new version is available. All updates come as a new software installer.

To update the software using automatic download option with Online Services:

- Click on the indicator displayed at the bottom left of the screen.
- A new update available message will appear.
- Click *Yes* to download and install the update.

To update the software on the website:

- Connect to the **website** through the Configure | Options.Click on *Products*.
- Click on *Products*.
- Select the software and version you want to use at the bottom of your screen.
- Click the *Software Download* button and save the installer on your computer.
- Click the *Download all Licenses & Calibrations* button and save the “selected-products.zip” file on your computer.
- Launch the installer.

Calibration file update

Each time a product is factory calibrated, a new configuration file is created. The latest version is available online (or on the USB stick provided with a new scanner). Since that file is related to the product calibration process, it does not have to be changed after a software update.

To update the calibration file:

Automatic method

- In the **Product manager**, make sure to be connected to the **Online Services**.
- Click the icon next to the calibration file to update.

Manual method

- Connect to the **website** through the **Help | peel 3d Online Services**.
- Find the product by entering its serial number in the text field and click *Apply*.
- Click on the arrow in the *Calibration* tab.
- Access to the **Product Manager** to change the calibration file.

License file update

License files are linked to the software version. They must be updated for each new version only (not for service releases). License files loaded for previous versions will be displayed as *Invalid version*.

A 90-day license is provided with every new scanner. After that period, a user license is issued. Subsequently, updates are required to continue using the software.

To update the license file:

Automatic method

- In the **Product manager**, make sure to be connected to the **Online Services**.
- Click the icon next to the license file to update.

Manual method

- Make sure to download and install the latest available version of the software.
- On the **website**, find the product by entering its serial number in the text field and click *Apply*.
- Find the product by entering its serial number in the text field and click *Apply*.
- Click on the arrow in the *License* tab.
- Access to the **Product Manager** to change the license file.

The license expiration date appears in the *Device Bar* located above the main **Menu**.

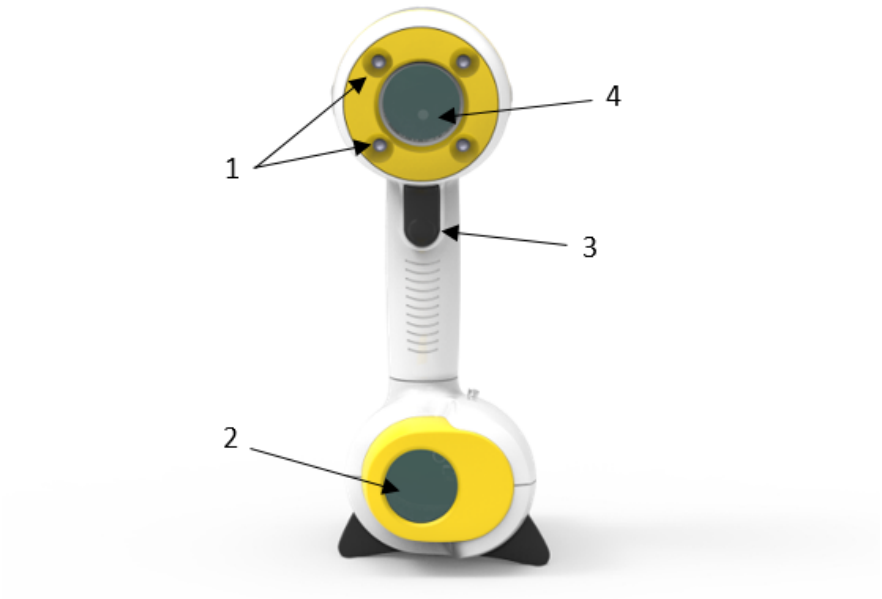
peel 3d

The **peel 3d** handheld scanner offers portable 3D scanning experience, providing fast and reliable measurements.

The **peel 3d** self-positioning scanner provides a fast measurement rate, and do not require manual data post-processing. It can be used for a wide range of applications, helping professionals throughout the entire product development process.

Hardware and Components

The **peel 3d** scanner features a USB camera surrounded by a set of four white LEDs and a white light pattern projector.



- Set of 4 LEDs
- White light pattern projector
- Trigger
- USB camera

The **peel 3d** scanner and all necessary hardware fit into one ergonomic protective case equipped with a custom foam insert. The calibration plate is located under the foam.

- Software installer
- USB cable
- Positioning targets
- **peel 3d** scanner
- Power supply

Technical Specifications

Weight	850 g (1.9 lb)
Dimensions	96 x 140 x 258 mm (3.8 x 5.5 x 10.2 in)
Light source	White light (LED)
Measurement rate	550 000 measurements/second
Resolution	1 mm (0.04 in)
Accuracy	Up to 0.500 mm (0.02 in)
Volumetric accuracy*	0.500 mm/m (0.006 in/ft)
Stand-off distance	400 mm (15.75 in)
Depth-of-field (from stand-off distance)	250 mm (10 in)
Scanning area	380 x 380 mm (15 x 15 in)
Software	peel 3d
Output format	.dae, .fbx, .ma, .obj, .ply, .stl, .txt, .wrl, .x3d, .x3dz, .zpr
Connection standard	USB 2.0

*With super-adhesive reflective targets or an object presenting sufficient geometry.

Operating Principles

Geometry - based positioning

The scanner requires geometry in order to position itself. The projector emits a white light pattern on the object. The pattern distortion on the object is recorded by one digital camera: the camera is placed on top of the scanner. The acquisition is made over the entire light pattern. The geometry information collected is used to build the surface in real-time positioning.

Intelligent hybrid positioning

The scanner detects positioning targets on and around the object. Intelligent hybrid positioning combines the positioning targets provided with the geometry information in order to provide more accurate results. This feature always uses all the information available, the geometry and positioning targets, to provide positioning. It does so while ensuring that sufficient data is available to guarantee accuracy. The built-in intelligence also prevents the acquisition of inaccurately positioned frames.

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System Connection

Connection steps

- Plug the power supply to a wall outlet or a power bar.
- Connect the power supply into the USB cable.
- Plug the USB cable into one of the USB port of the computer.
- At the very end, plug the connector of the USB cable into the scanner.

You must first unplug the USB cable from the scanner, afterward the sequence is up to the user.

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Calibration

System calibration

The scanner calibrates itself, with the user calibration plate, as a known reference. For optimal results, optimizes the calibration depending of the current conditions. We recommend proceeding to a calibration before each scanning project or each time scanning conditions vary.

Follow this procedure to complete the calibration process:

- Click on *Scanner calibration* in the main toolbar.
- Put the protective case on a stable flat surface and open the calibration plate.
- Position the scanner at approximately 20 cm (8 in) from the center of the user calibration plate, in a perpendicular angle.
- Press the trigger and slowly move the scanner along in order to match the white square with the green square in the center. Once the first measurement is taken, lock your arm and gradually move the scanner upwards for other measurements. There are a total of 10 measurements required for calibration.
- Once all 10 measurements are taken, follow the recommendations displayed in the *Scanner diagnostic* area.

There are one zone to look at:

- **Center zone**: Try to match the white square with the green square. The green square size changes indicating the distance required between the scanner and the user calibration plate.

The **Calibration details** window, on the left side of the screen, indicates the factory calibration date and the last optimization date.

The factory settings can be restored through the "Product Manager" on page 31.

If the calibration fails, some details need to be checked before concluding to a decalibrated scanner. Make sure that:

- There are no reflective objects near the user calibration plate. Detecting a false positioning target will make the process fail.
- There is no target near the user calibration plate.
- The user calibration plate targets are in perfect condition. Damaged targets will cause optimization failure message.
- If possible, to leave the user calibration plate in the case.

If all these steps fail, contact the **support@peel-3d.com**

Configuration

Automatic shutter

The *Automatic shutter* option allows changing the shutter speed automatically while scanning.

Since reflection properties differ from a surface to another, the *Automatic shutter* feature allows the scanner to automatically adjust its camera shutter speed for better surface detection. Carried out in real time, the *Automatic shutter* mode, optimizes scanning parameters. It works well if the light pattern is entirely contained within the object, otherwise it can be used as an initial approximation tool.

The *Automatic shutter* function should be checked while scanning mostly monochromatic and reflective objects.

Otherwise, it should be unchecked when two contrast colors or distinct reflection properties appear in the same field of view.

Manual shutter adjustment

If the scanner does not detect the object to scan, or for parts with different colors and/or reflection properties, we recommend manually adjusting the cameras shutter speed. This will provide optimal surface detection. The configuration parameters can be modified at all times, even without stopping the acquisition process.

Move the slider in the *Scanner parameters* box on the left side of the screen. This slider controls the exposure displayed in milliseconds. This is useful when scanning dark surfaces.

The *Auto. adjust* tool, accessible through **Configure | Scanner | Configuration** or by clicking the *Scanner configuration* in the main toolbar, adjusts and optimizes the parameters depending

on the object to scan. This works well if the light pattern is entirely contained within the object. It can be used as an initial approximation if the light pattern is partially enclosed within the object.

To save a parameter template, right-click and select the *Save preset* option. This option is useful when scanning similar objects. Factory settings can be restored through the Product Manager.

The configuration can be modified during the scan so different strategies can be used for scanning multicolor parts. In the case of low contrast, a compromise can be reached between the different colors, which still provides a good light pattern detection. However, in the case of high contrast, it is recommended to scan one section of the object, to change the configuration and to complete the scan. No need to stop scanning to access the *Configuration* dialog. To configure the scanner, hold it at the stand-off distance from the object (~40 cm) and press the trigger.

The scanner can be configured by adjusting the shutter speed for better light pattern observation on the surface. Four statuses (colors) are used to set optimal shutter speed:

- **No detection (black)**: No surface is detected.
- **Underexposed (gray)**: The cameras hardly perceive the light pattern reflection. There is not enough information gathered by the software to calculate and build a mesh from the surface. The shutter speed should be increased.
- **Optimal (yellow)**: The reflection of the light pattern is clean and defined. The surface calculation is made under ideal circumstances.
- **Saturated (red)**: The reflection of the light pattern is so intense the cameras are dazzled. The pattern is not clearly defined and may lead to a wrong reconstruction of the surface or an unusual amount of noise in the data. The shutter speed should be decreased.

Object Preparation

In order to provide better scan results, the object to scan must be prepared following some simple steps. peel 3d is an intelligent scanner self-positioning itself based on the object geometry. In the case of flat or shiny surfaces, positioning targets will provide better scan results.

For optimal scan results, it is also recommended to add white powder on more complex surfaces.

Instructions:

- The object must be clean and free of dirt.
- In the case of a shiny surface, first add powder to the object.
- For both powdered and flat surface objects lacking geometry, apply positioning targets with a distance of 20 mm and 100 mm from each other.

Note: The use of a turntable could be useful to scan as it allows rotating the object. For better scan results, apply positioning targets around the object.

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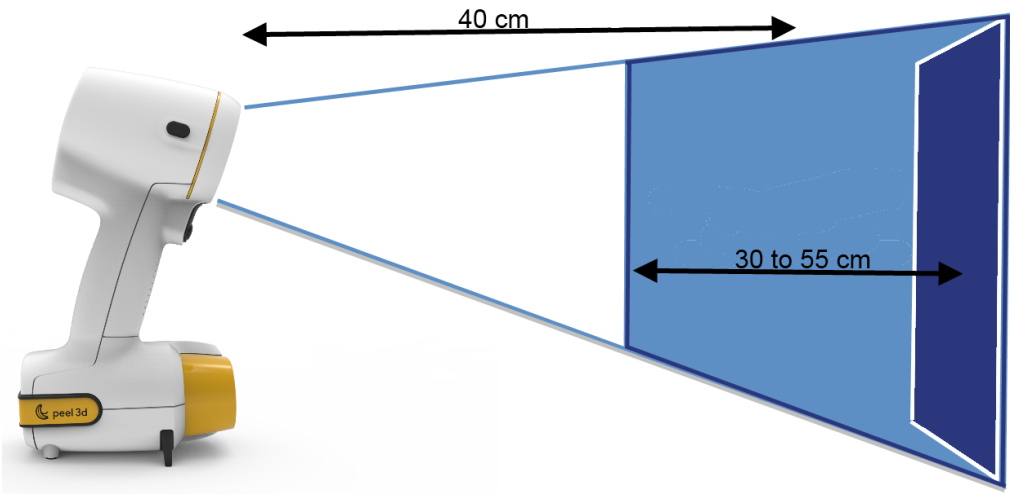
Acquisition Rules

Scanning distance

For better scan accuracy, the following scanner distance must be respected.

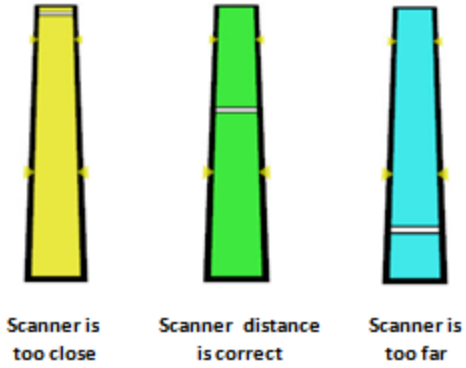
The scanner stand-off distance is 40 cm (~16 in). Its field of view goes from 30 to 55 cm (~12 to 22 in).



Screen indicators

While scanning, a **distance meter** is displayed on the left side of the screen, showing the distance between the scanner and the object.

Distance meter



- Red / Yellow LEDs to indicate the scanner is **too close** to the object: **move backward**.
- Green LED to indicate the scanner is at the **correct distance**.
- Dark Blue / Light Blue LEDs to indicate the scanner is **too far** from the object: **move forward**.

LEDs indicators:

- Blue LED to indicate the scanner is running.
- Red LED to indicate the scanner is **too close** to the object: **move backward**.
- Green LED to indicate the scanner is at the **correct distance**.
- Red LED to indicate the scanner is **too far** from the object: **move forward**.

When the scanner loses tracking, the two red LEDs light up.

Detection mode

The *Detection mode* allows to manually or automatically select the object surface texture (color and/or geometry). This mode can be changed while scanning. This option also features an automatic setting which detects the surface texture. This mode features three functions:

- **Uniform surface**: This function is the default mode. It is used with uniform color and geometrical texture.
- **Textured surface**: This function must be manually selected. It is used with non-uniform color or geometrical texture.
- **Automatic**: This function detects the surface texture depending on the object's color and geometrical texture.

Super adhesive retro-reflective targets

The *super adhesive targets* are suited to use with the scanner. They are hypoallergenic, safe and made of a plaster type adhesive. They provide good adhesion to both skin and fabric.

There must be a minimum of 15 mm around each target.

Field of view

The *Field of view* is the image scope the scanner can acquire during the scanning process.

For better surface results and to ensure optimal field of view, the user must respect a certain stand-off distance. Any data out of the scanner field of view will not be acquired.

Resume scan

Click the icon  to *Resume scan*.

This function is very useful especially when position tracking is lost. The user can choose where to resume the scan. He can also move the surface around and select a different area.

It is also possible to click on the surface to decide the area where to resume the scan. In order to resume the scanning process, the user needs to point the scanner on this area. If the area selected does not contain enough positioning information, the rectangle will become red and a warning message will be displayed.

Delete frames

Click the icon  to *Delete frames*.

This function corrects positioning errors, when the object geometry is not sufficient or slightly ambiguous. It can be used during the scanning process or during post-processing.

In the *Scanning parameters* expanding panel, it is possible to delete highlighted images, to review the list of affected frames and/or to pinpoint the incorrect ones. Frames selected from the list will appear in yellow in the 3D viewer.

All frames will be selected when expanding the list of frames. It is possible to select (or deselect) multiple frames using the *Shift* key, which might be useful when multiple frames must be deleted.

When used for post-processing, surface reconstruction will be required after deleting the frames.

The frames included in the selected area will appear in red.

For more information, see the **Delete Frames** section.

Targets

Two types of positioning targets are available with **peel 3d**.

Positioning targets

Type	
	Regular
	Super Adhesive

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Software Overview

This section contains information about general features and options.

Software Interface

peel 3d is a 3D software platform gathering multiple options into a user-friendly and simple environment.

Interface

These are the sections featured in the software interface:

Menu

Toolbar

Navigation panel

Display panel

Entity panel

3D viewer

Status bar

Contextual help

Open session

This option allows to open a session. Click  *Browse* to open the file explorer and to browse for the file on the computer. Select the file and click *Open*. Double-click on a recent opened file to open it.

To remove a file from the list, right-click on the file name and select *Remove from file history*.

Interface

The *Menu* and the *Toolbar* are complementary to each other. The toolbar offers the main functions, while some advanced functions are only located in the menu.

Menu Icon	Function	Menu	Action
	New session	File | New session	Creates a new session by reinitializing the sensor and clearing existing data
	Save session	File | Save session	Saves the session (CSF). The *Save* icon is not a *Save as*
	Import	File | Import *	Allows the selection of new data in the session: • Positioning targets • Meshes (*.csf, *.stl, *.obj) **Note**[2]: When importing a *.csf file with **peel 3d**, only the meshes included in this file will be imported.
	Export	File | Export *	Allows to export data to file: • Positioning targets (*.txt) • Mesh (See Mesh Output Format for the list of all the possible file extensions)
	Show the contextual help	Help | Show contextual Help	Opens or closes the contextual help

Different options are available regardless of the selected node in the *Navigation panel tree*.

Toolbar

Available toolbar functions vary depending on the selected node in the *Navigation tree*.

For more details concerning the toolbar, see:

Scan module

Mesh module

Navigation panel

The *Navigation panel* contains the *navigation tree* under which nodes are listed and displayed:

- **Scan module**
- **Mesh module**

When a CAD model is imported in a session, a new CAD model node is created under the navigation tree.

The eye icon  allows to show (or hide) the information within the *3D viewer*.

To toggle from one node to another, use Ctrl+R.

To rename a node or element in the navigation tree

- Right-click on it and select *Rename* option or
- Simply click on it and enter the new name.

Display panel

Depending on the devices or modules purchased, different sections will be displayed. For more details, see the **Display Options** section.

Entity panel

The Entity panel appears while creating an entity. Options and information are available depending of the module used and the entity created:

- **Building Mode**: It can be selected using the drop-down list. The **selector control** allows users to select, quickly and easily, entities created in the session.
- **Name**: This box allows to give a specific name to an entity.

- **Parameters**: This option allows setting the dimension (*Height*, *Width*, *Length*, etc.) by entering numerical values in the text boxes.
- **Details**: This section provides properties information of the active entity and also, if available, the *Standard deviation* and *Planarity error*.
- **Error Distribution**: This section shows a color map of the error distribution between the selection done and the entity created.

Selector control tool

The first icon  is designed to show all entities created. The second icon  is designed to show all derived entities while the others are used as filter to show each type of entities individually.

When user moves the mouse over an entity in the list, its outline appears highlighted in yellow in the 3D viewer.

A grayed out icon indicates that no such entity is created or, not suitable for this selection.

3D viewer

The 3D viewer shows the session results in real-time. Depending on the node selected, it displays either the positioning targets, the scan or the mesh. A right-click in the 3D viewer opens the **contextual menu**. When a function requires it, the **selection mini toolbar** appears in the 3D viewer.

Status bar

Located at the bottom of the screen, the *Status bar* displays different values concerning the current state of VXelements. The scanner status, displayed on the left, can take three values:

- **Ready**: The scanner is ready to start the acquisition process. When the scanner is **Ready**, the status bar shows the available 3D viewer controls, which depend on the *3D navigation mode* defined in the *Options* dialog.

- **Recording**: The scanner is currently acquiring data. When the scanner is *Recording*, the current frame number is shown as well as the current configuration parameters. The current acquisition frame rate is displayed on the right of the status bar.. A normal rate would be of approximately 15 frames per second. On the right end of the status bar is the **Memory meter**, displaying the amount of memory used by the software. When this value reaches 100 %, a dialog box notifies that the software has exceeded the amount of available memory and that resolution will have to be reduced (by using a bigger scanning volume or a lower resolution).
- **Disabled**: The software is doing computation and is unable to acquire data.

Contextual help

The contextual help provides immediate assistance and information about the software main features.

For more details on *Contextual help*, click **here**.

Configuration Options

The optimization options available are listed below and can be configured in the **Configure | Options** dialog.

The user can easily toggle from one section tab to another:

- General options
- Scan options
- Online services options

peel 3d general options

- **Software language**: The software is available in several languages. It must be restarted every time the language setting is modified.
- **Color theme**: Allows changing the theme or modifying the interface colors of the software.
- **Length unit**: Various length units are available in the software. It is recommended to use length units comparable to object size measured. The default value is millimeters (mm).
- **Use projects folder**: The software will create a folder in *My Documents*. This is the default folder for saving sessions.
- **Show toolbar button labels**: Labels will appear in the toolbar if this option is checked.
- **Temporary folder**: This option allows the selection of a different location for the temporary files. It can be useful in the case user want to optimize either space or speed of the local disk.
- **Clear Recent File History**: Click this button to delete the recent file history.
- **Clear list of silenced message boxes**: Click this button to delete the list of all the message boxes that were ignored and closed.

Scan options

- **Audible warning when position lost**: This option emits a sound when position is lost during scanning.
- **Enable auto-recovery while scanning**: Enabled by default, this option acts as a backup by automatically saving scan data during a session. If a session fails unexpectedly, data will be recovered next time the software is launched, even if a computer reboot is necessary. A message asking if you want to recover data will appear.
  - By clicking *No*: data will be deleted and will be impossible to recover; a new session will be opened as usual.

- By clicking *Yes*: saved data will be loaded and the scanned surface will be recovered. For raw scan data only. If the current session contained more than one scan, all scan data will be recovered. Parameters like laser power and resolution cannot be retrieved.

In the case of a saved session where the scanning went on after saving, the session will be loaded with the recovered scan data when launching the software. The session parameters will also be loaded.

Online services options

- **Connect**: When checked, the Online Services function is active (for more details, see **Online Services**).
- **Check for new version**: Select the frequency at which the update check will occurred.
- **Remember password**: Check the box to save the password.
- **Use online help**: Check this box to use the online help by default when an Internet connection is available.

Mouse and Keyboard Controls

Mouse controls

The *3D model* is located in the 3D viewer, where interaction is made through mouse actions.

The default mouse actions are summarized below. They have different actions depending on the selected mode.

Action	Effect
Left button	Rotates the object by clicking and holding the left button (or draws a selection box when the selection tools are activated)
Ctrl+left button	Selects an area (targets, triangles, etc.)
Right button	Opens a contextual menu containing the display options and commonly used tools
Left and right buttons	Spins the object around the current optical axis
Middle button drag	Translates the object (or the scanning volume)
Middle button click	Centers the viewpoint and the rotation center
Scroll wheel	Zooms in and out

Keyboard shortcuts

Keyboard shortcuts are available through the *Help menu* (**Help | Keyboard shortcuts**).

Navigation modes

Action	peel 3d
Rotate	Left button
Spin	Left and right buttons

Action	peel 3d
Pan	Middle button
Zoom	Scroll wheel

Contextual Menu

A right-click in the 3D viewer opens a contextual menu which contents vary depending on the device and the current module opened.

- **Predefined views** allows setting the required view such as X+, X-, Y+, Y-, Z+, Z- and isometric.
- **Set rotation center** allows picking a point from which the scan is going to rotate.
- **Center viewpoint** allows centering the viewpoint in the by clicking on a specific point of the mesh.
- **Fit to screen** brings the 3D model in the center of the 3D viewer.
- **Lock viewpoint** allows locking the viewer in its current position. It is still possible to zoom and rotate but the viewer will remain static while the acquisition is in progress. Useful for acquiring data on small details. The default value is unchecked.
- **Lock zoom** sets the zoom level while the viewer follows the movements of the scanner. Useful when scanning small details. The default value is unchecked.
- **Identify frames to be deleted** function allows identifying the frames that must be deleted.
- **Capture 3D viewer image** allows capturing and saving 3D viewer images from the current session.

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Display Panel

Depending on the devices or modules purchased, different options will be available in the *Display panel*.

General Display

These *General display* options are available.

- **Material glossiness**: This option allows adjusting the object material glossiness in the 3D viewer.
- **Clip view**: This allows viewing the 3D model by hiding a part of it in the 3D viewer. The orientation of the plan used to hide the object is set using the current view. By default, it hides 50% of the object, and it can be adjusted by using the slider in the upper right corner of the 3D viewer. This option can be useful to view the interior part of an object thereby allowing validating the 3D model.
- **Quick rendering while moving**: This option aims to lighten file, allowing to flow movements when rotating the part in the 3D viewer.
- **Show isolated patches**: Check this option to display the isolated patches in the viewer.
- **Show origin**: Displays the XYZ coordinate system.
- **Show viewpoint reference**: Displays the XYZ coordinate system in the bottom left corner of the 3D viewer.
- **Show linear scale**: Displays the linear scale based on the zoom level.
- **Viewer font size**: Allows to adjust the font size of the viewer display.

Mesh Display

The *Mesh display* allows changing the display of the mesh in the 3D viewer such as triangles, wire frame, triangles and wire frame or transparent triangles. This also allows changing the 3D model view by smoothing (or flatting) the object.

- **Shading**:
  - Smooth
  - Flat
- **Display as**:
  - Triangles
  - Wire Frame
  - Triangles and wire frame
  - Transparent triangles

File Types

The following table summarizes the file types available for each system.

.CST and .CLF files can be managed through the **Product Manager** and can be retrieved on the **website**.

System type	Configuration file	License file
Scanner	serial_number.cst	serial_number.clf

File extensions

Extension	Description
*.peel	It contains data which come from peel 3d software.
*.stl	Main output format of peel 3d software, compatible with various post-processing software applications.
*.txt	Text files used to store the positioning model when saved through the *Save positioning targets* function.

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Scan Module Overview

This data acquisition software is designed to be used with the peel 3d scanner and includes several features.

Using the module

Module interface

Add basic entity

Add basic alignments

Edit scan

Merge scans

Delete frames

Technical requirements

The software has standard **requirements** for installation and usage.

Using the module

Before launching the scan , the device must be connected, calibrated and configured:

- Click  to start the scan;
- Click  to stop the scan. A scan node will be created under *Scans* in the Navigation panel.

Positioning targets colors

Color	Description
White	Recorded, but not seen or used in the last image.
Red	Recorded and seen or used in the last image.
Other (blue, yellow, pink, ...)	- Recorded - Not referenced to the origin or the other targets. - Will be deleted after a stop scan if not linked to the other targets.

Scan Interface

Menu

The *Menu* and the *Toolbar* are complementary to each other. The toolbar offers the main functions, while some advanced functions are only located in the menu.

Toolbar

Toolbar icon	Function	Menu	Action
	Scanner calibration	Configure | Scanner calibration	To start he scanner calibration (if a scanner is connected).

Toolbar icon	Function	Menu	Action
	Scanner configuration	Configure | Scanner configuration	To start the configuration mode.
	Scan	-	To start the scanning process. See **Scan modes** for more details.
	Stop scanning	-	To stop (or pause) the scanning process.
	Edit scan	Tools | Edit scan	Starts the scan edition mode. Once the edition is finished, click on the icon to save the edition and leave. See **Edit scan** section for more details.
	Resume scan	Tools | Resume scan	This tool aims the scanner at the last frame or go back to a previously captured bunch of targets.
	Reset scan	-	To reset the current scan (parameters will not be reinitialized as in *New session*).
	Merge scans	-	To merge multiple meshes together. See **Merge scans** section for more details.
	Basic entities	Tools | Basic entities	Allows basic entity creation. See **Basic entities** section for more details.
	Basic alignments	Tools | Basic alignments	Allows basic alignments creation. See **Basic alignments** section for more details.
	Add scan	Tools | Add scan	Adds a new scan in the Navigation tree.
	Delete selected targets	Tools | Delete positioning targets	To delete scanned positioning targets.
	Delete Isolated Patches	-	To delete permanently isolated patches hidden by the **Remove isolated patches** parameters.

Navigation panel

Scan node

The *Scan* node is created in the *Navigation tree* when a scan is performed or when a session with a scan in is opened. When this node is selected, the 3D viewer shows the final result of the scan with triangles structured as a .stl file.

Right-click on the *scan* node to access these options:

- *Create mesh*
- *Show only selected*
- *Rename*
- *Delete*

Scan details

The *Scan details* panel provides information on the selected scan in the Navigation tree.

- **Resolution**: resolution value set in the **Scan parameters**
- **Estimated triangle count**: estimate of the number of triangles.
- **Triangle count**: total number of triangles in the scan.
- **Vertex count**: total number of vertices in the scan.
- **Target count**: total number of positioning targets detected in the scan.

Scanner parameters

Detection mode

The *Detection mode* allows to manually or automatically select the object surface texture (color and/or geometry). This mode can be changed while scanning. This option also features an automatic setting which detects the surface texture. This mode features three functions:

- **Uniform surface**: This function is the default mode. It is used with uniform color and geometrical texture.

- **Textured surface**: This function must be manually selected. It is used with non-uniform color or geometrical texture.
- **Automatic**: This function detects the surface texture depending on the object's color and geometrical texture.

Automatic shutter: Since reflection properties differ from a surface to another, the *Automatic shutter* feature allows the scanner to automatically adjust its cameras shutter speed for better surface detection. Carried out in real time, the automatic shutter mode optimizes scanning parameters. It works well if the light pattern is entirely contained within the object, otherwise it can be used as an initial approximation tool.

The *Automatic shutter* box should be checked while scanning mostly monochromatic and reflective objects.

Otherwise, it should be unchecked when two contrast colors or distinct reflection properties appear in the same field of view.

Shutter: This option is used if the part to scan is not detected by the scanner, or with parts of different colors and/or reflection properties. It is recommend to manually adjust the cameras shutter speed for an optimal surface detection. The shutter parameters can be modified at all times, even without stopping the acquisition process.

It can be done by moving the slider (see the **System Configuration** section). The slider controls the exposure displayed in milliseconds. A higher value means more light will come from the projector and it will look more saturated, which is useful when scanning dark surfaces.

Configuration preset: A configuration template can be saved by right-clicking on the grey window. The template can later be used through the list. It can be useful when scanning similar objects. The default configuration can also be reset using the *Factory default*.

Positioning parameters

- **Target required**: This option allows selecting if positioning targets are required or not. In some precise cases, positioning targets can be required all over a surface to prevent position tracking loss or to make sure the model is accurate.

- In some other cases, the operator can add targets on a surface for the same reasons mentioned in the previous sentence. The targets required box would then need to be checked prior to scanning.
- **Semi-rigid positioning**: This parameter allows to scan objects which perform micro-movements, such as body parts.
- **Show positioning status**: when this option is enabled, the software indicates positioning issues and provides, in some cases, the action to solve the problem.

Scan parameters

The *Scan parameters* provides information such as the number of triangles and vertices in the current scan.

- **Resolution**: allows to adjust the required resolution.
- **Use clipping planes**: allows to clean the STL file and reduce the session file by hiding the surface outside clipping planes.
-
  - In the *Scan parameters* expanding panel, check the *Use clipping plane*s box to hide the surface outside clipping planes
  - Right click in the *Name* box to add a plane
  - *Add* a plane (**Line, Vertices** or **Targets**). It is also possible to *Remove* or *Edit* the plane through the *Name* box
- **Fill positioning targets** allows to fill the holes created by the positioning targets on the object surface.
- **Optimize scan mesh** slider allows to optimize the mesh by cleaning the edges, increasing resolution on high curvature areas and by minimizing scan noise.
- **Decimate scan mesh** slider allows to reduce the total number of triangles by increasing the size of triangles on areas with low details and low curvature.
- **Auto. fill holes** slider allows to control the size of the holes to be filled automatically. When increasing the value of the slider, it also increases the maximum size of the hole to be filled.
- **Remove isolated patches** slider allows to control the size of the patches to be removed automatically. When increasing the value of the slider, it also increases the maximum size of the patches to be removed.

Positioning node

The *Positioning* node gives access to selection tools (mini-toolbar).

Positioning parameters

Information displayed is the same than **Positioning** information of the *Scan node*.

Entities node

The *Entities* node is created in the *navigation tree* when an entity is created. Different entities are available. See **Add basic entity** section for more details.

Entities details

- **Entity count**: number of entity contained in the *Entities node*.
- **Name**: name of the selected entity.

Other *Entities details* will vary depending of the entity: *Normal*, *Center*, *Standard deviation*, etc.

Alignments node

A new alignment node is created when adding an alignment. Each alignment added is available under this node. Different alignment methods are available. See **Add basic alignment** section for more details.

Right click on a alignment to:

- *Activate* the selected alignment.
- *Export alignment*
- *Rename* the alignment

Alignments details

The alignments details are displayed in the expanding panel: *Name*, *Mode of alignment*, *Translation* and *Rotation* axis, etc.

Add Basic Entity

This section contains information on how to add basic entities.

- Angle
- Distance
- Line
- Plane
- Circle
- Cylinder
- Point
- Sphere
- Slot
- Rectangle
- Cone
- Polyline

Note that not all the basic entities listed above are available with all the software modules.

Add an Angle

Tools | Basic entities | Angle

This tool measures the angle between two planes, two lines or a plane and a line by choosing the corresponding building mode.

Add a Distance

Tools | Basic entities | Distance

This tool measures a distance between a point and a line, a point and a plane, two points by choosing the corresponding building mode. When working with a line or a plane, the shortest distance from the point will be considered.

Add a Line

Tools | Basic entities | Line

This tool allows to build lines using one of the following building modes:

- **Triangles selection**: This building mode allows adding an entity by making a selection of triangles in the 3D viewer.

- **Point selection**: A line passes through all selected positioning targets or points and the resulting line minimizes the distance to each point or positioning target. The user can then specify the length and orientation of the resulting line.
  - **Vertex selection**: This building mode allows adding an entity by selecting at least three vertices in the 3D viewer. Each vertex must be individually selected.
- **Two Planes Intersection**: Two intersecting planes must be chosen among those created. The resulting intersection will be a line. If the planes are parallel or nearly parallel, an error message or a warning message will be displayed as the calculation will not be enough accurate to use this entity as a basis for measurements.
- **Average line**: Use this mode to create an average line, i.e. a line created by averaging the values of the selected lines. This building mode can be used with two or more existing lines.
- **Plane normal and point**: This option allows building a line from a specific plane and a known point. The resulting line has the same orientation as the plane normal and is passed through the known point.
- **Line on plane projection**: A line is chosen and projected on a plane. If the plane normal and the line are parallel, an error message is generated as the resulting line would not be accurate. Again, the user can change the length of the line and flip its direction, if needed.

Add a Plane

Tools | Basic entities | Plane

This tool allows to build a plane directly from the scan data, using one of the following building modes:

- **Triangles Selection**: This building mode allows adding a plane by making a selection of triangles in the 3D viewer. The selection tools are available through the *Select* menu.
- **Point selection**: The available points are reference origin, sphere center, point and slot center. When selecting more than three points, the plane is passed through them using a best fit algorithm.
  - **Positioning target selection**: Planes can be created using positioning targets instead of triangles. This is useful if some targets represent distinct features in the environment. The same building options are available as when selecting triangles.
  - **Vertex selection**: This building mode allows adding an entity by selecting at least three vertices in the 3D viewer. Each vertex must be individually selected.
- **Average plane**: This building mode can be used with two or more existing planes. It will average the selected planes values (normal and position).
- **Plane offset**: New planes can be created based on a fixed offset from an already defined plane. The plane is offset in the direction of the normal of the selected plane.
- **Plane offset through a point**: When this option is selected, a plane is created in the same orientation as the selected one, centered at the selected point.
  - **Middle plane**: This building mode can only be used with two planes. It will create a plane at the center of two planes.
- **Point and coplanar line**: This mode allows creating a plane using a selected point and a coplanar line.
- **Point and normal line**: This mode allows creating a plane that has the same normal than the selected axis through the selected point.
- **Draw line**: This mode allows creating a perpendicular plane to the 3D view using a line drawn on the current view.

Add a Circle

Tools | Basic entities | Circle

This tool allows to add a new circle.

Set the following building modes:

- **Boundary selection**: This building mode allows selecting a closed boundary to fit the entity.

Circles made from boundary selection will allow to:

- Select the boundary from which the circle will be constructed.
- Define a plane projected in which the circle will be projected.
- **Point selection**: The *Points selection* uses at least 3 points (entities) through which the software will fit the best possible circle. After the selection, it is possible to reject points with a distance filter and to consult various statistics on the created entity.
  - **Vertex selection**: This building mode allows adding an entity by selecting at least three vertices in the 3D viewer. Each vertex must be individually selected.
- **Plane-cone intersection**: This mode allows creating a circle, which its center is at the intersection of plane and axis of an existing cone. The circle created has the same normal as the plane and the same diameter as the cone at the height of the intersection point.
- **Plane-cylinder intersection**: This mode allows creating a circle, which its center is at the intersection of plane and axis of an existing cylinder. The circle created has the same normal as the plane and the same diameter as the cylinder.

Add a Cylinder

Tools | Basic entities | Cylinder

This tool allows the creation of a cylinder using one of the following building modes. The user can consult and adjust values through the expanding panel.

- **Triangles selection**: This building mode allows adding an entity by making a selection of triangles in the 3D viewer.
- **Vertex selection**: This building mode allows adding an entity by selecting at least three vertices in the 3D viewer. Each vertex must be individually selected.

When clicking on *Create*, the cylinder will be created and available in the entities mode of the *Navigation tree*.

Add a Point

Tools | Basic entities | Point

This tool allows to create point entities. The created points can later be used as a basis for alignments or for specific measurements on the scan data. The user can add a new point using one of the following building modes:

- **Vertex selection**: Create a point on the mesh vertex and pick the specific vertex in the 3D viewer. It is possible to do the same thing with positioning targets by clicking on it in the 3D viewer or by selecting it in the list of positioning targets.
- **Line-plane intersection**: A point is created at the intersection of a line and a plane, like the axis of a cylinder intersecting with its top plane so to find the center of the cylinder top circle.
- **Three planes intersection**: The intersection of 3 given planes will define a point in space. If two planes are parallel, the point will not be calculated. If two planes are almost parallel a warning message will be displayed.
- **Two-line intersection**: The intersection between two lines, or the point closest to it in the case of a non-exact intersection, is created as a point entity. As with other intersections, an error message is displayed if the lines are nearly parallel.
- **Midpoint**: Use this building mode to calculate and create the midpoint between two points.
- **Point on line projection** and **Point on plane projection**: A selected point can be either projected on a line or on a plane.

Add a Sphere

Tools | Basic entities | Sphere

This tool allows to create a sphere using one of the following building modes.

- **Triangles selection**: This building mode allows adding an entity by making a selection of triangles in the 3D viewer.
- **Vertex selection**: This building mode allows adding an entity by selecting at least three vertices in the 3D viewer. Each vertex must be individually selected.

When clicking on *Create*, the sphere will be created and available in the entity node of the *Navigation tree*.

Add a Slot

Tools | Basic entities | Slot

This tool creates an oblong slot using the following building mode:

- **Boundary selection**: This building mode allows selecting a closed boundary to fit the entity.

Slots made from boundary selection will allow to:

- Select the boundary from which the slot will be constructed.
- Define a constraining plane in which the slot will be created.
- **Triangle selection**: This building mode allows adding a slot by making a selection of triangles in the 3D viewer. The selection tools are available through the *Select* menu. The *Triangle selection* building mode requires a constraining plane and a triangle selection made within the slot.

The normal of the slot can also be inverted.

- **Vertex selection**: This building mode allows adding an entity by selecting at least three vertices in the 3D viewer. Each vertex must be individually selected.

Add a Rectangle

Tools | Basic entities | Rectangle

This tool creates a rectangle using one of the following building modes:

- **Boundary selection**: This building mode allows selecting a closed boundary to fit the entity.

Rectangles made from boundary selection will allow to:

- Select the boundary from which the rectangle will be constructed.
- Define a constraining plane in which the rectangle will be created.
  - **Triangles selection**: This building mode allows adding an entity by making a selection of triangles in the 3D viewer.
  - **Vertex selection**: This building mode allows adding an entity by selecting at least three vertices in the 3D viewer. Each vertex must be individually selected.

Add a Cone

Tools | Basic entities | Cone

This tool allows the creation of a cone, using one of the following building modes:

- **Triangles Selection**: This building mode allows adding an entity by making a selection of triangles in the 3D viewer. The selection tools are available through the *Select* menu.
  - **Vertex selection**: This building mode allows adding an entity by selecting at least three vertices in the 3D viewer. Each vertex must be individually selected.

Add a Polyline

Tools | Basic entities | Polyline

This tool builds a polyline using the following building mode:

- **Vertex Selection**: This building mode allows creating a polyline by manually selecting vertex on the scan data. The polyline will be created by connecting all straight segments between consecutive selected vertex. To create a closed polyline use the *Closed* check box.

Add a Basic Alignment

This section contains information on how to add basic alignments.

- Automatic
- Point selection
- Plane-Line-Point
- Apply alignments

> **Note that not all the basic entities listed above are available with all the software modules.**

Automatic Alignment

Tools | Basic alignments | Automatic

The *Automatic* alignment function allows aligning the mesh to the world coordinate system XYZ from the center of mass .

Click the icon to align automatically. The alignment information will be displayed in the expanding panel in the *Alignment details* section.

Point Selection Alignment

Tools | Basic alignments | Point selection

This function allows to align existing entity points to a specific coordinate. A new reference frame will be created based on the new coordinates.

Plane-Line-Point Alignment

Tools | Basic alignments | Plane-Line-Point

This function allows to perform an alignment using a plane, a line and a point.

Apply Alignment

Tools | Basic alignment | Apply alignment

This function allows to import an alignment in the current session.

- **Select source**: Allows to select an existing alignment from a mesh in the session.
- **Mode**: Allows to chose the complete alignment or make a custom selection.
  - *Complete alignments*: reproduces the alignment from the starting point to the ending point.
  - *Custom selection*: It is possible to select a portion of the alignment as the starting point and the ending point.

Click **Import alignment from file** to import an existing alignment to the current session file. Once clicking on this icon, a dialog box opens allowing to browse a text file (*.txt) representing the transformation matrix.

Check **Invert pose** box to invert the alignment. The alignment information will be updated in real time in the *Details* panel as in the 3D viewer.

Edit Scan

This option is available during or after the scan acquisition.

To edit the scan

- Click 
- Edit the scan using available tools in the *Toolbar*.
- Click  to leave the *Edit scan* function.

Edition tools

Icon	Function	Menu	Description
	Edit scan	Tools | Edit scan	Starts the scan edition mode. Once the edition is finished, click on the icon to save the edition and leave.
	-	Tools | Selection (available while scanning)	These are the selection tools available while scanning.
	-	Tools |	These are the selec-

Icon	Function	Menu	Description
		Selection (available after scanning)	tion tools available once the scanning process has been stopped.
	Delete triangles	-	To delete the selected triangles.
	Delete isolated patches	-	To delete permanently isolated patches hidden by the **Remove isolated patches** parameters. .

Merge Scans

When scanning a large area, it is useful to scan over multiple sessions and/or with multiple scanners. This function allows merging scans into one single session hence outputting one single mesh for the whole surface. The alignment is performed using common positioning targets or common surface by *Best-fit*. It is only accessible when a session is opened with either positioning targets and scanned surface.

To merge scans:

1. Click on icon  to open the *Merge* windows.

2. Click:

- **Add** to browse for previously saved sessions to add to the *Sessions list*.
- **Remove** to remove the selected session.

3. *Select* the scan to align in the mobile box before choosing the alignment method.

4. **Align** the scans.

5. Click *Merge* to launch the computing of the resulting mesh with defined resolution.

Alignment methods

Targets best-fit

- **Minimum match points :** Minimum number of targets to match within the accepted alignment tolerance.
- **Matching tolerance :** Maximum distance between the targets to consider them a match.
- **Align**: Launches the alignment with the given parameters. All targets used for the alignment will be displayed in red.
- **Accept** Accepts the alignment and switches to the next scan to align.
- **Reset** Cancels the resulting alignment.
- **Merge**: Merges and creates a final session which includes all data.

Targets displayed in red color are the one used for the alignment.

Surface best-fit 

- **Maximum distance (mm)**: Maximum distance between the two surfaces to consider them in the best fit algorithm.
- **Pre-align**: This tool displays two windows; the left window is the fixed model and the right is the mobile model. Click 3 points on the same area of the part in both windows.
- **Align**: Launches the alignment with the given parameters.
- **Accept**: Accepts the alignment and switches to the next scan to align.
- **Reset**: Cancels the resulting alignment.

Align and merge by *Global registration*

When merging three or more sessions, it is recommended to use the *Global registration* to refine the alignment after the initial *Best-fit*. This algorithm will consider all the loaded scans and optimize their global alignment.

Merge option

Resolution (mm): select the desired resolution for the scan merge. By default, the resolution of the fixed scan will be set.

Delete Frames

To delete frames

- Click on the  icon.
- Using the mouse cursor  , click on a point in the scan displayed in the 3D viewer. It will select frames which are included at the position picked.
- By default, all frames are selected to be deleted. In the *Delete frames* expanding panel, click on  to display the frame list. Uncheck boxes to keep frames. To see a particular frame, click on the name of the frame under the list, it will be highlighted in the 3D viewer.
- Click *Delete frames* button.
- Click on the *Delete frames*  icon to exit the function.

Mesh Module Overview

The following topics are covered in the mesh module section:

Mesh Module Overview

The mesh module is a post-treatment module integrated in the software. This module includes a set of tools and features allowing the extraction of information needed in a CAD software. It also includes the tools to create a ready-to-print mesh.

Main features

Alignment

It allows aligning the scan with the coordinate system.

Mesh improvement

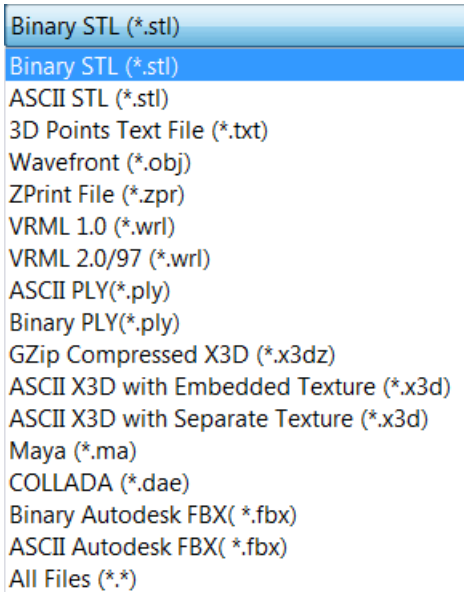
It allows improving 3D scan mesh and making it suitable for the CAD or 3D printing process. The main improvements consist of healing the mesh, filling holes, enhancing surface smoothness, optimizing file size with a decimation tool, etc.

Input formats

Meshes: Only *.peel are accepted.

Output formats

Created meshes:



Technical requirements

It has standard **requirements** for installation and usage.

Using the Module

It is possible to create or **import** a mesh from a *.csf file from a scan using the create mesh button.

It will allows to use the post-treament functionalities.

Mesh editing typical workflow

Steps	Action
1	**Clean the mesh**
2	**Align to origin**
3	**Edit the mesh**
4	**Improve the mesh**
5	**Add entities**

Clean the mesh

Several options are available to clean a mesh. Each option is described under the section.

Align to origin

It is possible to align the mesh to the origin (see **Align to Origin** section).

Edit the mesh

Several tools are available to edit a mesh. Each tool is described under the **editing tools** section.

Functions are applied to the selected mesh. Make sure to select the proper mesh before each operation.

Improve the mesh

It is possible to improve the mesh using several tools (see the **Improve** section for more details).

Add entities

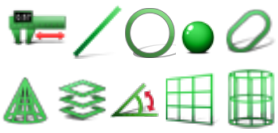
Several types of entities are available. See the **Add basic entity** for further details.

Mesh Module Interface

Menu

The *Menu* and the *Toolbar* are complementary to each other. The toolbar offers the main functions, while some advanced functions are only located in the menu.

Toolbar

Icon	Function	Action
	Undo	Allows going back to the last action performed on the mesh.
	Redo	Allows to redo the undone editing action on the mesh.
	Add entity	Allows to create entities. See **Add Entity** section for more details.

Icon	Function	Action
		
	Align	Allows to create an alignment. See **Add Alignment** section for more details.
	Delete	Allows deleting the triangles of a selected area. First, select the mesh in the node and select the triangles to be deleted. See the Selection section for more details.
	Copy	Allows copying selected triangles from the active mesh and creating a new mesh out of the selection. First, select the area of the mesh that needs to be copies and click the icon.
	Cut	Allows removing selected triangles from the active mesh and creating a new mesh out of the selection. First, select the area of the mesh that needs to be cut and click the icon.
	Clean mesh	Allows to clean the mesh by simultaneously removing irregularities. See **Clean mesh** for more details.
	Improve	Allows to edit mesh on triangles. See **Improve** section for more details.
	Edit	Allows to edit the size and shape of meshes. See **Edit** section for more details.
	Combine	This function allows to combine two or more meshes into a single mesh. See the **Combine** section for more details.
	Merge	This function allows to merge two or more meshes. See the **Merge** section for more details.

Navigation panel
Mesh node

Right-click on the *mesh* node to access these options:

- *Duplicate*
- *Properties*
- *Show only selected*

- Rename
- *Delete*

Mesh details

Triangle count: number of triangles counted within the active mesh.

Vertex count: number of vertices counted within the active mesh.

Selected triangles: number of triangles selected using a selection tool.

Entities node

The entities added become available through this sub-node.

Right-click on the *Entities* node to:

- Order entities
- Hide all entities
- Show all entities
- Show only selected

These are the possible options when right-clicking on an entity:

- *Delete*: To definitely delete the entity.
- *Order entities*: This option allows ordering the entities by type, by order of creation and by name in the *Entities* node.
- *Send to*: Possibility to send the entity to another mesh or entity.
- *Hide all entities*: To hide all entities located under the *Entities* node.
- *Show all entities*: To show all entities which are located under the *Entities* node in the 3D viewer.
- *Show only selected*: To show only the selected entity in the 3D viewer.
- *Rename*

To select an entity, click on the entity under the *Entities* node or directly on the highlighted entity in the 3D viewer. Multiple entity selection is possible under the *Entities* node by pressing the *Ctrl* key and the mouse *left* button.

Entities Details

The entities details are displayed in the expanding panel: *Entity count*, *Name*, *Center* and *Normal coordinates*, *Standard* and *Min/Max deviations*, etc.

Alignments node

A new alignment node is created upon adding an entity. Each alignments added are available under this node. Different alignment methods are also available. See **Add alignment** section for more details.

Right click on the alignment to:

- *Activate* the selected alignment
- *Export alignment*
- *Rename* the alignment

Alignments Details

The alignments details are displayed in the expanding panel: *Name*, *Mode of alignment*, *Translation* and *Rotation* axis, etc.

Clean Mesh

Tools | Clean mesh

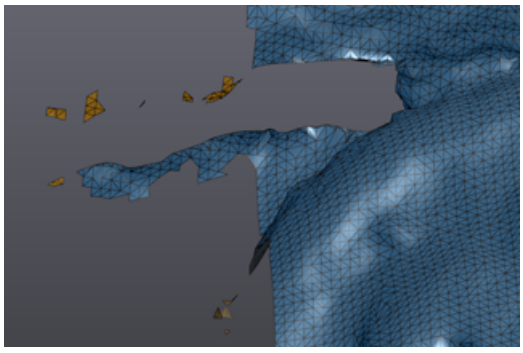
This function allows to clean the mesh by simultaneously removing irregularities such as intersecting triangles, small holes, etc.

To clean a mesh

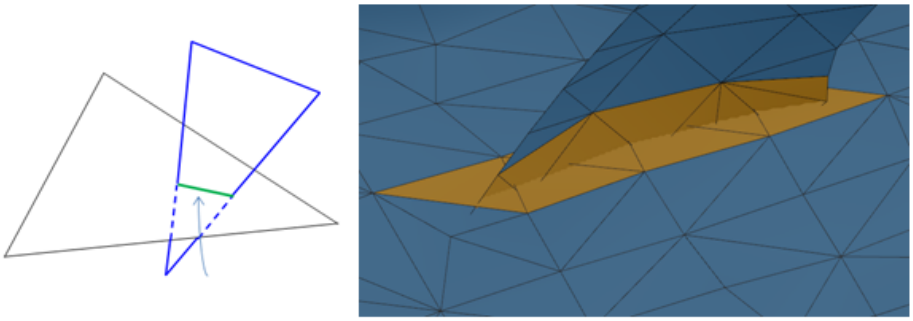
- Click  .
- Most of **cleaning options** are checked by default. Uncheck the corresponding checkbox not to apply an option.
- A count of each elements found on the mesh will be displayed.
- Adjust *Parameters* using sliders and combo boxes.

Cleaning options

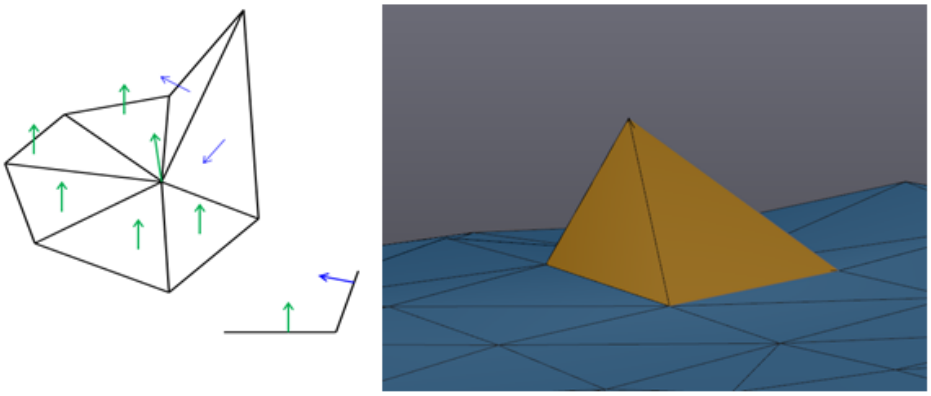
Isolated patches: To select isolated triangle patches. The desired threshold can be adjusted using the slider in the **Parameters**. Isolated patches are small sections of meshes which are isolated. They are considered as such if the ratio between its size and the size of the largest section is less than the defined threshold value (default 1%).



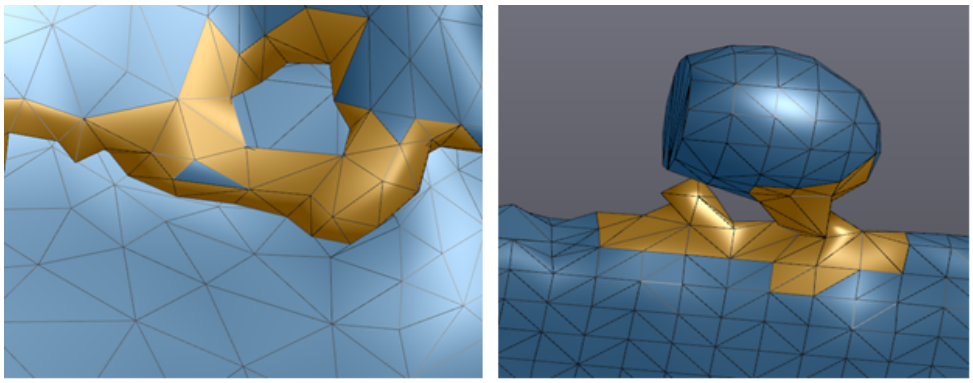
Self-intersections: To remove self-intersecting triangles. Self-intersections are found when a triangle is intersected by one (or more) other triangles. Then, both triangles are removed.



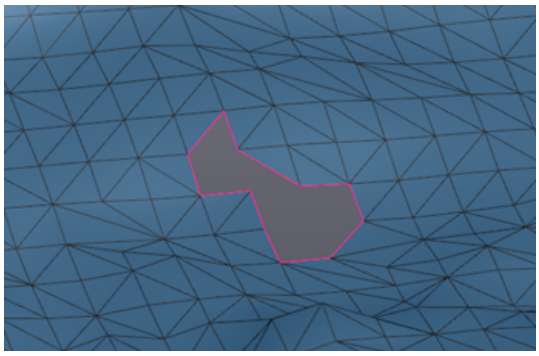
Spikes: To remove spikes. It is possible to adjust the level in the ***Parameters***. A spike is detected on a mesh when there is at least one triangle from a vertex with a very different normal, compared to a fixed threshold of 60 degrees.



In addition, this detection method can also detect small tunnels.

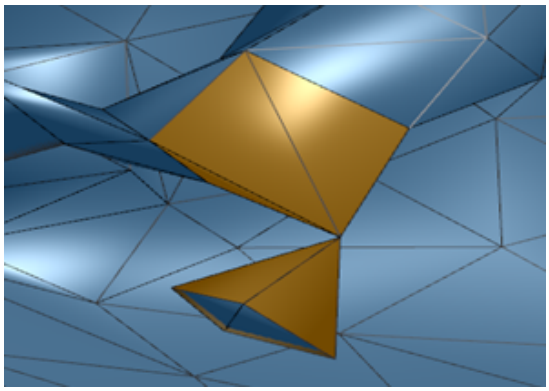


Small holes: To fill small holes. It is possible to adjust the *Max hole size* threshold in the **Parameters**.

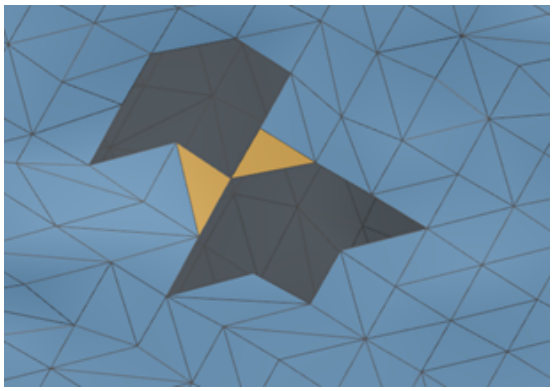


Singular vertices: To remove singular vertices. Singular vertices are found when:

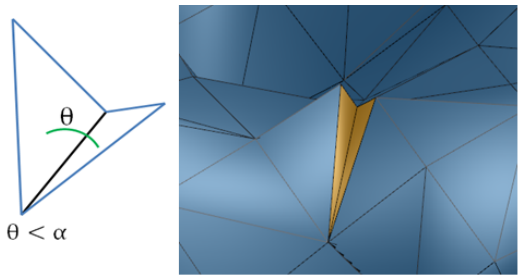
- Two pyramids touch each other at one point.



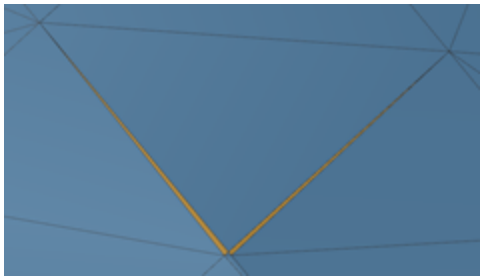
- More than two border edges are in contact with it.



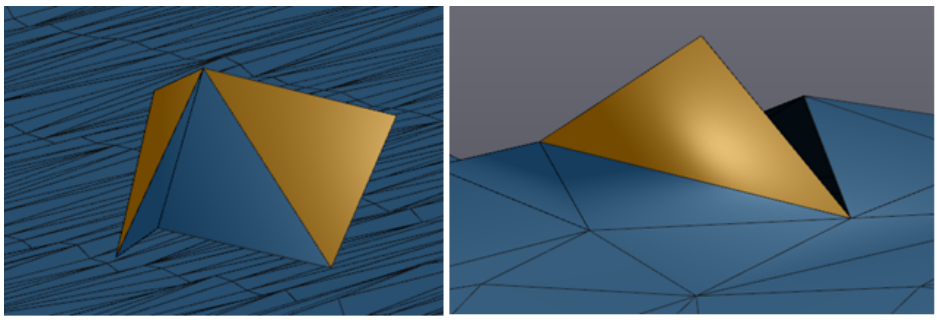
Creased edges: To remove creased edges according to the required angle set in the **Parameters**.



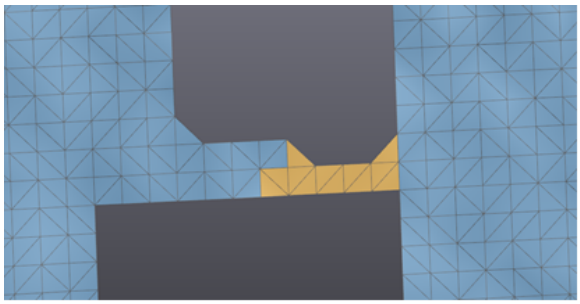
Narrow triangles: To remove narrow triangles (degenerated, compressed or slim).



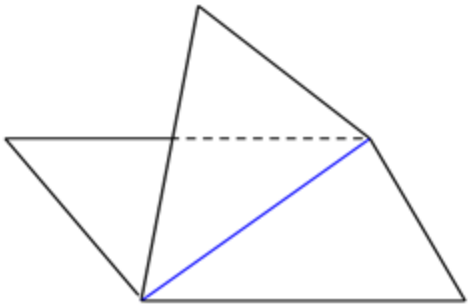
Outcropping triangles: Check this box option to remove outcropping triangles. An outcropping triangle has two edges on the mesh boundary.



Narrow bridges: To remove small bridges between meshes. Threshold of the bridge width can be set.



Non-manifold triangles: Count of non-manifold triangles detected in the mesh. This occurs when an edge is associated with more than two triangles.



Parameters

Isolated patches threshold: By increasing the threshold value, smallest isolated patches can be automatically removed.

Spike level: To adjust the required level. If the threshold value is set to 100, a maximum of spikes will be removed.

Angle between creases (°): To adjust the minimum angle allowed between two triangles.

Narrow bridges width (edges): To adjust the minimum width of narrow bridges.

Max hole size (edges): To adjust the maximum hole size to be filled. The size of the hole is determined by the amount of edges.

Best Fit

Tools | Add alignment | Best fit 

- Surface best-fit
- Global registration

Surface best-fit 

Click the icon to align two or more meshes together or a mesh with a CAD.

Item selection:

- **Fixed**: There can be multiple fixed item selected. This is the mesh or CAD that will not move during the operation.
- **Mobile**: All the session meshes can be selected but only one at a time.

Surface best-fit:

- **Maximum distance**: This is the maximum distance search between two surfaces to consider them as the same surface.

Pre-alignment mode:

- **Automatic**: Automatic pre-alignment of the fixed and mobile item selection. Following the pre-alignment, the surface best fit will automatically be calculated.
- **Manual**: Select at least three points on the fixed model (located on the left side of the screen). Then, select the same points on the mobile model (right side).
- **None**: There is no pre-alignment and the surface best-fit alignment can be launched directly.

Global registration 

This function is only available when there is at least three items (CAD or mesh). It allows finding the best solution for the alignment while considering all the meshes selected at once.

Item selection

- *Fixed*: Only one fixed item can be selected. This is the mesh or the CAD that will not move during the operation.
- *Mobile*: At least two meshes must be selected.

Align

Maximum distance: This is the maximum distance search between surfaces to perform the global registration.

- *Align*: To launch the function.
- *Accept*: To accept the registration.
- *Reset*: To reset the registration.

Combine

Tools | Combine

This function allows to combine multiple meshes.

- Select a *Mesh* under the *Meshes* node.
- Click  .
- In the expanding panel, select the meshes that you want to combine.
- Click OK.

Merge

Tools | Merge

This function allows to merge two (or more) meshes.

To merge meshes:

- Select a *Mesh* under the *Meshes* node.
- Click  .
- In the expanding panel, select meshes to combine.
- Click OK.

- **Maximum distance (mm)**: Maximum distance allowed between two overlapping vertices.
- **Smoothing layers**: This option allows to define the amount of triangle rows that will be smoothed during the merge in the overlap sections.
- **Keep watertight**: This option is available when one of the mesh to merge is already water-tight.

It is possible to apply a *priority* in order to keep the quality of one mesh in particular (*High, Normal, Low*).

Selection Tools

Tools | Selection

To have access to the selection tools, first click on a mesh in the Navigation panel under the node. The mini toolbar will appear in the upper left corner of the 3D viewer. It can either be displayed in *Compact* or *Expanded* mode. Click the white drop-down arrow to select a mode.

To make a selection:

- In the mini-toolbar, click on one of the selection tool icons.
- Press the CTRL key and left-click on the mouse simultaneously. Then, make a selection moving the mouse around.

To deselect a section of the selection, press the CTRL and Shift keys and make a selection using the mouse.

All the selection tools featuring the selection tolerance can be adjusted interactively with the slider.

- **Rectangle selection**
- **Free form selection**
- **Brush selection**
- **Connect**
- **Sudden change**
- **Similar curvature**
- **Similar normal**
- **Boundary selection**
- **Isolated patches**
- **Curvature selection**
- **Triangle picking**

- Select through
- Select backface
- Selection modes
    - Select all
    - Clear selection
    - Inverse selection
- Grow the selection
- Shrink the selection

Rectangle

Tools | Selection | Rectangle

This tool makes a rectangular shape selection. Press Ctrl+Left mouse click and release it when the selection is completed.

Free Form

Tools | Selection | Free form

This tool makes a free form selection (lasso).

- For a straight line contour, press the Ctrl+Left button.
- For a free curve contour, press the Ctrl key and hold the mouse left button.
- Once the selection is completed, right click to end it or release Ctrl key.

Brush

Tools | Selection | Brush

This tool allows a brush shape selection (square, circle, oval and so on) with customized thickness.

- For a straight line, press Ctrl+Left button.
- For a free curve, press Ctrl and hold the mouse left button.
- Once the selection is completed, right click to end it or release Ctrl key.

The *Brush size* slider allows adjusting the thickness.

Connect

Tools | Selection | Connect

This tool allows to select all triangles connected to a given triangle.

Sudden Change

Tools | Selection | Sudden change

This tool allows selecting all triangles connected to others until sudden curvature change appears in the mesh using Ctrl+Left mouse button.

Use the *Selection tolerance* slider to adjust the selection sensitivity.

Similar Curvature

Tools | Selection | Similar curvature

This tool allows selecting all triangles connected to other triangles with same curvature clicking on CTRL + the mouse left button.

Use the *Selection tolerance* slider to adjust the selection sensitivity.

Similar Normal

Tools | Selection | Similar normal

This tool allows selecting all triangles connected to other triangles with a similar normal clicking on Ctrl and the mouse left button.

Use the *Selection tolerance* slider to adjust the selection sensitivity.

Boundary Selection

Tools | Selection | Boundary selection

This tool allows selecting all the boundary triangles. Once clicking on this icon, all the boundaries appear in pink.

Isolated Patches

Tools | Selection | Isolated patches

This function allows to select triangle patches.

By increasing the threshold value, smallest isolated patches can be automatically removed. The result is shown instantly in the 3D view. If the threshold value is set to 100, only the largest patch will be kept.

Curvature Selection

Tools | Selection | Curvature selection

This tool allows selecting high curvature areas. The slider allows adjusting the curve radius. The higher the value is, the larger the selection.

Triangle Picking

Tools | Selection | Triangle picking

This tool allows to select a single triangle using Ctrl + left button.

Grow the Selection

Tools | Selection | Grow the selection

This tool increases the current selection size by adding a layer of triangles for each mouse click (one triangle in every direction).

Shrink the Selection

Tools | Selection | Shrink the selection

This tool decreases the current selection size by removing a layer of triangles for each mouse click (one triangle in every direction).

Select through

Tools | Selection | Select through

This tool allows to select all the triangles within an area, even those on a different layer.

Select Backface

Tools | Selection | Select backface

When active, this function allows to select in the negative normal of the mesh in addition to the positive normal. Then, the surface is selected without regard to the normal. The model negative normal is shown in dark grey in the 3D viewer, while the positive normal appears in blue.

Note: If the *Select through* function is active, the *Backface* function has no effect.

Selection Modes

Select all 

Tools | Selection | Select all

This mode allows selecting all triangles of the mesh.

Clear selection 

Tools | Selection | Clear selection

This mode allows clearing the current selection of triangles.

Inverse selection 

Tools | Selection | Inverse selection

This mode allows inverting the current triangle selection; unselected triangles will be selected. In opposition, selected triangles will no longer be part of the selection.

Improve

Tools | Improve mesh

The *Improve* menu provides the following tools to edit the mesh:

- **Fill holes**
- **Decimate**
- **Refine**
- **Edit boundary**
- **Smooth mesh**
- **Defeature**
- **Remove spike**

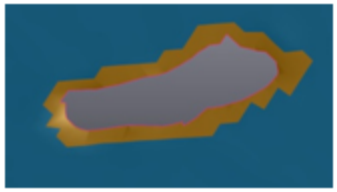
Improve | Fill Holes

Tools | Improve mesh | Fill holes

This function allows filling holes in the mesh. It is mainly used with mesh preparation for surfacing or 3D printing.

Fill hole mode

- **Whole/Partial/Bridge**: This allows applying the function to the whole selected boundary, partially or by building a bridge.
- **Filling method**: This allows to choose between:
  - *Curvature*: The fill match the curvature of the surrounding mesh.
  - *Flat*: The fill is generally flat.
  - *Adaptative*: The fill matches the curvature and keeps more continuity on fillets.
- **Smooth boundaries layer**: This defines the number of layers around the hole to smooth.



- **Clean boundary**: This is used to check and fix bad boundary conditions improving quality results.

Whole fill mode options

- **Selected boundaries**: The slider is used to select multiple boundaries to be filled simultaneously.
- **Boundary navigation**: This allows navigating between holes to fill.

Partial fill mode options

First part: Select the first, last and the middle point. The first and the last points will define the start and the end of the filling. The middle point will decide the filling side.

Bridge fill mode options

First part

- Select the first, last and the middle point. The first and the last points will define the first side of the bridge.
- Click in the middle of the first two points created. The first side of the bridge will be created.

Second part

- Select the first, last and the middle point. The first and the last points will define the second side of the bridge.
- Click in the middle of the two last points created. The bridge will be created.

Improve | Decimate

Tools | Improve mesh | Decimate

The mesh decimation reduces the number of triangles in the mesh, with minimal changes to the object shape. This function aims to preserve the mesh actual topology, reducing the number of triangles in flat areas while keeping more in high curvature areas.

- **Reduction (%)**: This allows setting the mesh final number of triangles by adjusting the percentage.
- **Estimated triangles count**: This allows setting the mesh estimated number of triangles.
- **Max deviation**: This allows setting the maximum deviation value allowed between the decimated and the original meshes.
- **Fix vertices**: Check this box if the decimated mesh vertices should be a subset of the original vertices.
- **Preserve boundary**: This option will preserve the actual mesh boundaries.

Improve | Refine

Tools | Improve mesh | Refine

This function allows refining the mesh by increasing by four the number of triangles in the mesh. This generates a new triangulation with smaller triangles than the actual mesh. This function makes the surface smoother.

- **Preserve Boundary**: This option keeps the actual mesh boundaries. If the option is checked, the boundaries will not be affected by the *Refine* function.

Improve | Edit Boundary

Tools | Improve mesh | Edit boundary

The *Edit boundary* function allows to rebuild boundary using curves created in the function.

Boundary selection mode:

- **Multiple**  : Allows rebuilding the entire boundary selected. It is possible to select more than one boundary at a time (No preview available for more than one boundary).
- **Partial**  : Allows rebuilding a portion of the boundary.
- **Fit to entity**  : Allows rebuilding a boundary in the shape of circle, rectangle or slot.

Multiple and *Partial* mode

- **Curve tension**: Adjusts the curve tension using the slider. The higher the value, the smoother the curve is.
  - **Analysis layers**: Defines the number of triangle layers around the boundary to be taken in consideration during the operation.
- **Selected boundaries slider**: The slider is used to select multiple boundaries to be smoothed simultaneously from small to large boundaries.
- **Apply**: Click this button to apply changes.

Fit to entity mode

- **Analysis layers**: Defines the number of triangle layers around the boundary to be taken in consideration during the operation.

- **Entity mode**: Choose between an existing entity or best-fit the boundary to a circle, a rectangle or a slot.

Improve | Smooth Mesh

Tools | Improve mesh | Smooth mesh

This function allows removing noise and smoothing the mesh.

- **Smoothing weight**: This slider allows controlling the level of smoothing applied on the mesh.
  - **Iterations**: This option can be set to specify the number of attempts used to smooth the mesh.
- **Mesh shape**
  - *Free form*: This option is used for non-mechanical mesh to obtain a better overall smoothing.
  - *Prismatic*: This option helps to maintain sharp edges.
- **Maximum deviation (mm)**: Check this box allows setting a maximum deviation of the smoothed mesh from the original.
- **Preserve boundary**: Check this box to allows keeping the actual mesh boundaries.

Improve | Defeature

Tools | Improve mesh | Defeature

This function is a combination of *Delete* and *File hole* on the selected triangles, in one click.

It can be applied on multiples areas simultaneously. It is not suitable when unselected triangles are present in a selection.

Example:

Improve | Remove Spike

Tools | Improve mesh | Remove spike

The *Spike* filter operation allows reducing noise on the mesh by removing spikes.

- **Spike level**: To adjust the required level. If the threshold value is set to 100, a maximum of spikes will be removed.

Edit

Tools | Edit mesh

The *Tools* menu provides tools which allow editing the size and shape of meshes:

- **Scale**
- **Mirror mesh**
- **Flip/Fix normals**
- **Cut mesh**
- **Watertight remesh**

Tools | Cut Mesh

Tools | Edit mesh | Cut mesh

This function allows cutting a mesh through a plane on the mesh.

- **Plane**: Choose the plane to cut the mesh. It is possible to resize the plane using the control points.
- **Plane offset (mm)**: The value that offsets the selected plane. It is possible to drag the plane along the arrows.

Once a plane is selected, the result is displayed in the 3D viewer.

- **Keep both parts**: Check this box to keep both parts of the mesh.
- **Fill cut plane**: Check this box to fill the hole(s) created when cutting the mesh.

Tools | Mirror Mesh

Tools | Edit mesh | Mirror mesh

This function allows to create a symmetrical duplicate image of the mesh.

- **Plane**: Choose the mirror plane.
- **Transformation**
  - *Flip Only*: To create an inverted mesh.
  - *Mirror and sew*: To create a symmetrical mesh.
- **Keep original mesh**: Check this box to keep the original mesh.

Tools | Flip Fix Normals

Tools | Edit mesh | Flip/Fix normals

This function allows changing and correcting the normal orientation of the mesh by selecting a point on the surface to reverse the normal.

- **Flip normals**: This option inverses the normal of all triangles connected with the root vertex.
- **Fix normals**: This option harmonizes the normal of all triangles connected with the root vertex.

Tools | Scale

Tools | Edit mesh | Scale

This function allows scaling entities by angular degree.

Select *Centroid* to scale the mesh from his geometric center or *Origin* to scale it from the origin point (0,0,0).

- **Non uniform**: This checkbox allows using different scaling factor for X, Y and Z direction.
- **Dimensions (mm)**: The dimension of the final mesh bounding box size in X, Y and Z direction can be set directly. This is useful to fit a mesh to a specified 3D printer built size. The *Scale factor* will adjust automatically.
- **Scale factor**: This option is set at one by default and means no scaling. A value lesser than one results in a reduction, while a value greater than one results in an increase.

Tools | Watertight Remesh

Tools | Edit mesh | Watertight remesh

This function allows the reconstruction of the mesh model; it acts like a global re-triangulation and a subsequent smoothing, to heal the whole mesh by removing holes and abnormal triangle structures.

Use the slider to adjust the *Resolution*.

A *fine* resolution means better details conservation but longer processing time.

Properties

This function provides information on the mesh properties.

Select **Tools | Properties** or right click on the mesh to display information. It is possible to *Copy* the *Properties* information as CSV file.

- **Triangle count**: Provides the number of triangles counted within the active mesh.
- **Vertex count**: Provides the number of vertices counted within the active mesh.
- **Mean edge length**: Provides the mean length of all the triangles lengths.
- **Watertight**: Indicates whether the mesh has is watertight or not. *Watertight: No* means there are holes on the active mesh.
- **Volume**: Provides the volume of the mesh.

If the properties of a mesh indicate *Watertight: Yes*, it means the volume is accurate.

On the other hand, if the properties indicate *Watertight: No*, the volume is only approximate.

- **Area**: Provides the sum of all the triangles areas.
- **Boundary count**: Provides the number of boundaries counted within the active mesh.
- **Boundary perimeter**: Provides the sum of all the boundaries lengths.
- **Center of mass (mm)**: Provides the position where all of the mass is concentrated on the mesh following the X, Y and Z axis.
- **Bounding box size (mm)**: Describes the dimension of the smallest box that can be fitted on the mesh following the X, Y and Z axis.