Calibry 3D scanner

User Manual

Congratulations on purchasing Calibry 3D scanner — state-of-the-art handheld professional 3D scanner!

This device uses the latest technology in scanning with structured light and allows to capture even the most complex surfaces.

This manual contains information on installation and usage of Calibry Nest software, scanner operation and recommendations for the scanning process.

When using the device, remember that a 3D scanner is a high-precision optical device that requires careful handling. Careful usage and compliance with the rules of usage will ensure a long life for the scanner.

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1. Your Calibry

Calibry (Calibry Mini) Kit

In your Calibry (or Calibry Mini) kit you will find:

- the scanner;
- a power supply;
- a power cable;
- 1 meter USB 3.0 black connection cable;
- 5 meter USB 3.0 blue connection cable;
- a power injector;
- a set of markers (magnetic and sticky for Calibry; sticky and paper-cut for Calibry Mini);

In addition to the scanner, a Calibration Kit is included; either in a separate box for Calibry or in the box with the scanner for Calibry Mini.

Calibry 3D Scanner kit

Calibry Mini 3D Scanner kit

Hardware Design of the Scanner

The image below shows the main components of Calibry 3D scanner:

Geometric camera

Texture flash

Texture camera

Projector

Touchpad display

START button

STOP button

Data & Power cable connector

Calibry Mini has slightly different arrangement of components, with the projector located in the middle and the texture camera located at the bottom.

2. Calibry Nest Installation

Calibry Nest, Scanner Shell and Add-ons

For any Calibry scanner to work, installation of Calibry Nest is required on a computer that the scanner is going to be plugged into. Nest is the software that both controls the scanner and provides tools for post-processing of scanned data. This is achieved with the use of two software modules:

• Calibry Nest itself (nest.exe) is software for post-processing 3D scans and editing 3D data. Nest itself does not control the scanner and can be used as a standalone 3D viewer and basic 3D editor.
• Calibry 3D scanning module (scanner-shell.exe) is a software used to control the scanner and facilitate the scanning process. Without this module the scanner is not going to work.

Apart from these two modules, the package also includes Visual C++ 2019 x64 Redistributable package, containing all the libraries Nest is using. It might be already installed on your computer, but if not — Setup Wizard will suggest adding it to the system. It is highly recommended to do so to ensure proper functioning of the software.

Also, the FTD3XX Driver is included to guarantee proper scanner discovery and its further stable operation.

Calibry

System Requirements

Before installing Calibry Nest, please make sure your system meets the following requirements:

Minimal:

- OS: Windows 8.1/10/11 x64
- Processor: Intel Core i5
- Memory: 16GB
- Video Card: 2GB, OpenGL 4.3 support
- USB: 3.0 or higher*

Recommended:

- OS: Windows 8.1/10/11 x64
- Processor: Intel Core i7
- Memory: 32GB
- Video Card: 4GB, OpenGL 4.3 support
- USB: 3.0 or higher*

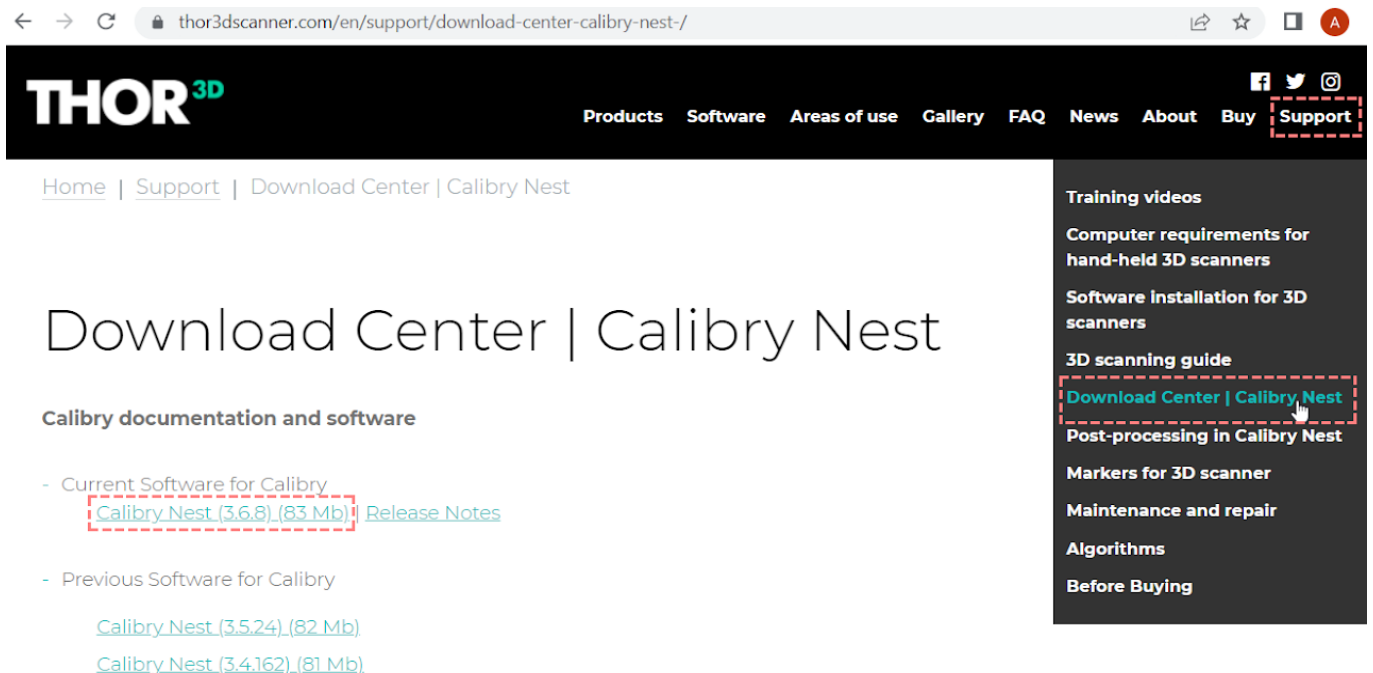In general we recommend using PCs/laptops manufactured after 2018.

It is also important to note that CPU-integrated video cards (Intel HD Graphics, etc...) are not supported and stable functioning of Calibry Nest or the scanner is not guaranteed.

* — Starting from Calibry Nest 3.5 it is possible to use USB 2.0 ports but scanning speed can be affected by the limitations of USB 2.0.

Downloading and Installation

To install Calibry Nest, download the installation file in the Download Center on our website, then launch the installer and follow the instructions. After installation is complete, shortcuts for launching Calibry Nest will appear on a desktop and in the Start Menu.

Updating Calibry Nest

Calibry Nest doesn't update automatically, but it will notify you when a new version is available.

Untick «Check for updates on Startup» to disable this notification. If you change your mind, go to Settings >> General and tick it back again.

When updating Calibry Nest, there is no need to delete the previous version. Just download a new version and install it on top of the old one.

If you experience any difficulties, please contact our Technical Support (support@thor3dscanner.com) — we're always happy to help!
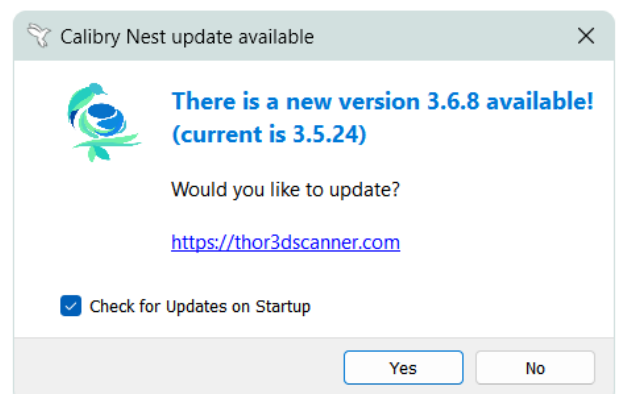
3. Calibry Nest Interface

Welcome Screen

When Calibry Nest is launched, a Welcome Screen appears. It shows a list of recently used files, a link to the Quick Guide and the latest news and blog posts. Links to our social media are also shown in the right bottom corner. Click outside of the Welcome Screen or press Escape to close it.

3. Calibry Nest Interface

Calibry Nest Main Window

The main window of Calibry Nest consists of the following sections:

1. Main Toolbar is the primary panel of instruments used for processing scans;
2. Side Toolbar shows a combination of tools varying depending on the stage of processing and the type of data opened;
3. Files Panel (aka Project Panel) shows the scans and all results generated during post-processing;
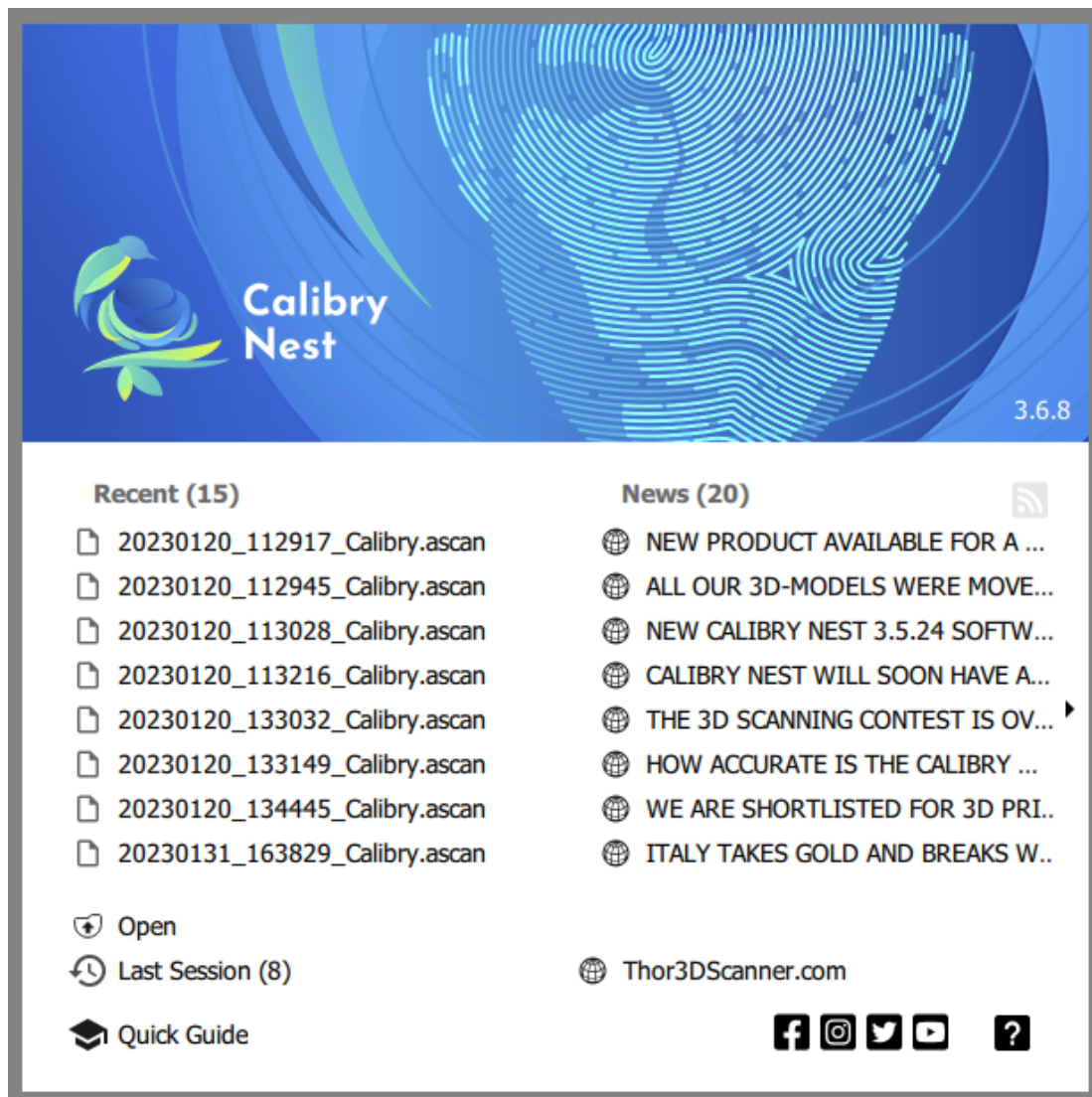4. Editing area shows the data of a currently selected project. Here the data can be edited;
5. Scanner panel shows scanner controls as well as a list of all scans stored on the current PC/laptop;
6. Status Bar shows the progress of any process, its level of completion and some additional status data;
7. Memory Monitor opens a small window where RAM and VRAM usage is shown.
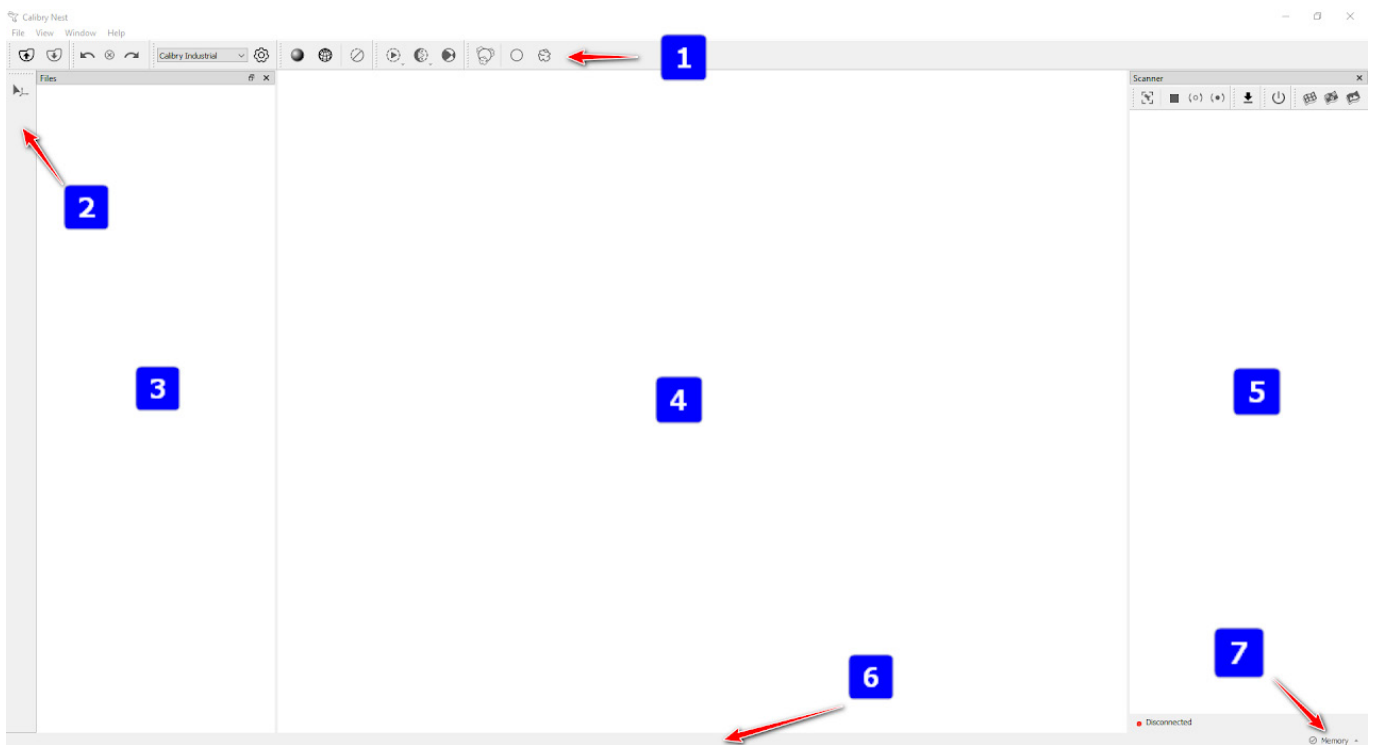
Main Toolbar and Side Toolbar, their buttons and functions are described in more detail in Chapter 10: Tools and Toolbars.

Files Panel (Project Panel)
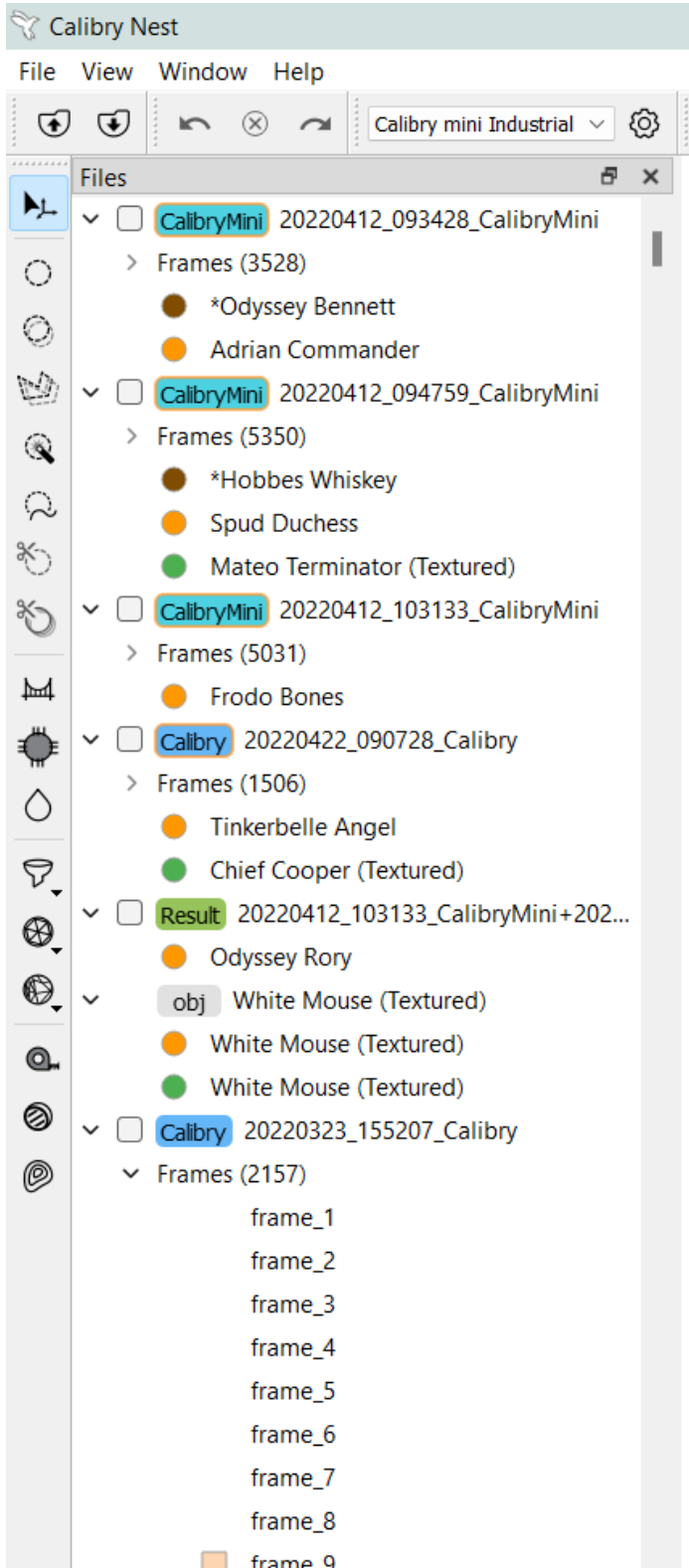
The panel on the left side of Calibry Nest main window is Files Panel. It is also often referred to as the Project Panel. It shows all the files and results being currently used.

If it is a scan, File panel shows a type of scanner used to make it, how many frames it contains and, if there are some results, they are shown below the Frames list.

Orange circles designates polygonal results. If the circle turns brown, it means that this result is no longer valid and cannot be used for alignment. It happens if the scan undergoes another registration, which changes the point cloud.

Green circle means that the marked result contains texture.

Golden frame around the scan label means that this scan is marked using Priority Mode.

If a frame is marked with a pink square — it means it also contains a texture frame.

If it is a combination of two or more scans, it is shown here with a green result label and the result name includes the names of all the scans used to make it.

If it is a model, it is shown with a file-type label.

More on these labels and designations in Chapter 8: Postprocessing a Scan.

Scanner Panel

The panel on the right side of Calibry Nest main window is the Scanner panel. It shows the list of all the scans made on a given computer (or copied there afterwards). It also contains the Scanner Toolbar that might be used as an alternative to the touchscreen of a scanner.
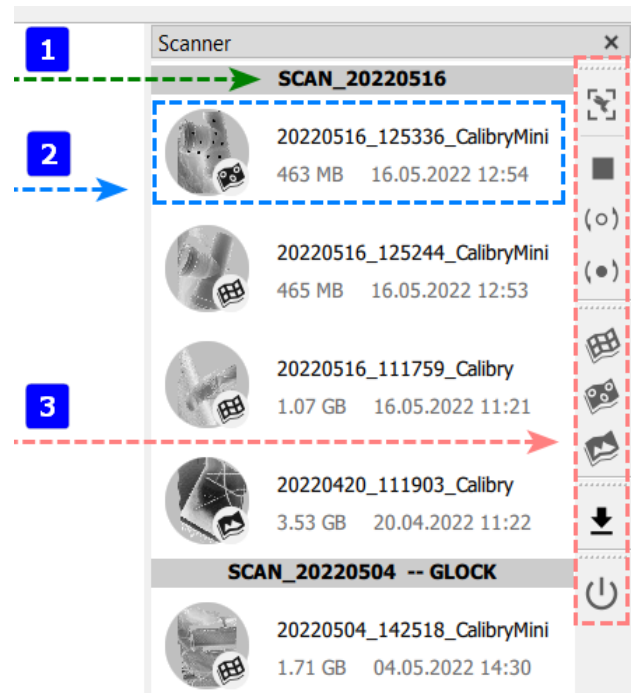
All scans are grouped in folders [1]. Scanning date is used as a default name (SCAN_yyyymmdd) and a new folder is created every day, but the name of each folder can be easily changed if need be both prior and after scanning.

Individual scans are represented as an image of the first frame of each scan. There is also a label that shows which type of tracking mode was used [2]. By default, scan names are comprised of date (yyyymmdd), time (hhmmss) and type of scanner used to make it, but can later be renamed if needed. Second row shows scan size and its timestamp (in case the file was renamed).

Double-click on any scan to open and process it in Nest. You can also double-click other files you want to open without waiting for the previous file to be fully loaded. Files will be added to the queue and will be loaded sequentially.

Starting from Nest 3.5.24 onwards, Scanner Toolbar [3] is placed vertically on the right side of the scanner panel, but can be easily detached and moved to a different location if needed. Scanner Panel itself can also be detached and placed on the other side of the main window.
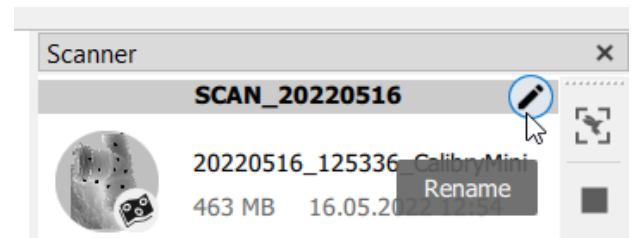
Scanner Toolbar buttons and functions are described in Chapter 5: Scanner interface.

The name of a given folder can be easily changed by hovering a mouse over the right end of a name bar and pressing the pencil icon. After renaming is complete, press Enter to apply changes.

By clicking the name of any folder you can quickly select all scans in this folder. It might be useful if you want to open or delete all scans stored in the folder. Respective buttons are situated at the bottom of the panel.
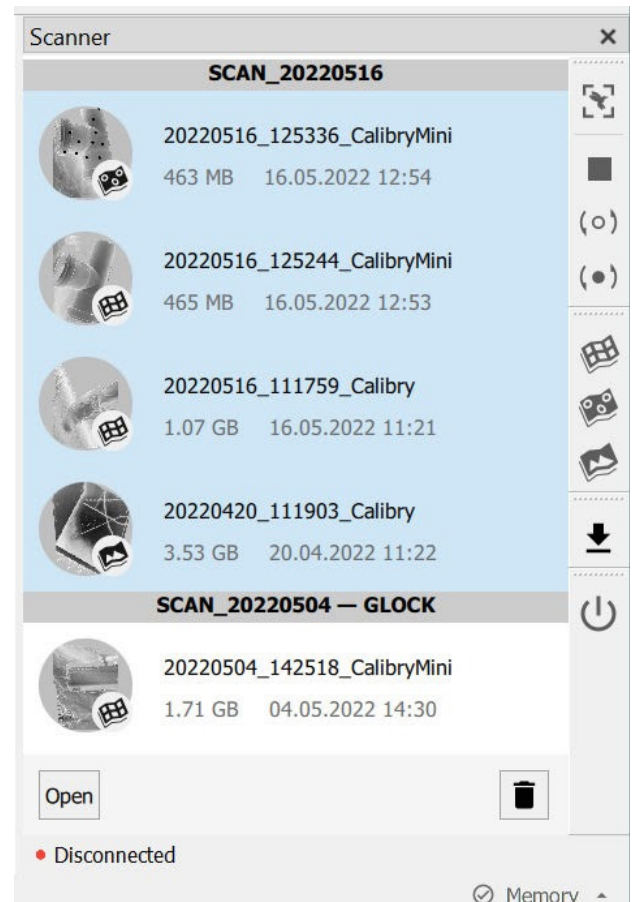
Multiple scans can also be selected by holding Ctrl or Shift and selecting scans with a right click.

When deleting scans, keep in mind that files are deleted to the recycle bin by default. To delete a scan permanently, hold the shift while clicking the trash bin icon (in this case it will turn red in). The same logic works both for deleting individual scans as well as for groups of selected scans.
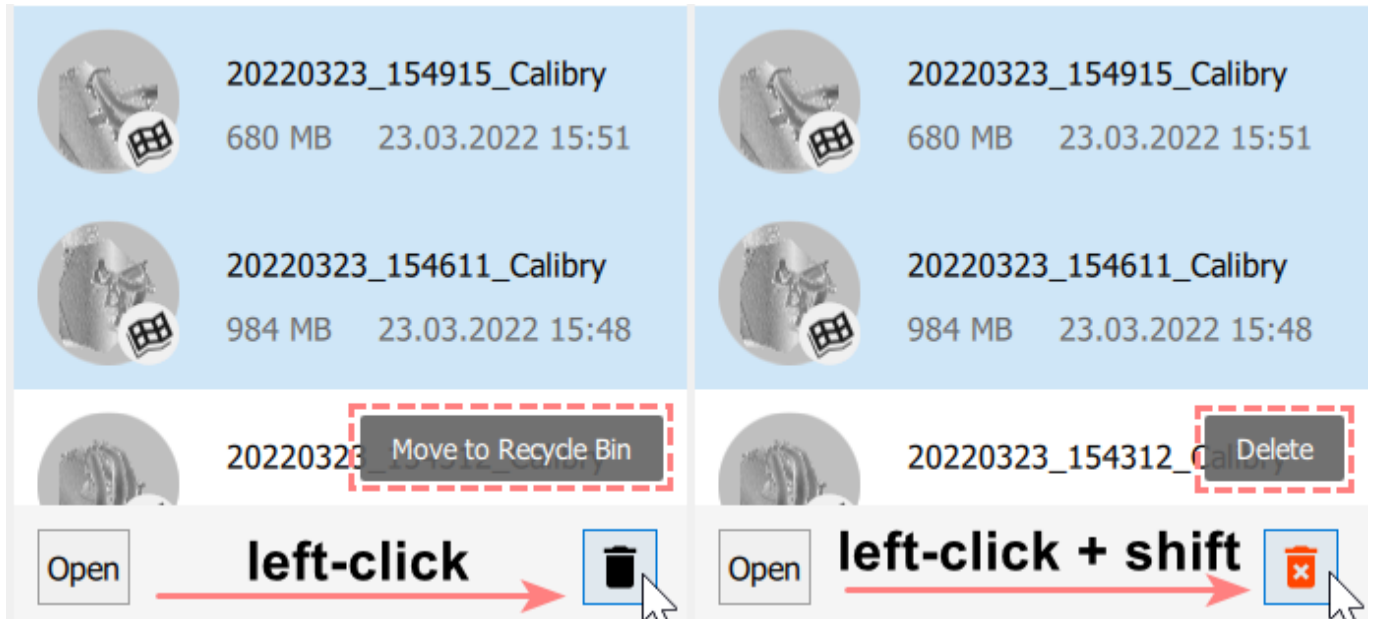
If you click any individual scan on the Scanner panel, the extended info panel will be displayed, showing additional data about the scan.

In addition to the tracking mode used, the number in the lower-left corner of the preview shows the amount of frames in the selected scan (1021 in this case).

This extended info panel also contains several pictograms, representing the setting used to make this scan. Their meaning is covered in Chapter 5: Scanner Interface.

Here you can rename, delete or open the scan. You can also press Open in folder button and the folder containing this scan will be opened (useful when scans have to be copied to an external drive or for online file sharing).
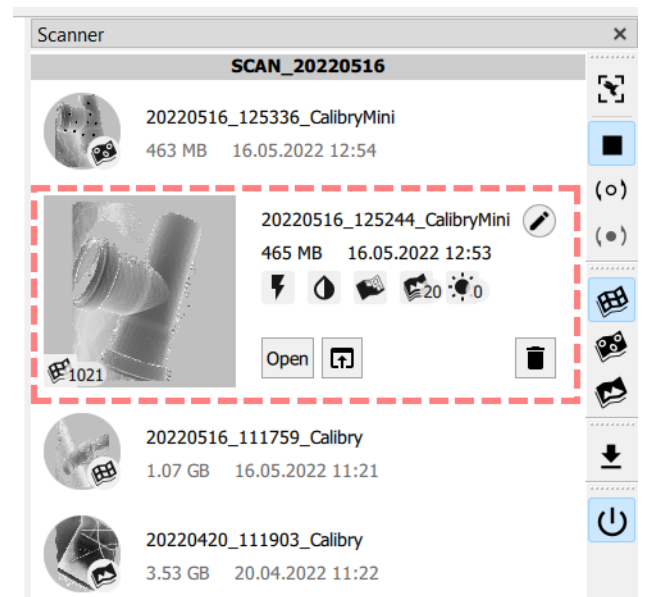
It is important to note that these are so-called raw (unprocessed) scans. These are original scans made with the scanner and they do not contain any edits made in Calibry Nest, unless they are deliberately overwritten with the edited scans (which is generally not recommended, unless the user is fully aware of what they are doing).

These files can be used to start anew if something went wrong during post-processing. It is also these files that are usually requested by Thor3D Tech Support in case a user has any difficulties and find themselves in need of assistance. Please keep these files intact until you are completely sure that you've finished with the project and no longer need them.
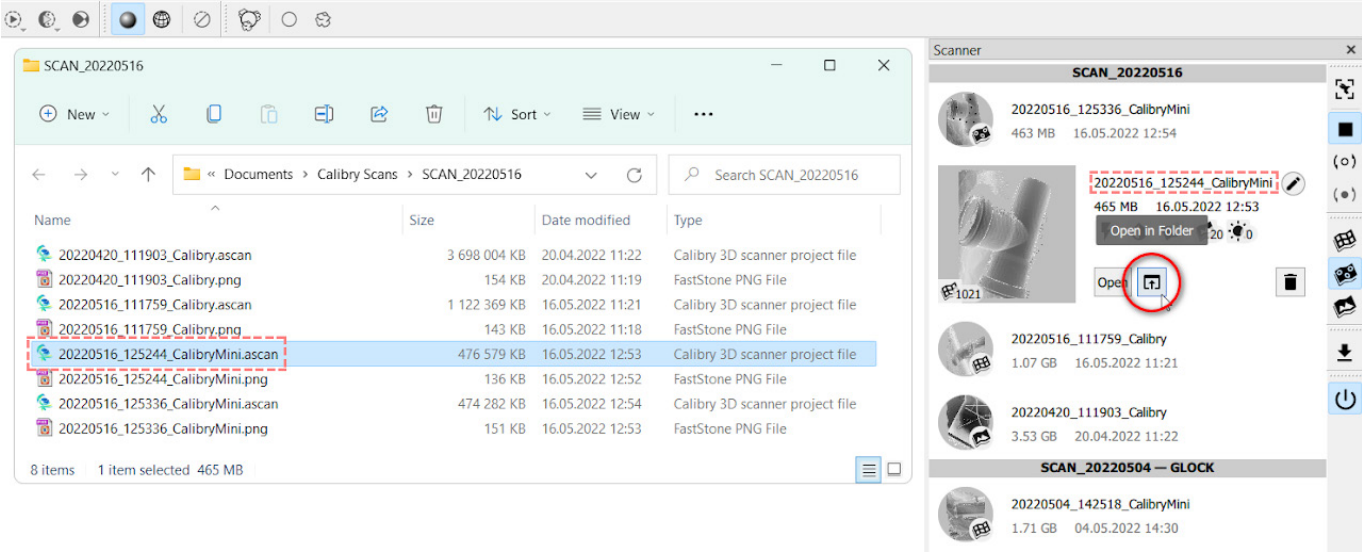
You can also access the folder containing all the scans by double-clicking the bird tray icon in the notification area.
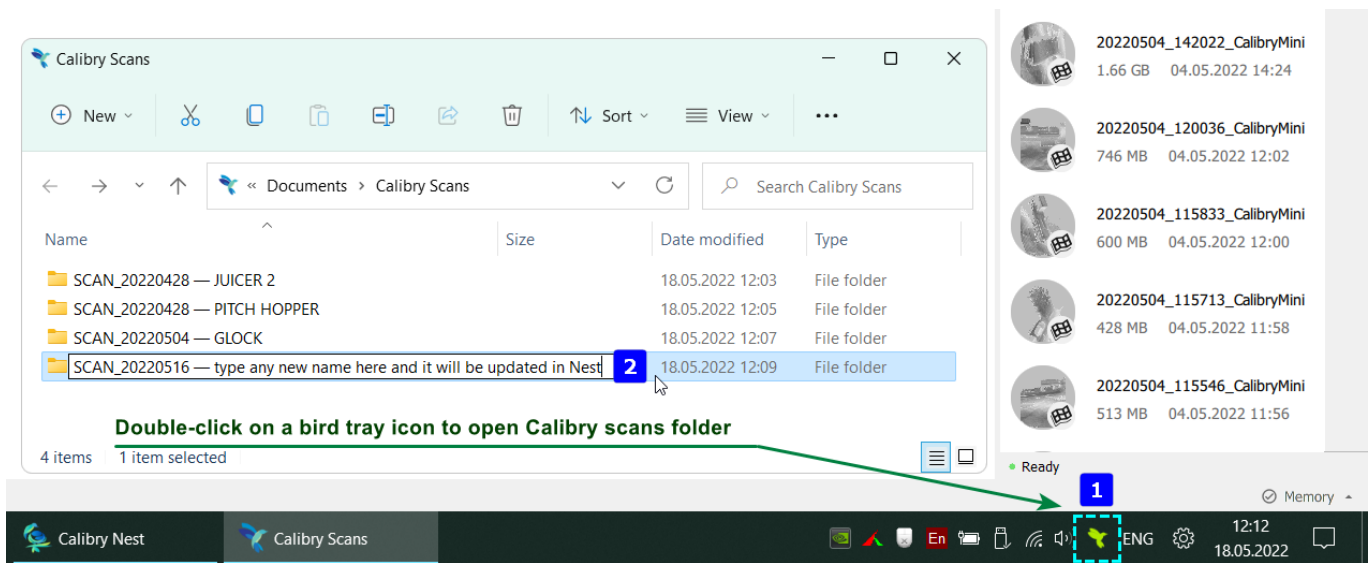
Calibry Tray Icon

When Nest is running, Calibry Tray Icon is visible in the system tray (near the system clock).

Its color represents a scanner status. It duplicates the status shown in the lower left corner of the main window and might be a helpful visual clue when Nest window is minimized. More on the scanner status in Chapter 4: Scanner connection.
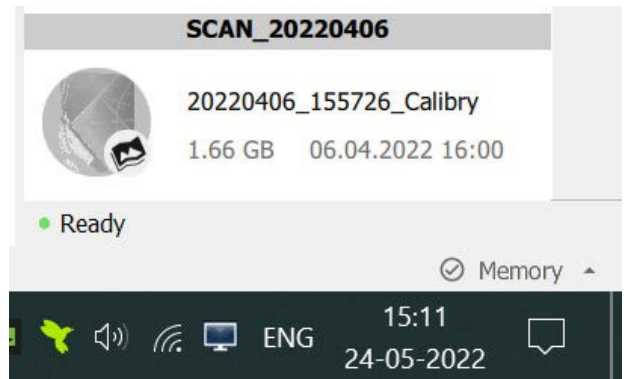
You can always access the unprocessed scans stored locally on a given computer by double-clicking this icon. Renaming any folders and files in the Calibry Scans folder will also be reflected on the scanner panel. Scans and scan folders copied here will also appear on the scanner panel.

Double-click on a bird tray icon to open Calibry scans folder

Calibry Tray Icon has a context menu with several additional options:

— Scanner can be started and stopped from this menu;

— The scanner screen can be shown on the computer screen by using Show Scanner Screen option. It is useful during demos, trainings and presentations. Scanner can also be fully controlled from this screen, which may also be useful when scanner is used on a tripod and/or being controlled from a distance.

— Settings submenu contains starting options.

• Start by connect starts the scanner right after it is plugged into a computer and boots up.
• Start by button allows user to activate scanner with the hardware «PLAY» button after it was switched off.
• Startup with system adds Calibry Tray Icon to Windows autoruns, so it becomes available right after a computer is restarted or boots up.

— Change scans Folder which allows user to pick any folder to be used as a scan storage folder (all new scans will be saved there, but old ones will not be moved to the new location).

— About shows the version of currently installed 3D Scanning Software module (scanner-shell.exe). This module version may differ from the currently installed version of Nest.
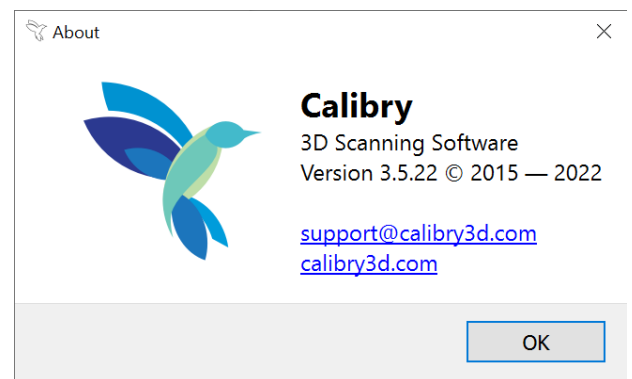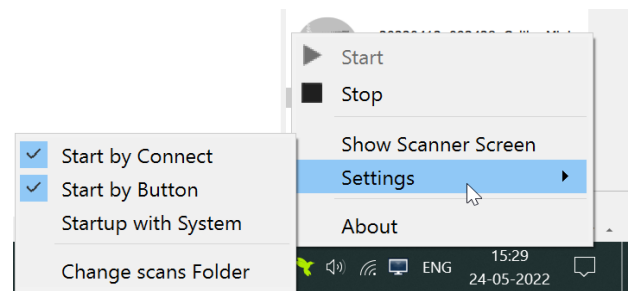
Language Menu
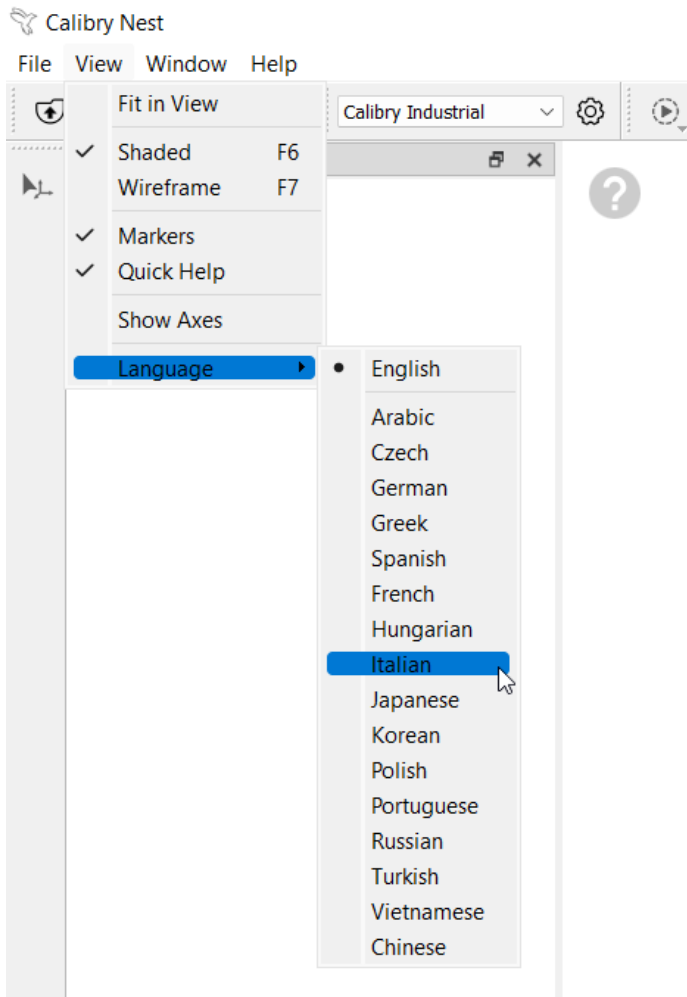
Select the language of Nest interface from the dropdown menu in View >> Language

Managing Toolbars
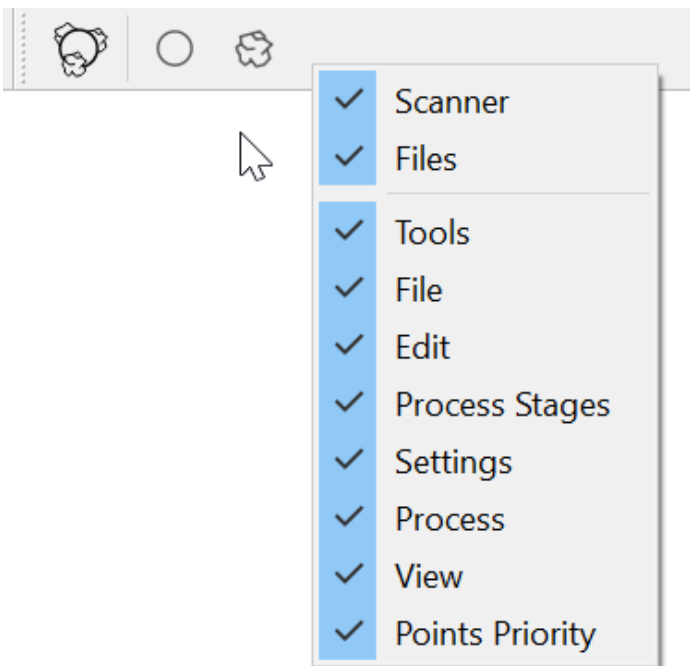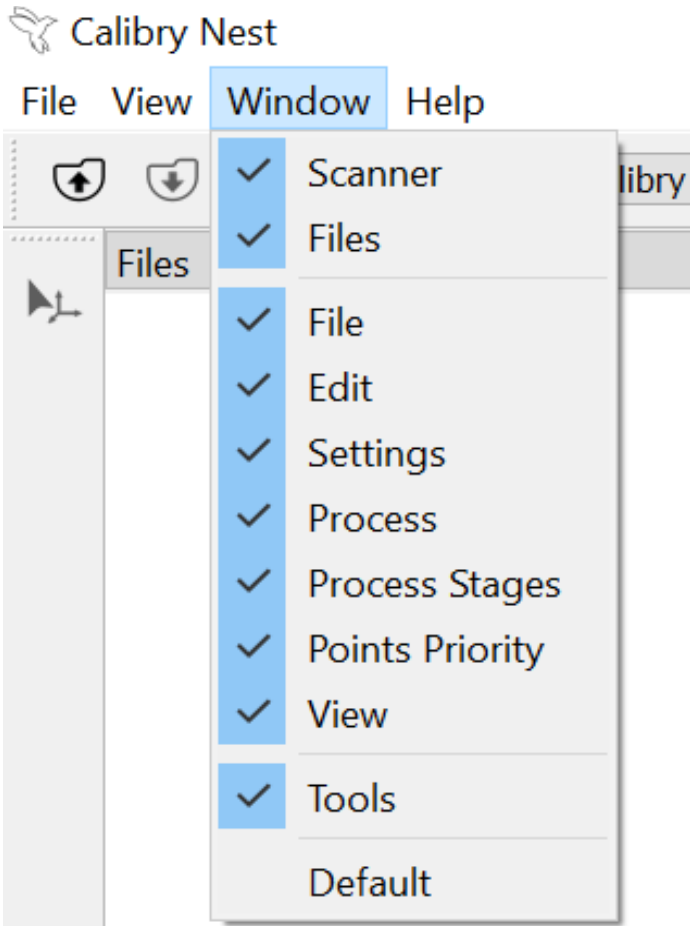
Window menu allows to temporarily switch on or off certain panels and processing buttons.

This can also be done by right-clicking the Main Toolbar.

All panels and process bars in Nest can be detached, moved, and attached to different parts of the window. To return to the default view — select Window >> Default.

Settings

Nest Settings can be accessed by clicking on the gear icon on the main toolbar. It contains two tabs, shown below side-by-side:
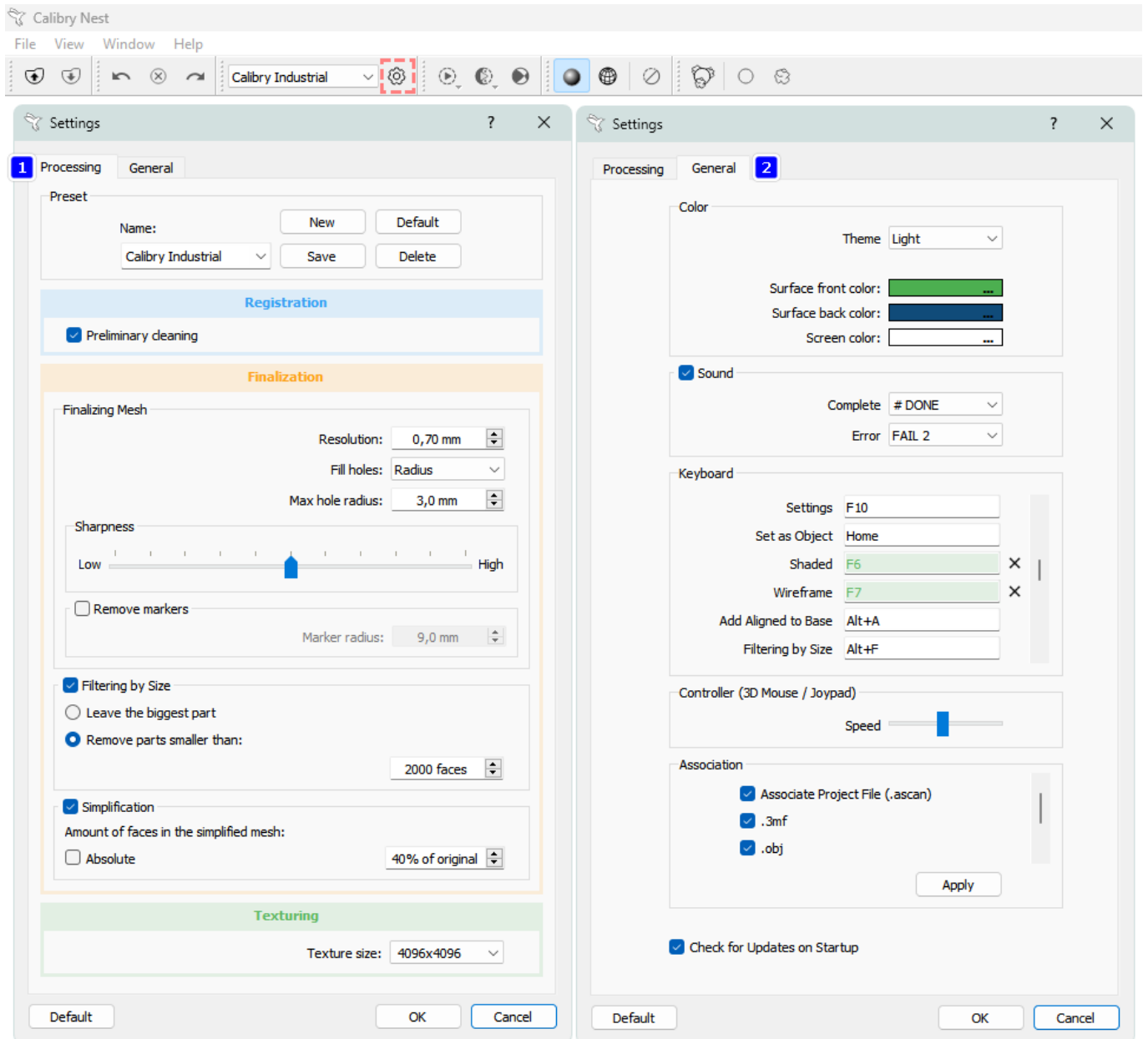
Processing [1] tab contains settings for scans post-processing. These settings are described in detail in Chapter 8: Post-processing a scan.

General [2] tab provides interface settings including the following:

- Theme and color settings allow users to change basic colors for 3D-data in Nest and to pick Light or Dark interface theme.
- Sounds settings allow to set a sound for successful completion of a task or to notify a user about an error.
- Keyboard hotkeys can be associated with and modified for almost every function and process in Calibry Nest.
- The sensitivity of a 3D mouse or Gamepad can also be changed here.
- Association of Nest with supported 3D formats can be enabled or disabled as needed.
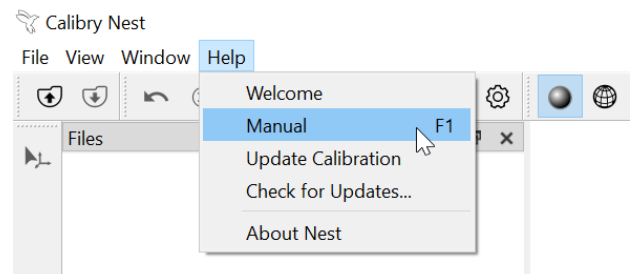
Help, Hints and Guides

Help contains the option to display the Welcome Screen, as well as access the Manual.

Calibration can be updated and updates for Calibry Nest can be checked.

About Nest opens up a pop-up window showing details of the current Nest version used.

Plus, there are a couple of additional interface elements providing context help to a user: Quick Help and Quick Guide.

Quick Help is a question mark button in the upper left corner of the main window of Nest. It can be shown or removed using a context menu.
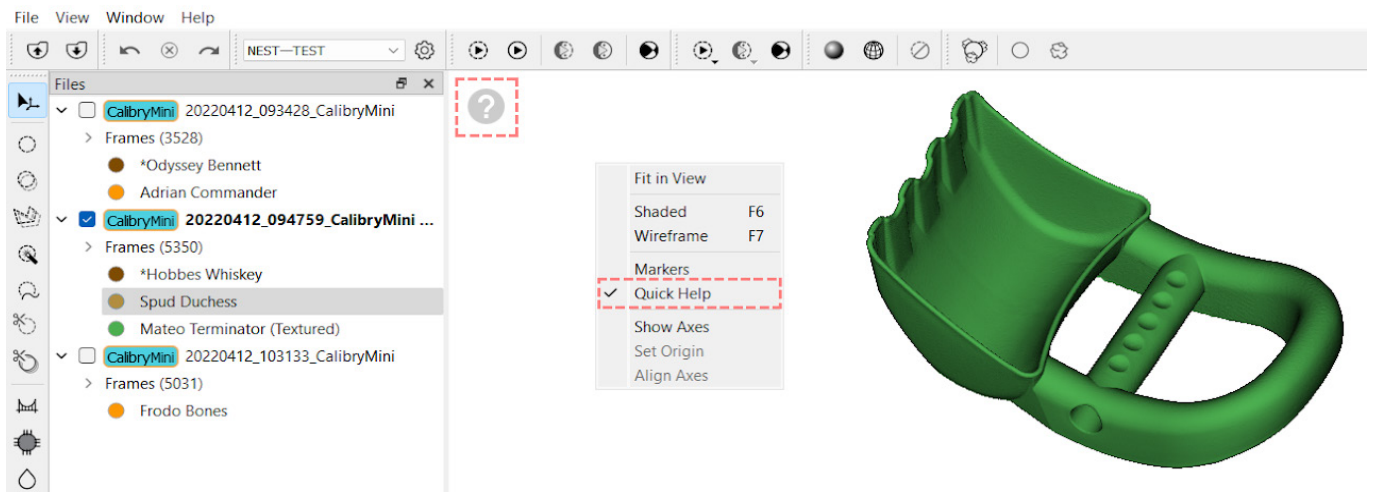
When pressed, it opens up an overlay showing mouse and keyboard controls that can be used in the current editing mode. This list of hints changes, depending on the processing stage or the tool used.
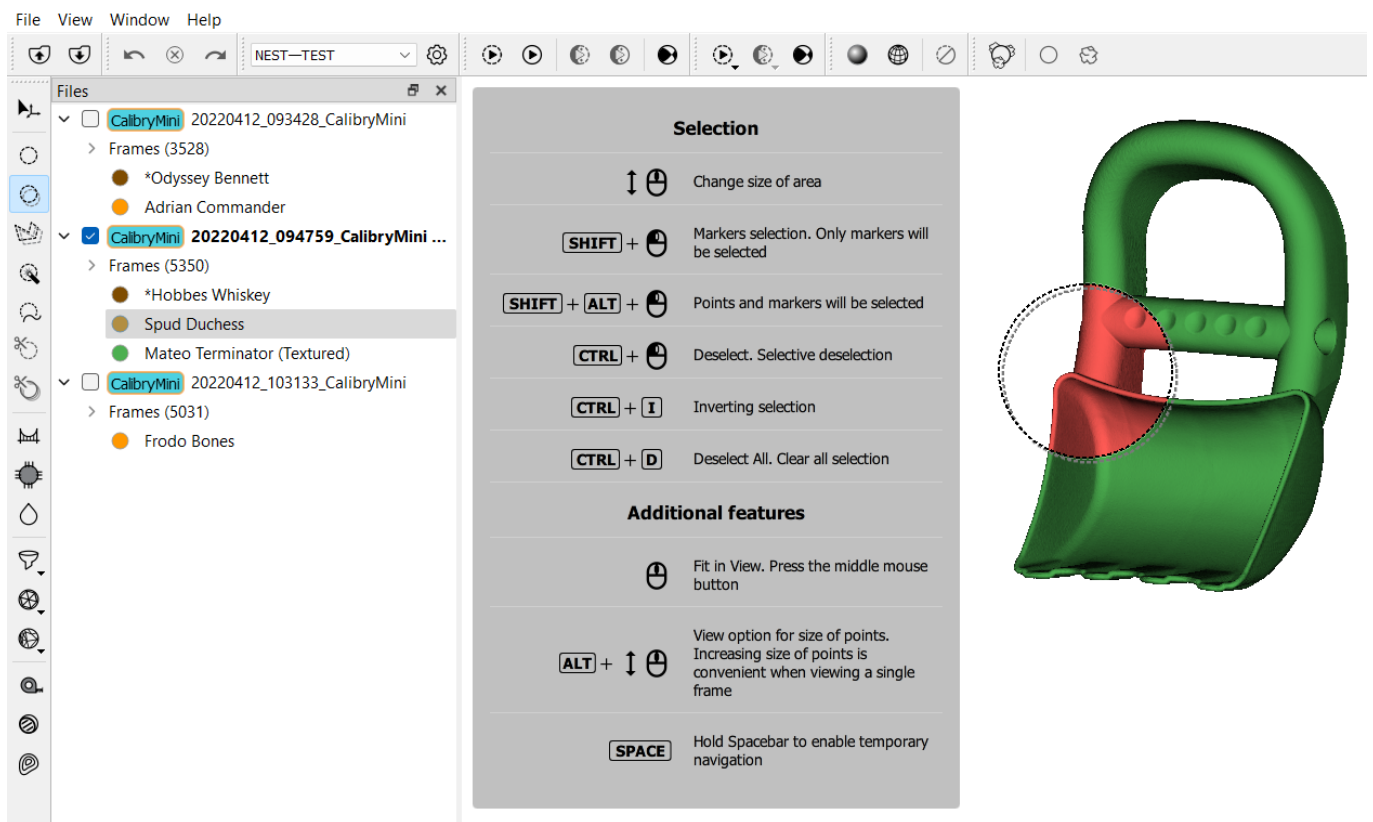
To close Quick Help overlay, simply click on it and it will minimize back into the question mark button until clicked again.

Quick Guide is an overlay that shows descriptions of the post-processing settings. Go to Settings and click the question mark button at the upper-right corner of the Settings window to activate the Quick Guide overlay. Use arrow buttons to move through the settings and descriptions. Use the overlay X button to close the Quick Guide.
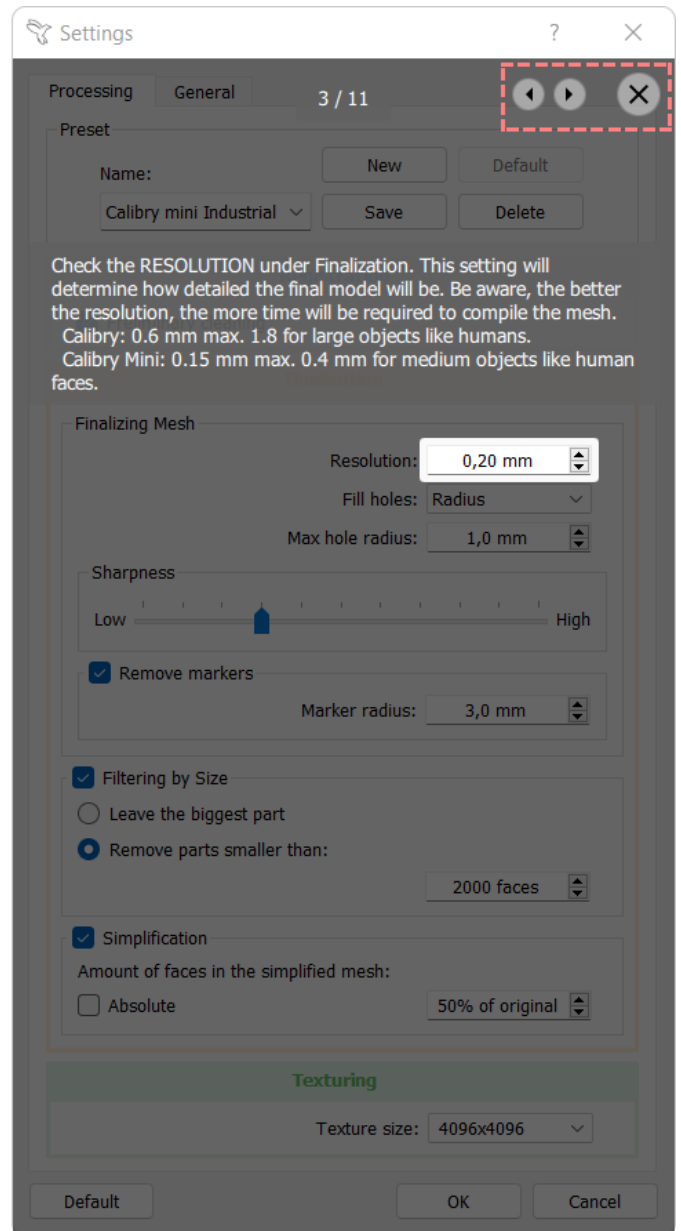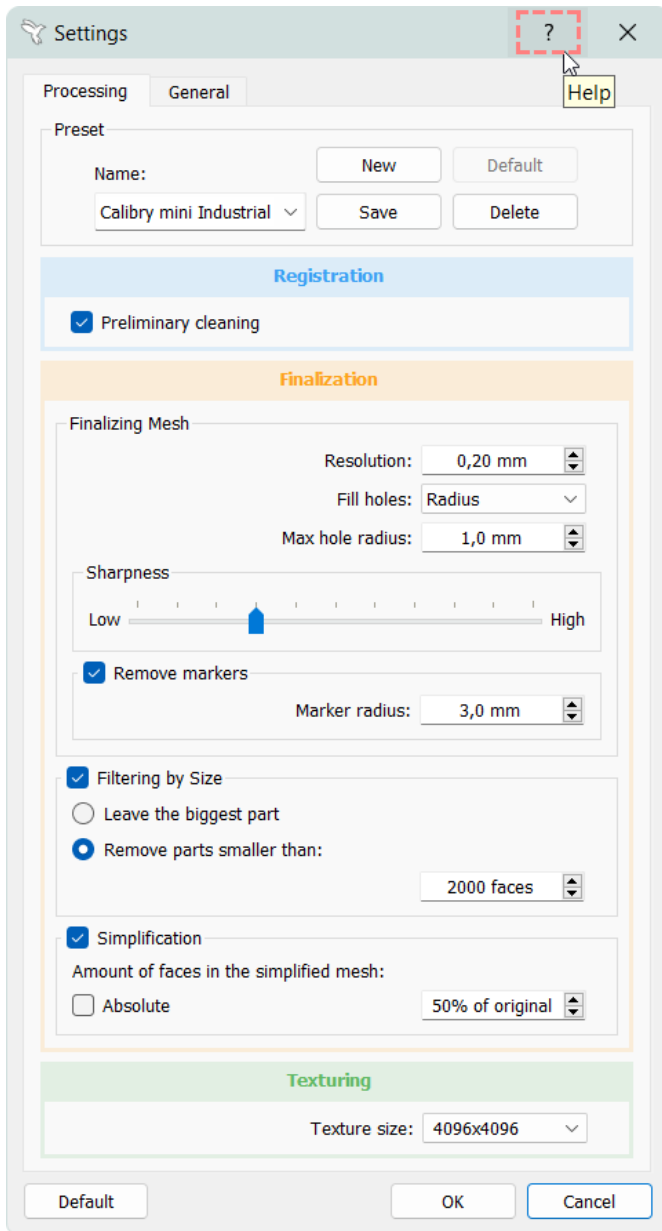
Status Bar, Progress Bar and Logs Panel

At the bottom of the Calibry Nest window there is a line that combines Status Bar, Progress Bar and Logs Panel. This line shows information about recently loaded data (scans or models) and current task progress (opening/saving files, post-processing operations, etc.):
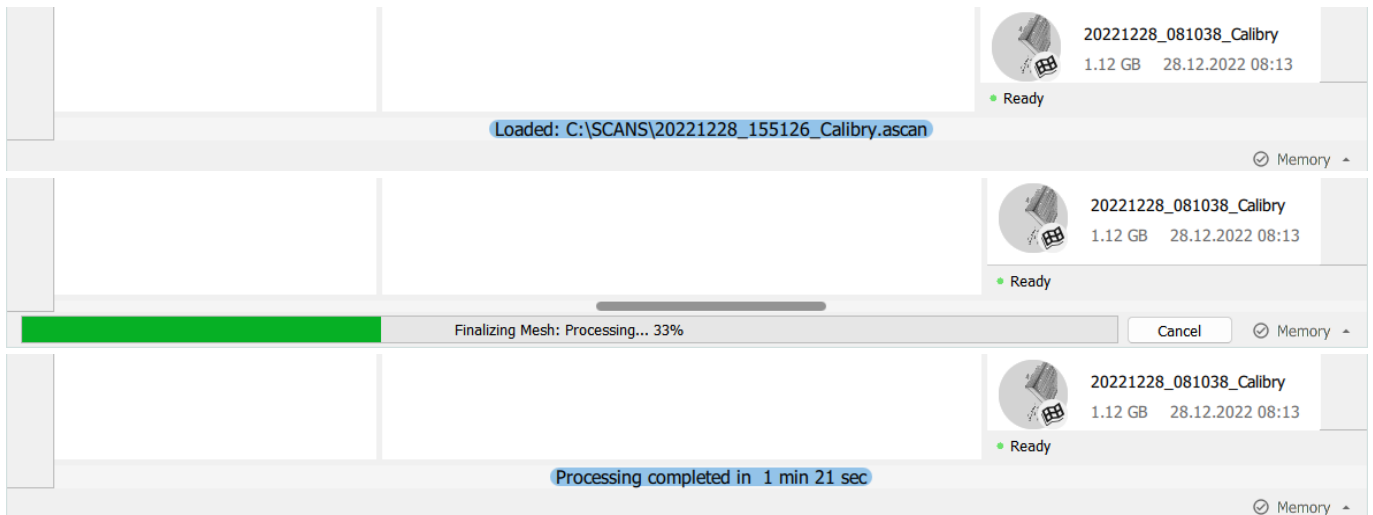
Clicking or pulling the bar up opens a Log Panel that shows the history of actions, timestamps, processing parameters and time passed since each operation:
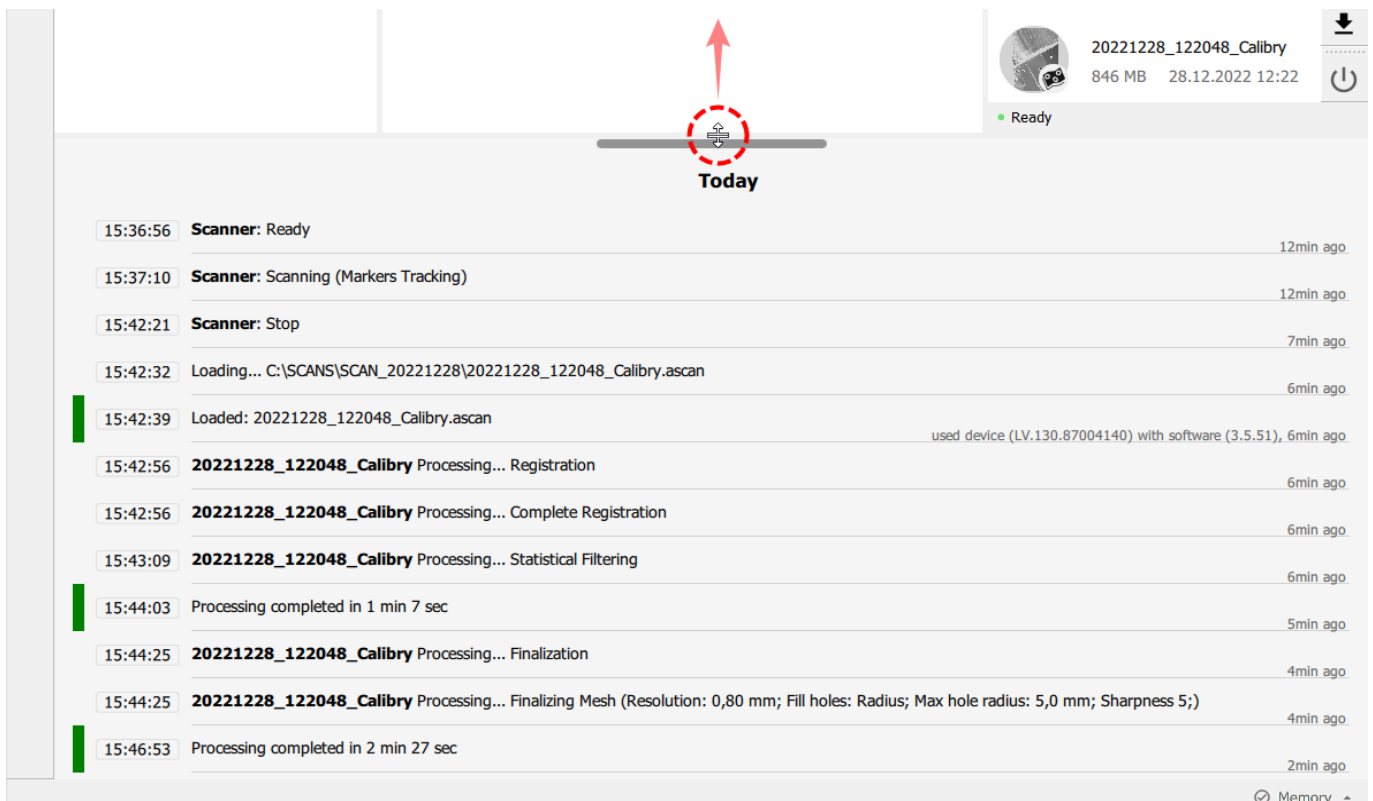
Memory Monitor

To see how much PC/laptop RAM or Video Memory (VRAM) is being used during post-processing, select the Memory tab in the right bottom corner.

This window is also detachable and can be docked to any convenient location or can be left floating.

4. Scanner Connection

Connection Sequence

The safest and the most correct connection sequence goes as follows:

1. Plug the blue 5m USB cable into the scanner. Secure the connection by tightening the screws of the connector;
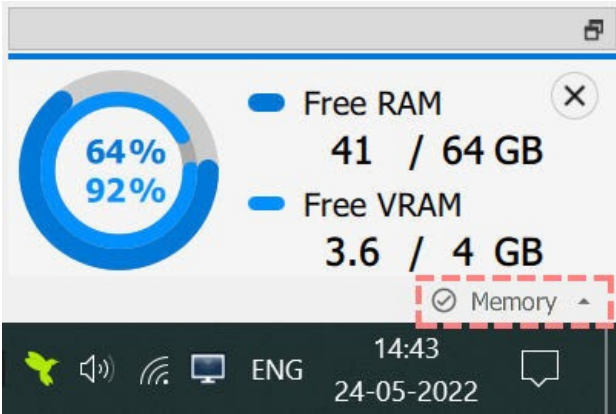2. Plug the other end of the blue cable to the power injector (silver box);
3. Plug the black 1m USB cable to the power injector. Secure the connection by tightening the screws of the connector;
4. Plug the black USB cable into a PC/laptop USB port version 3.0 or higher. The indicator on the power injector should light up. It should not be blinking;
5. Plug the power supply (black box) to a grounded power outlet using the power cord. The indicator on the power supply should light up;
6. Plug the black power connector to the power injector;
7. Start Calibry Nest for the scanner to be properly detected and prepared for work.

The result should look like the picture below:

Calibry Nest Modules

Calibry Nest is comprised of two software modules:

• Calibry Nest itself (nest.exe) is software for post-processing 3D scans and editing 3D data. Nest itself does not control the scanner and can be used as a standalone 3D viewer and basic 3D editor.
• Calibry 3D scanning module (scanner-shell.exe) is software used to control the scanner and facilitate the scanning process. Without this module the scanner is not going to work.

By default, when Nest is started, it also starts the scanning module. In the same way, when Nest is closed, it also terminates the scanning module. Although it is possible to run the scanning module independent of Nest, described default sequence is more preferable for most users and will be used in all further examples, unless otherwise specifically stated.

The easiest way to make sure the scanning module is running is to check the presence of the Calibry icon in the notification area (near the system clock). The scanning module works in the background and normally does not show any windows.

Scanner Status

The color of Calibry tray icon represents the current status of a scanner plugged into a PC/laptop. It is also duplicated by the status, visible in the lower right corner of Calibry Nest main window (at the bottom of the scanner panel).

White. Scanner is not connected (no scanner). It is the default state when Calibry Nest is starting. It stays this way if scanner is not used or not detected.
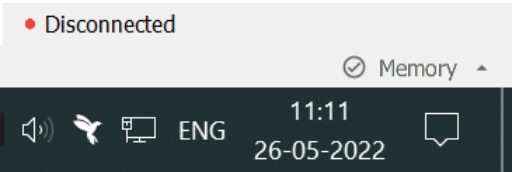
Orange. Scanner is connected, but still booting up or swithed off. This status means that the scanner was detected, but it is not fully prepared for operation yet. It can also mean that the scanner was switched off. Long-press Play button on the scanner handle or right-click Calibry icon and choose Start from the menu. On/Off button on Calibry Nest scanner panel can also be used to bring the scanner back online (to Ready status).
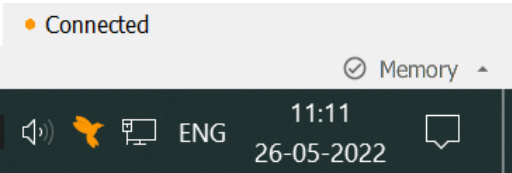
Green. Scanner is connected and ready for use. This is the most common state for the scanner to be in. It means that everything is okay and scanning can be started at any time. If scanner wasn't used for more than 30 second, its screen will turn off, but the status will not change. Just grab the scanner, tap the screen to wake it up and start scanning. Short-pressing either of scanner handle buttons will have the same effect.
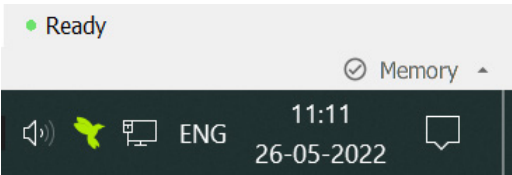
Red. Scanner was recently disconnected and reconnection attempts are being made. This status indicates recent loss of connection with the scanner and that software makes three consecutive attempts to reconnect. If all three fail, Calibry icon turns white. If this status appears with no apparent reason, check that the cables are connected firmly.
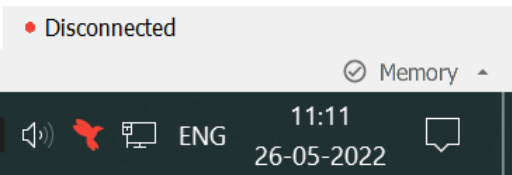
Purple. Scanner is connected, but something prevents it from working normally. In most cases this status indicates that ether power supply is missing or the factory calibration file cannot be downloaded. Make sure power supply is properly connected and Internet connection is available for the software to download the factory calibration.
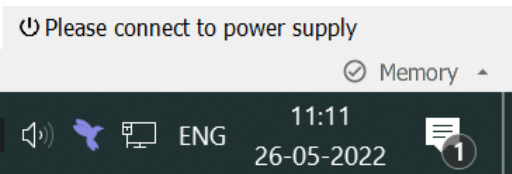
If everything is done correctly, after a scanner is plugged into a PC/laptop and Calibry Nest is started, the status is going to briefly change to Connected (orange) and then to Ready (green). If it is done for the first time and no scans are yet stored on this PC/laptop, the message «Please calibrate the scanner» will appear on the scanner screen. It will be replaced with «Empty. Start scanning now!» message after the calibration is performed (more on calibration in Chapter 6: Scanner Calibration). After that the scanning can be started. More on scanning in Chapter 5: Scanner Interface and Chapter 7: Scanning. This initial screen will later show all the scans stored locally on a given PC/laptop.
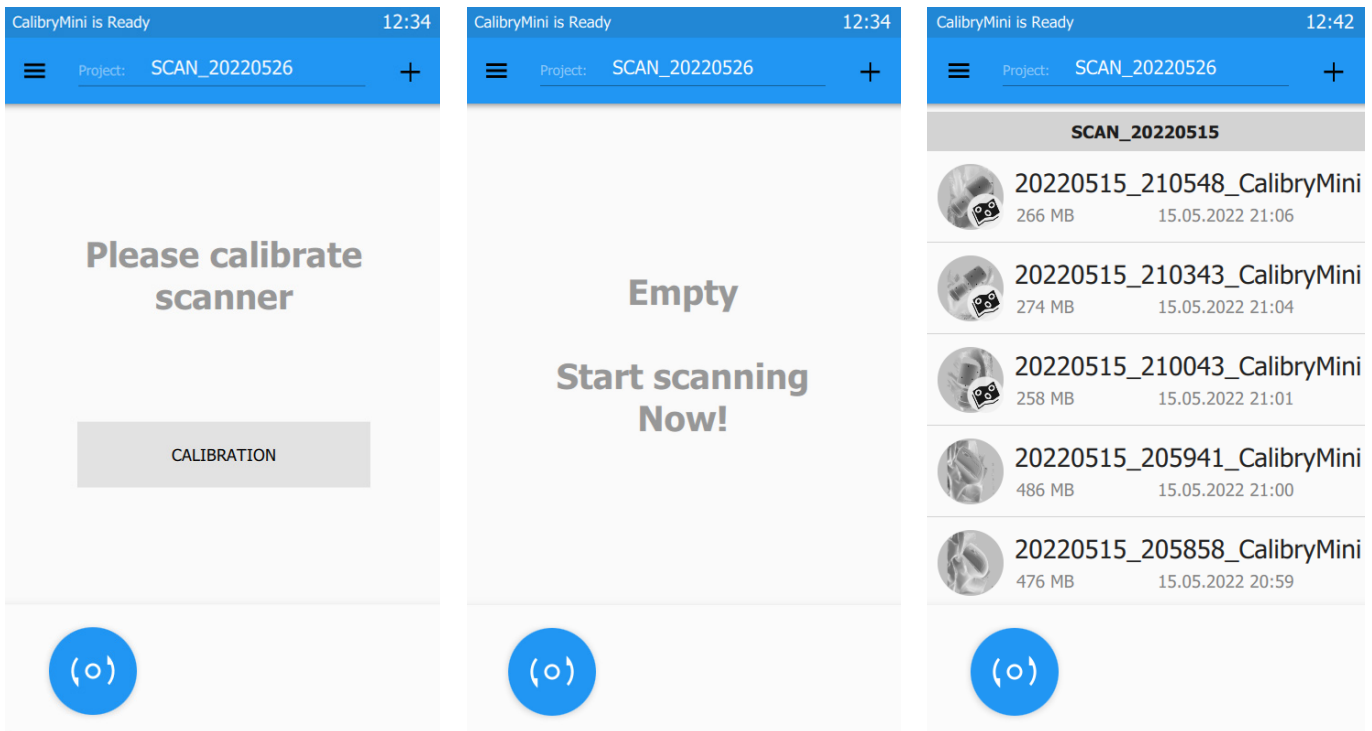
If something goes wrong...

If you experience any difficulties connecting or using Calibry scanners, remember that we are always ready to help! Kindly contact our Technical Support (write to support@thor3dscanner.com or use the feedback form on our official website thor3dscanner.com), and we will gladly assist you and provide a solution to any problem.

Do not attempt to open or repair the scanner on your own. Calibry scanners and their components are not intended to be serviced by the end user. Any unauthorized attempt to do so can lead to the loss of warranty.

Always use only cables and units from the original Calibry package or components provided/replaced by Thor3D-authorized distributors.

Never plug any other device apart from the scanner into the power injector! Most USB devices will be immediately and irrecoverably damaged! The scanner uses additional 12V power supply fed through the blue USB cable, which can severely damage most USB electronics using standard 5V power. Such an action could also potentially damage the power injector itself or the PC/laptop used. None of these cases are covered by warranty.
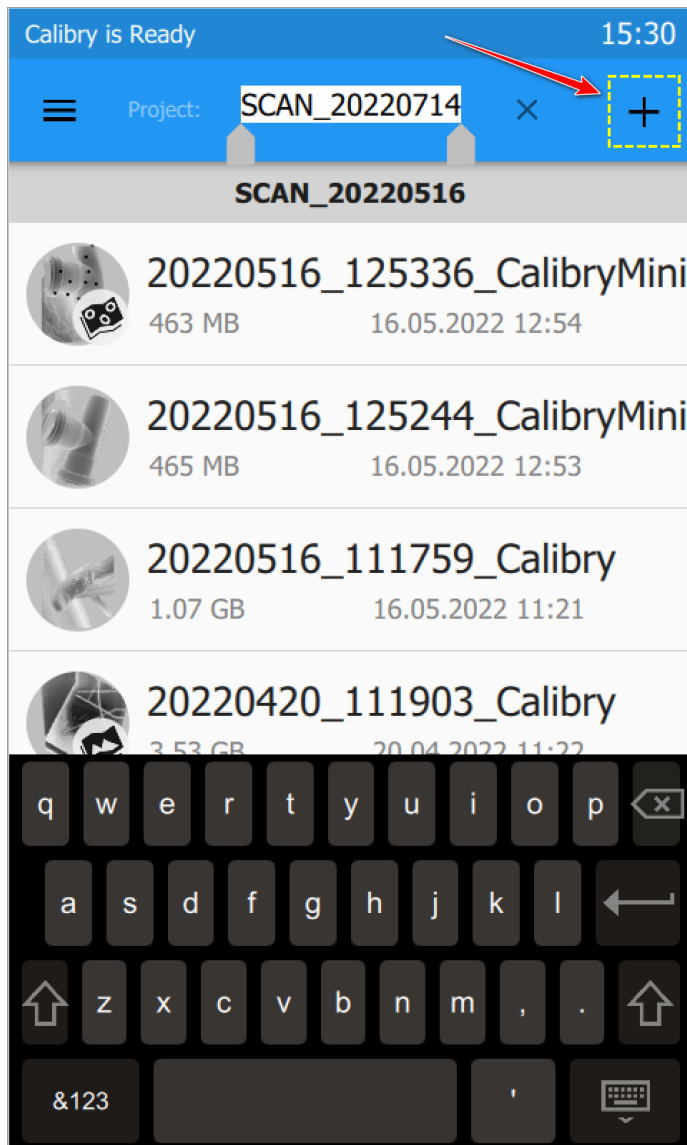
5. Scanner Interface

Main screen
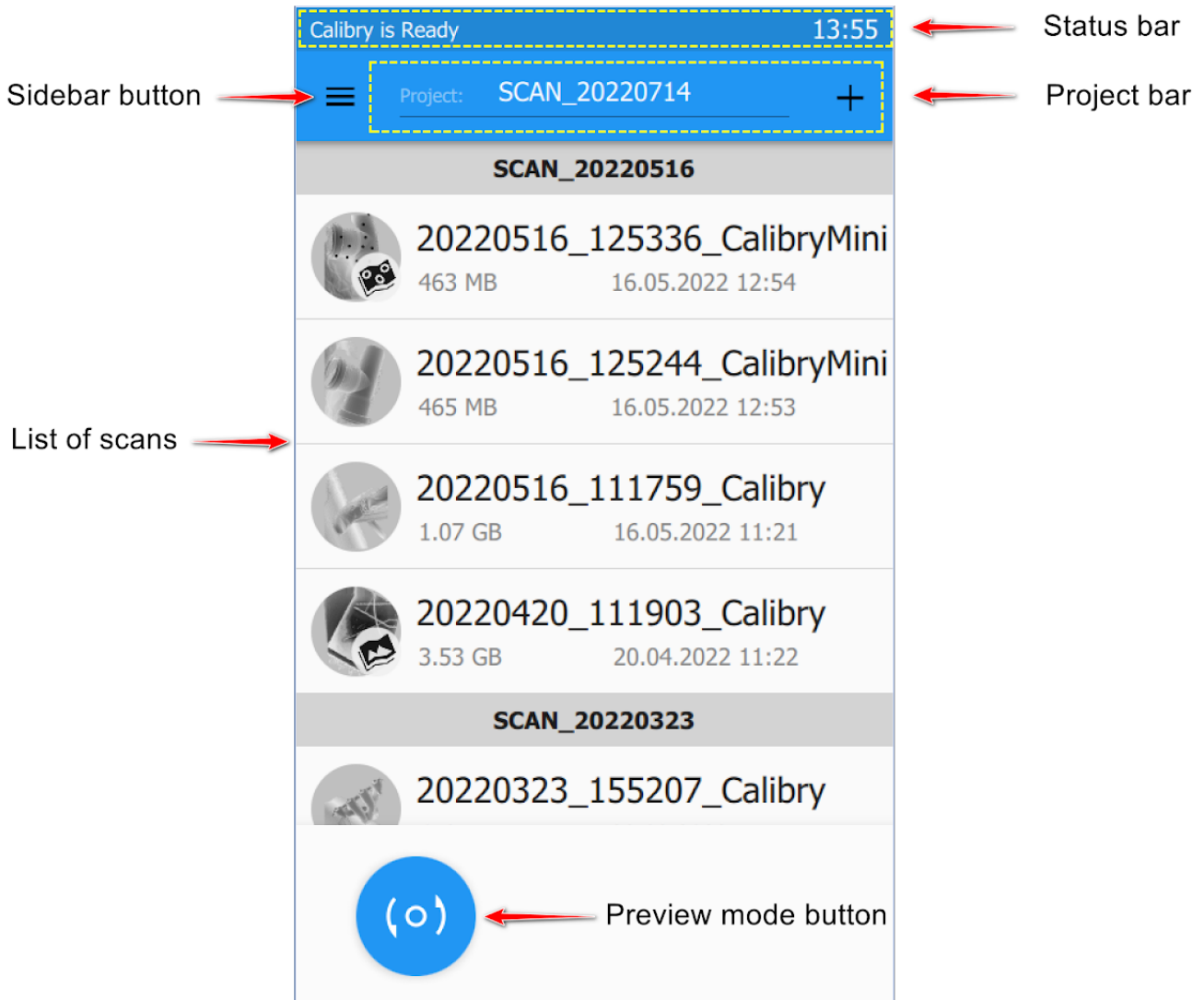
The current scanner state and time are displayed in the status bar. Also the warnings are displayed here, for example, if the scanner needs calibration or there's not enough free space on the drive, the exclamation mark will appear near the clock. Tap on it to see the corresponding warning:
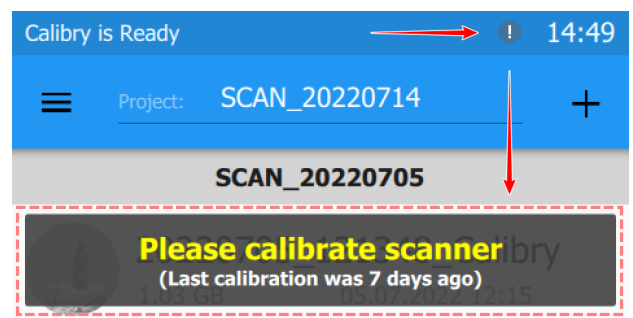
The scans are sorted in the scans list by creation date – the newer the higher. Also the scans can be grouped into corresponding project sections.

At any moment you can switch to a different project by clicking on the project name in the list of scans. Also you can create a new project by entering a new name for it or clicking «+» button in the project bar.

All following scans will be placed in the folder with the specified name. By default the standard name contains the current date in the format SCAN_YYYYMMDD, but it can be changed with the screen keyboard.

All the scans are saved to the computer hard drive which the scanner is connected to. The folder names match the names of the project sections.

Any scan in the list can be deleted by simply swiping it to the side:
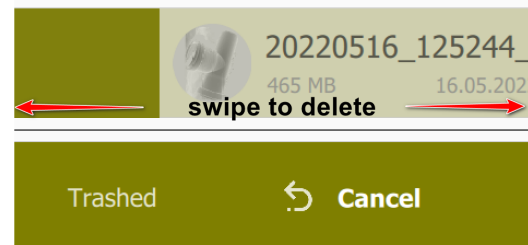
After that you can cancel the action for a few moments. If not, the scan will be moved to the Recycle bin of your computer.

Calibry

Sidebar

The sidebar shows the amount of available space (gray) and the space currently used up for storing scans (blue).

Note that scans are stored not inside the scanner, but on the PC/laptop the scanner is currently connected to. This diagram shows the amount of available space only for the drive used for storing scans, not for the entire system.

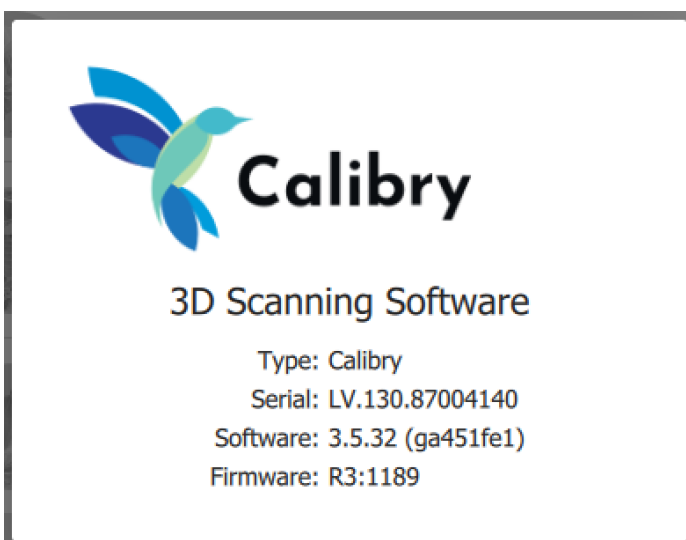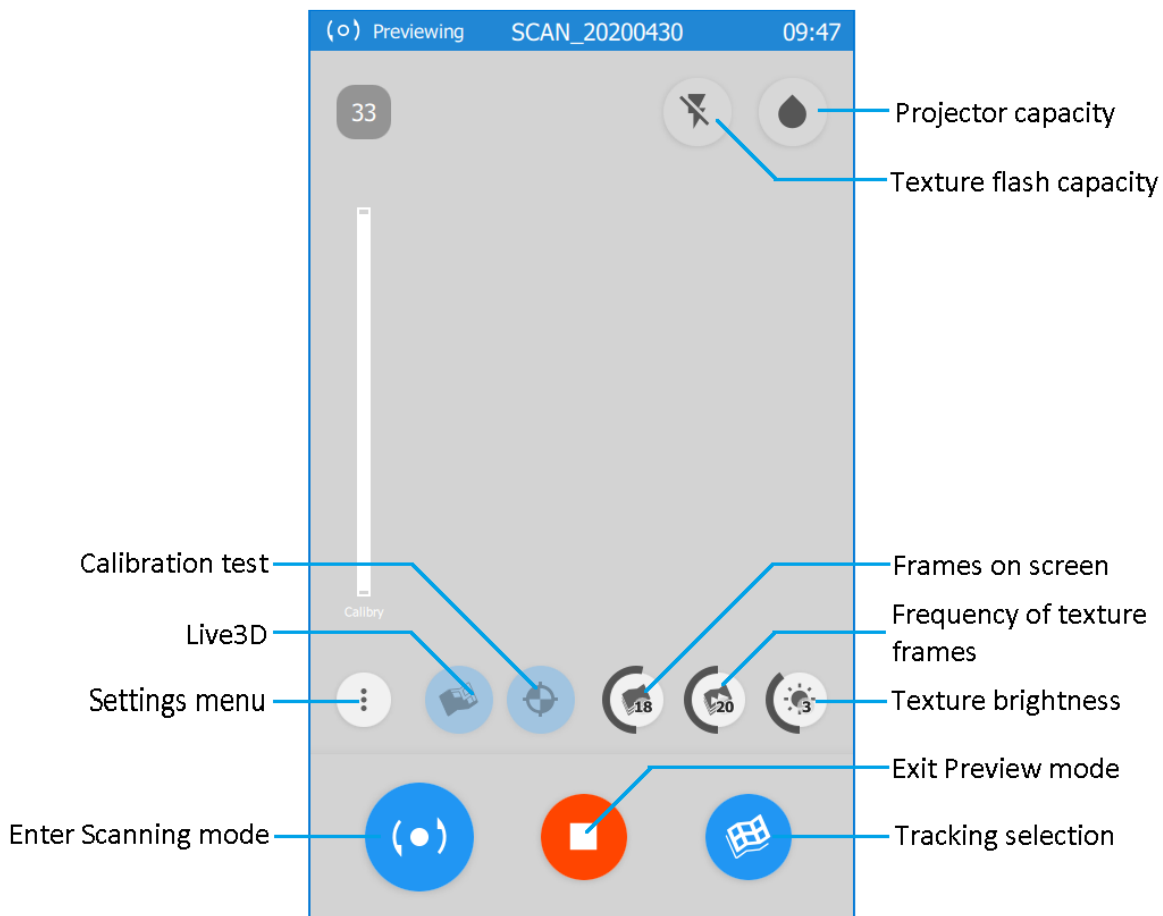Calibry

	11:18
←	Scanner

Language *   English ▾

Texture Brightness
― 0 +

Frequency of Texture Frames
― 20 +

Frames on Screen
― 18 +

Frames per Second Limit
― 35 +

DEFAULT

CALIBRATION
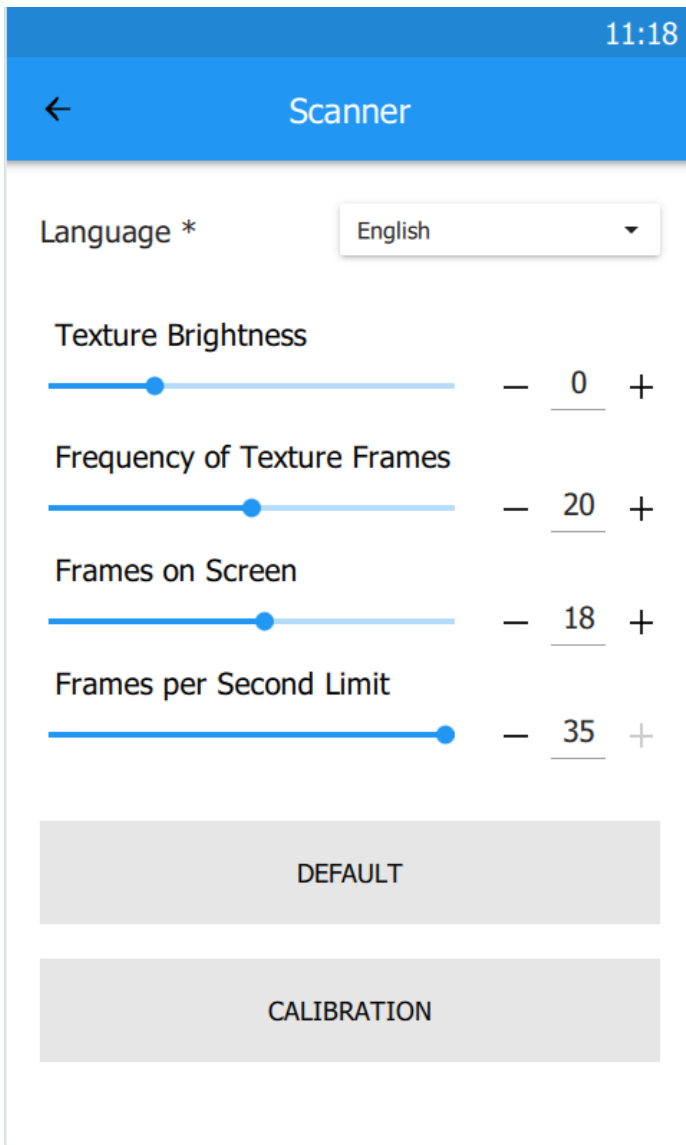
If you tap Sidebar —> Settings, the screen with scanner setting will appear. Here you can change the interface language (the scanner will be restarted) or scanning settings (including resetting them to defaults, shown in the picture) and start calibration process. These settings and the calibration process are covered in more details in Chapters 6: Calibration and Chapter 7: Scanning.

Calibry

3D Scanning Software

Type: Calibry
Serial: LV.130.87004140
Software: 3.5.32 (ga451fe1)
Firmware: R3:1189

The sidebar also has the Scanner button to access scanner settings and About button that shows type of the scanner used, its serial number, Scanner Shell and firmware versions.

Preview mode

To enter Preview mode, press «Play/Pause» button on the scanner handle or «Preview mode» button on the scanner touchscreen. You can press these buttons again to start scanning and the background color will change to black. But initially it is gray. It means that Preview mode is activated and no data is being recorded yet.

Projector capacity

Texture flash capacity

Calibration test

Live3D

Settings menu

Frames on screen

Frequency of texture frames

Texture brightness

Exit Preview mode

Enter Scanning mode

Tracking selection

Preview mode allows you to check or change the settings and modes. Plus, you can use it to find the best starting position, check the distance to the object and determine if you have enough markers in the scanning area (in Marker Tracking Mode).

In order to get back to the list of scans, press «Stop» on the scanner handle or «Stop» on the touchscreen.

Set the projector capacity to dark (black droplet), normal (black and white droplet) or light (white droplet) according to the color of the object you are about to scan. It is preferable to scan on maximum projector capacity. This is especially relevant for dark surfaces that reflect light badly. However, if the scan obtained contains too much noise, lower levels can be used.

Set the Texture flash capacity to maximum (black lightning), medium (black and white lightning) or switched off (crossed out lightning). This value is set to maximum by default and rarely changed. It is better to start with the texture brightness slider first. If desired level of brightness is difficult to achieve, then changing this setting may help. This setting is only active in Geometry Tracking Mode, since Marker Tracking Mode and Texture Tracking Mode are both using the texture camera for tracking purposes and Flash Capacity is always set to maximum.

Set the Tracking selection to geometry, markers or texture accordingly.

Live3D activation button allows to switch on or off Live3D mode. In this mode a temporary preliminary model is created in real time and helps to assess scan quality.

Calibration test button opens up a test window that allows to check the quality of current calibration.
More info on the calibration test in Chapter 6: Calibration.

Settings menu button opens a slider menu with three settings: texture brightness, frequency of texture frames and frames on screen. These three sliders are also available as three buttons.
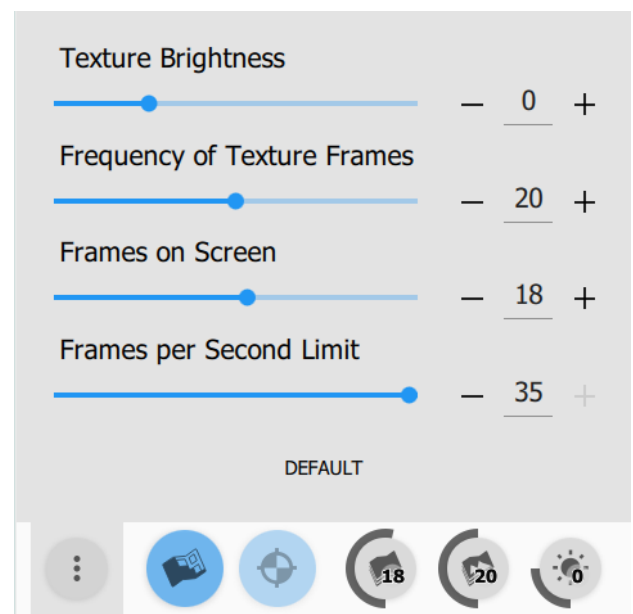
Texture Brightness defines brightness of texture frames.

Frequency of Texture Frames defines how often texture frames will be captured and stored for further texturing of a model.
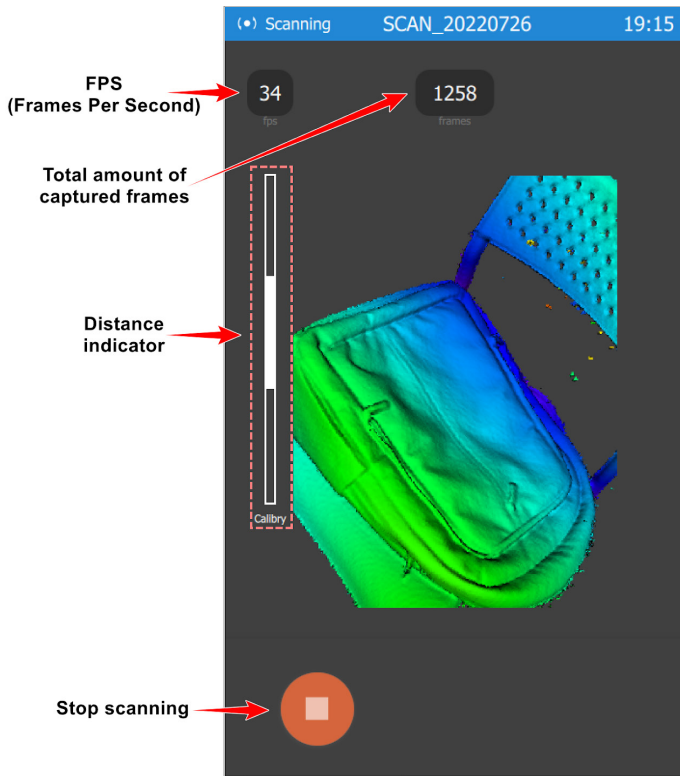
Frames on Screen defines how many frames will be shown on screen if Live3D is disabled.

Frames per Second Limit allows to decrease the scanning speed (useful for powerful computers).

These settings are covered in detail in Chapter 7: Scanning.

Texture Brightness

— 0 +

Frequency of Texture Frames

— 20 +

Frames on Screen

— 18 +

Frames per Second Limit

— 35 +

DEFAULT

Scanning Mode

FPS
(Frames Per Second)

Total amount of
captured frames

Distance
indicator

Stop scanning

After scanning is started, two important counters are visible: FPS counter (Frames Per Second) and a counter of total amount of frames collected thus far.

Distance indicator on the left side represents depth of view and shows the position of the scanned object in respect to it.

Press the Stop button in the lower left corner to stop scanning and get back to the preview mode. You can also use play/pause button on the handle for the same effect.

Stop button on the handle will stop current scanning and get you back straight to the list of scans.

PC/laptop Scanner Control (optional)

The scanner can also be controlled using the Scanner Control Panel.

Using this panel, it is possible to open the scanner screen, switch to Preview or Scanning mode, stop scanning, choose the tracking mode, update calibration and switch the scanner on or off.
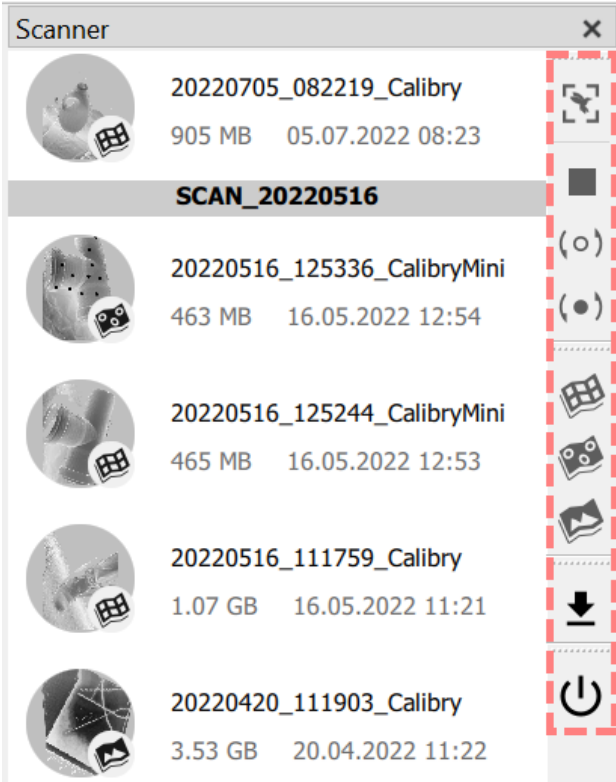
The scanner screen can be duplicated on the computer by using the «Show scanner Screen» option. It is useful during demos, trainings and presentations. Scanner can also be fully controlled from this window, which also might be useful when the device is used on a tripod and/or being controlled from the distance.

To access this function, right-click Calibry tray icon and choose «Show scanner Screen».
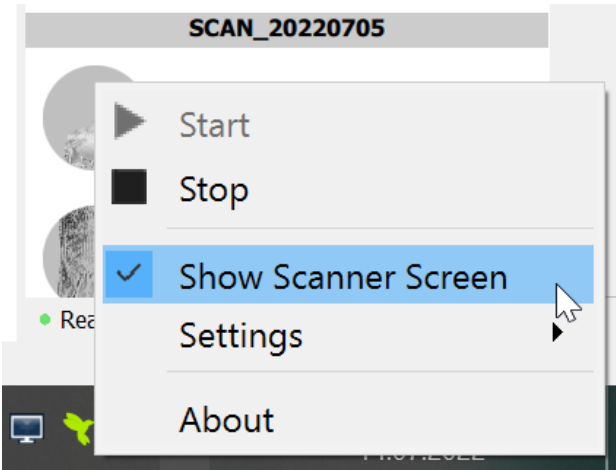
Show Scanner Screen is also accessible on the scanner toolbar on the right side of the scanner panel in Calibry Nest:
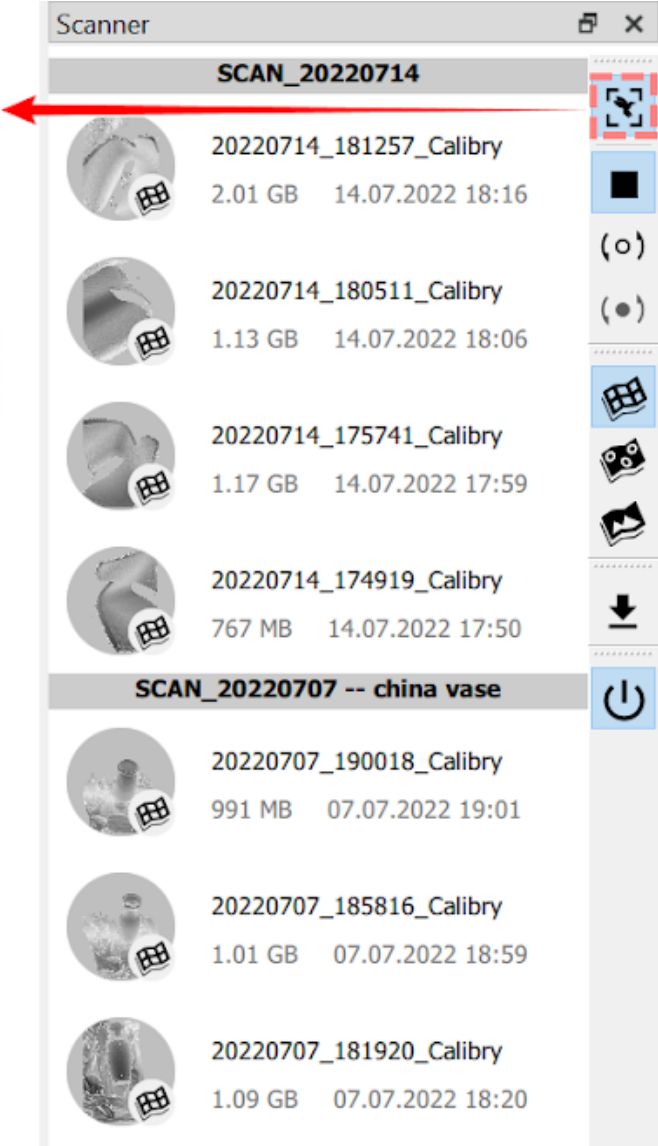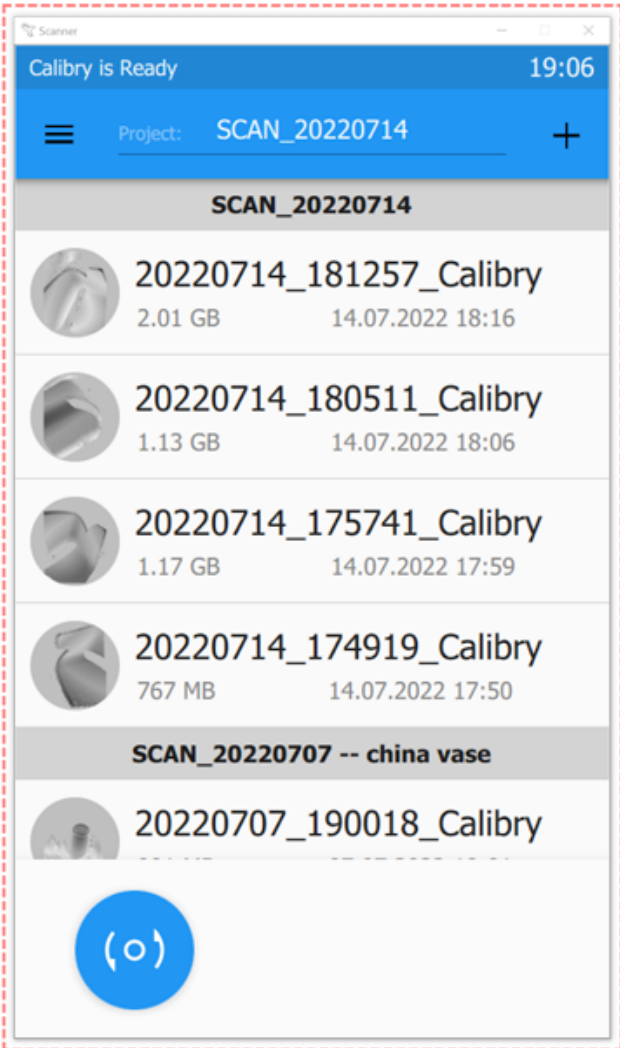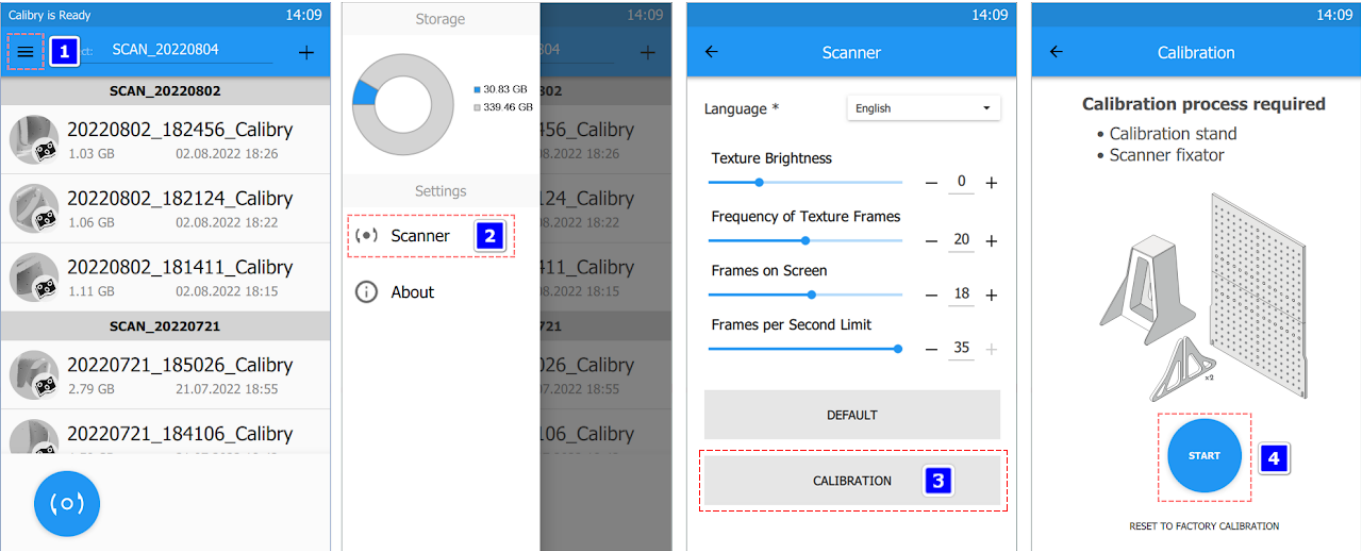
6. Scanner Calibration

General Info

- Scanner calibration is the procedure of measuring its optical parameters, which are factored in the scanning algorithms. The parameters are recorded into special files, which are called calibration files.
- Factory calibration is performed by the manufacturer. It is downloaded automatically during the first connection of a scanner to a computer after Calibry Nest is installed. If this file is missing, the device will not work.
- Manual calibration should be performed by a user. Impacts during transportation, temperature fluctuations and other factors can affect optical properties of the device. It is recommended to calibrate the scanner regularly. When the user calibration file is missing or outdated, the scanner might work incorrectly. If the manual calibration hasn't been performed for more than three days, a warning is displayed.

In order to enter the calibration mode, tap Sidebar Button (three horizontal bars in the upper-left corner of the screen), then tap «Scanner» and choose «Calibration» in the scanner settings. On the next screen tap «Start» to begin the calibration process:

Calibry

Manual Calibration of Calibry

Assemble the scanner stand. Screw the top part to the scanner. Assemble the calibration plane. Place the scanner at the distance of approximately 50cm (20'') from the calibration plane. Make sure you have about 120cm (50'') of space on the floor or on the table to move the scanner into all positions for calibration. In the correct position the scanner should be oriented slightly upward.
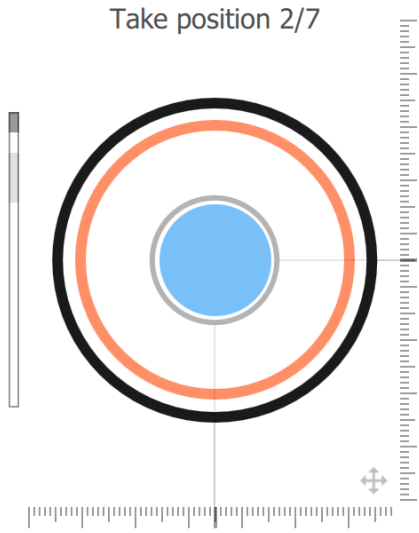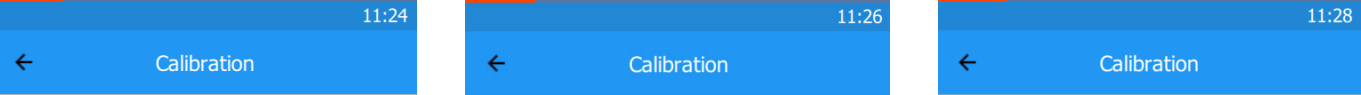
Manual Calibration of Calibry Mini

Place the calibration plane and the scanner on an even surface (like a table or a floor) at a distance of approximately 20cm (8'') from each other.

Calibry

The idea is to align the orange fixed circles with the black ones, the position of which depends on moving the scanner forward-backward, left-right and rotating it.
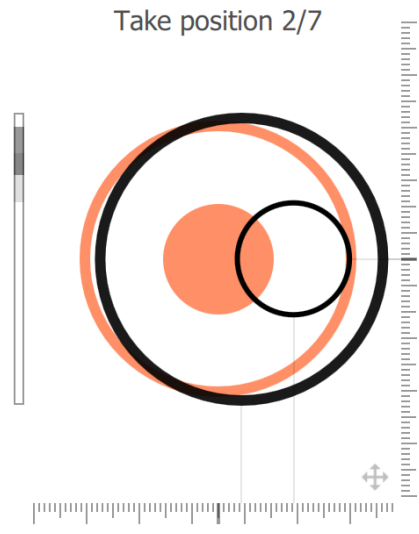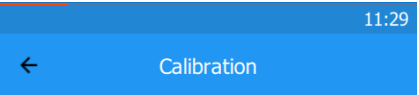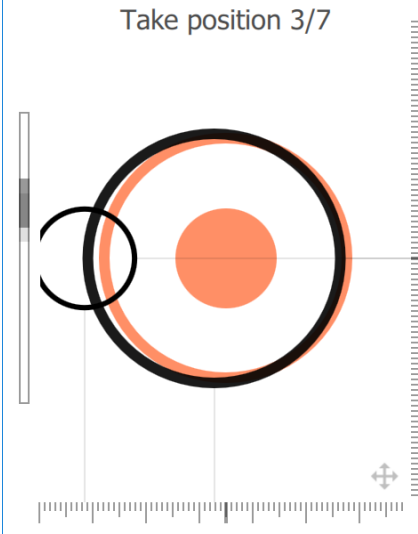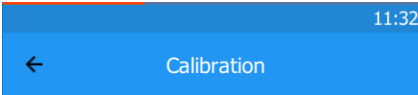

Scanner is moved closer
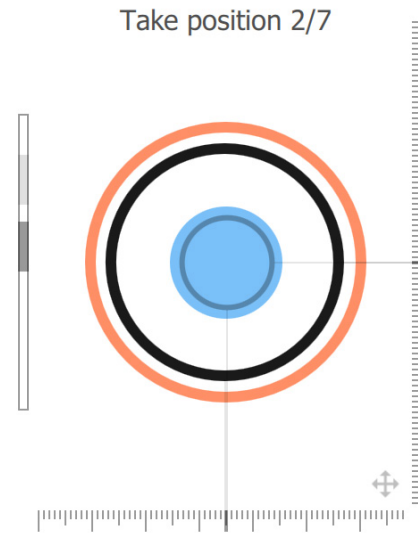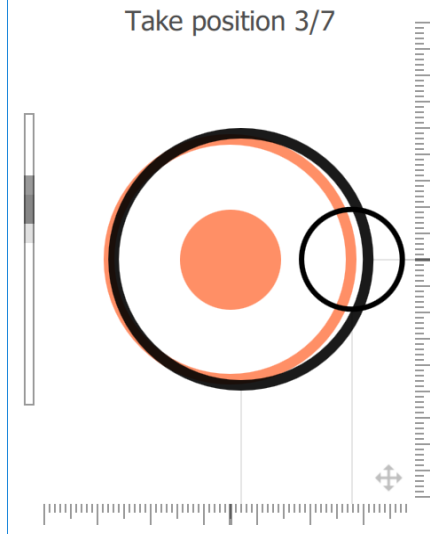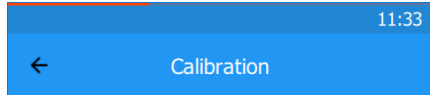

Scanner is moved farther
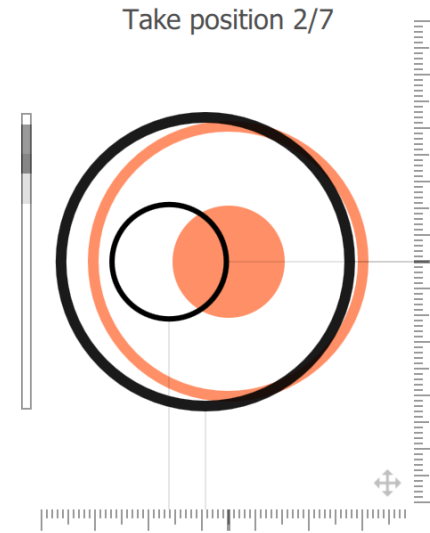
Scanner is moved left

Scanner is moved right

Scanner is rotated left

Scanner is rotated right

- As soon as the right position is found, the scanner will show the «Freeze» message on the screen and the red circles will be replaced by the blue ones. Don't move the scanner for a moment. It usually takes a couple of seconds for a scanner to capture the data. As soon as the position is fixed, the message of transition to the next step will appear on the screen.
- Slowly move the scanner away from the calibration board. You can also align with the indicator in the left part of the screen in order to know how much the scanner needs to be moved. As soon as the software finishes the calibration in the second position, it will move over to the third, fourth and so on. There are seven positions in total.
- As soon as the scanner is calibrated in all seven positions, it should show the «Calibration successful» message and will restart. After that it will be ready for use.
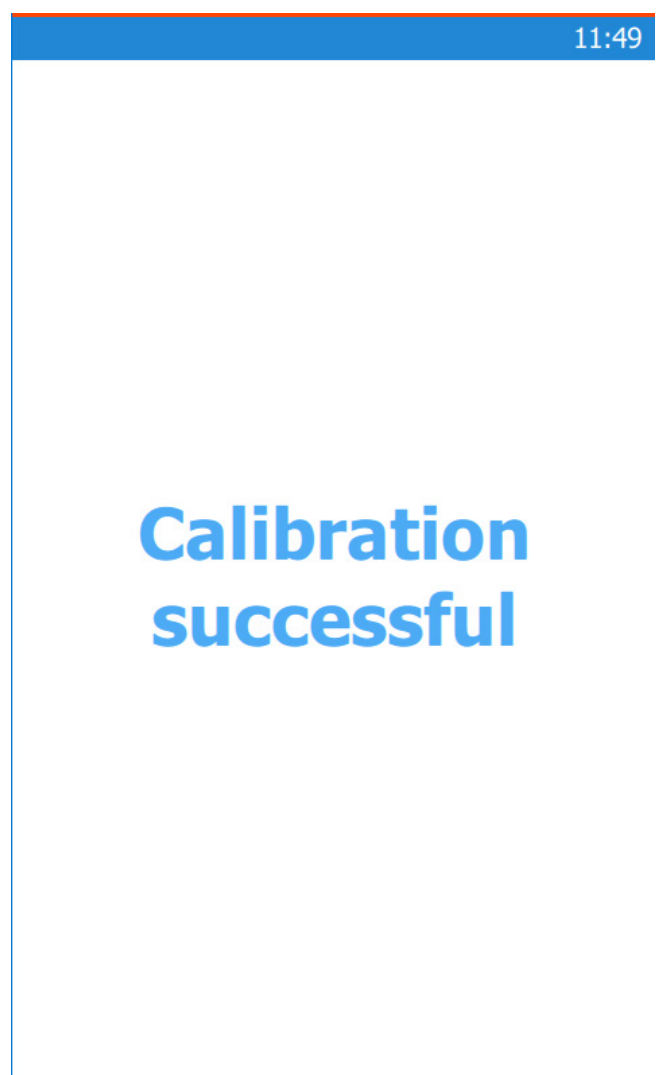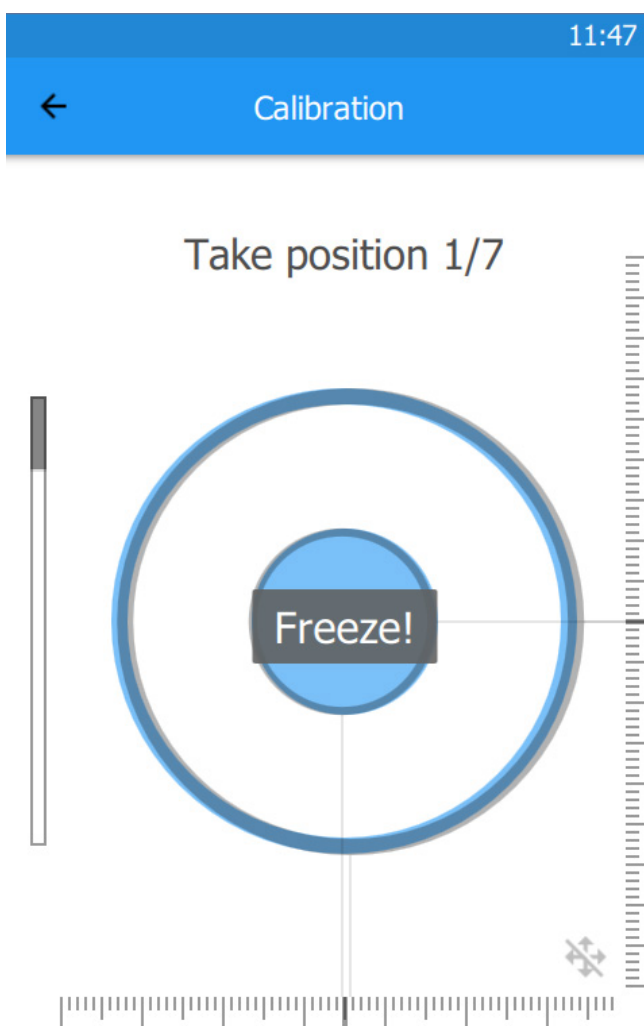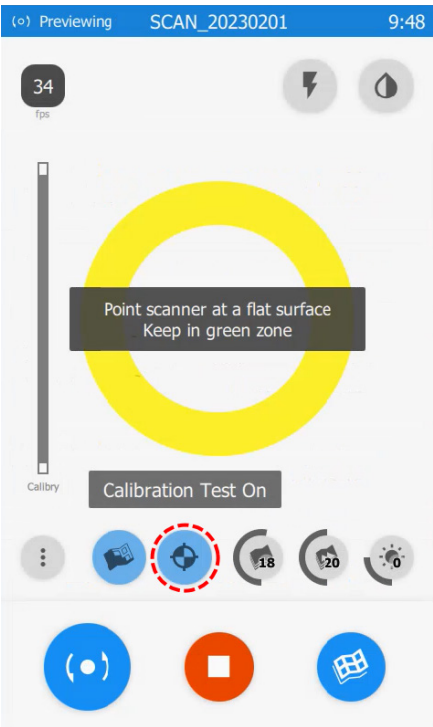
Calibration Test

The Calibration Test is used to check how well the scanner is calibrated.

1. Launch the calibration test from the Preview mode screen.
2. Direct the scanner on a flat, non-shiny surface like a plain wall.
3. Follow the prompts in order to reach the optimal scanning distance and you will get one of the following results:

- Bad
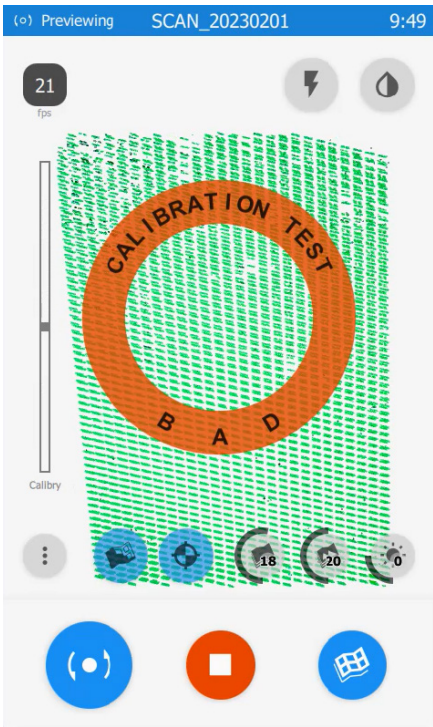- Normal
- Good
- Excellent

Scanning with the calibration quality Bad is not possible. Please Calibrate the scanner again.

Start the calibration test and point the scanner on a flat, matt and light-colored surface
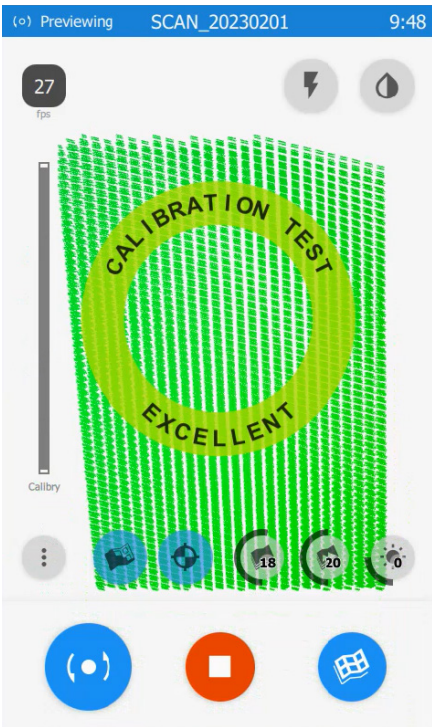
The calibration is excellent! It's time to scan!

The calibration or the test-surface is bad. Calibrate the scanner and repeat the test

7. Scanning

General Scanning Recommendations

- Make sure the scanner is well-calibrated. Ideally, perform the calibration right before scanning. Refer to Chapter 6: Calibration for more details on the calibration process.
- Do not scan in conditions of high illumination. Avoid direct sunlight and bright artificial light. If possible, scan indoors and dim the lights.
- Keep optimal scanning distance between the object and the scanner. If the object is mostly green on the scanner screen — you're doing great. The areas that are too close to the scanner are shown in red. The areas that are too far from the scanner are shown in blue and purple.
- The optimal focal distance (green zone) for Calibry is 75cm (31''), but it is possible to scan in the range from 55cm (23'', red zone) to 95cm (39'', purple zone).
- The optimal focal distance (green zone) for Calibry Mini is 24cm (10''), but it is possible to scan in the range from 18cm (7.5'', red zone) to 32cm (13'', purple zone).
- Try to keep the most important areas in the center of the frame as you're scanning.
- While scanning, constantly and smoothly rotate, tilt and move the scanner to change the light grid position on the object. This will help get more diverse data, capture more details and achieve even density of the point cloud.
- If the surface is difficult to scan, try to scan the area at a 80-90° angle to this surface.
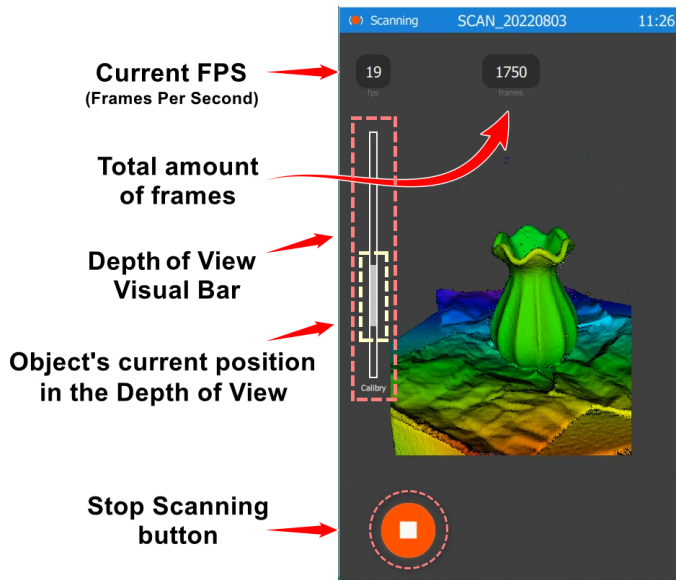
Preview Mode

Preview mode helps find the optimal scanning distance and check or change all the scanning settings. To get there, press «Play» on the handle once or tap Preview mode on the touchscreen:
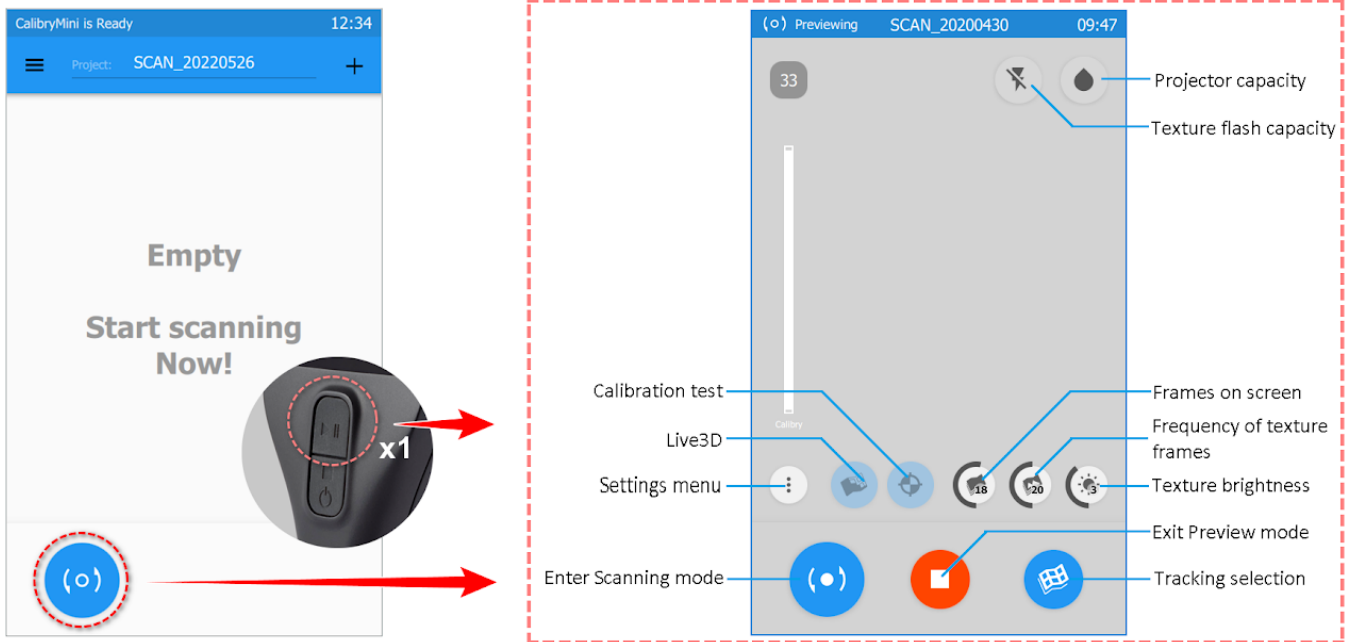
Tracking Modes

First and foremost, you have to choose which tracking mode you are going to use. Scanners capture hundreds and even thousands of separate frames during each scan. These frames then should be stacked together in a consistent way to create a point cloud. Tracking refers to the way it is done and to the information used to achieve that. It is literally how a scanner keeps track of what it looks at and how it moves in respect to the object. Depending on the type of object, its shape, material, size, color and other properties, you may want to use different types of tracking. Calibry scanners support all three of these: geometry tracking, marker tracking and texture tracking. You can toggle between them by tapping the tracking selection button at the bottom right corner of the touchscreen. Let's take a closer look at each one of these tracking modes.

Scanning in Geometry Tracking Mode

Current FPS
(Frames Per Second)

Total amount of frames

Depth of View Visual Bar

Object's current position in the Depth of View

Stop Scanning button

Choose Geometry Tracking Mode if the object has lots of peculiar geometrical features. The mode is recommended for scanning objects of organic or irregular shapes – human bodies or their parts, sculptures, free-flowing surfaces with lots of bends, geometry-rich parts, etc. It is not recommended if the object has regions without strongly pronounced geometrical features (big planes like in case of a table, or round and symmetrical objects like barrels or pots) and also if these features repeat periodically, forming a pattern (lattices, grids, molds with repeating elements and so on).

Still, there are ways of scanning even symmetrical and featureless objects in Geometry Tracking Mode by adding crumpled paper or crumpled fabric around the object. This additional geometry has to be at least partially visible in the frame while you are scanning and it should not be moved in the process. Also, elevating an object over the level of additional geometry helps to separate them easily during post-processing.

Symmetrical objects might be difficult to scan in geometry mode, because the object looks the same from all sides.

Putting crumpled paper around the object adds random geometry making scanning easier.

Putting an object on a little stand makes it easier to separate needless data from the object during post-processing.

Calibry

Scanning in Marker Tracking Mode

Choose Marker Tracking Mode if the object doesn't have peculiar features for tracking. This mode works well with long flat surfaces that have little or no prominent features or with the objects that have repetitive and symmetrical structure. The example might be a car hood or car roof, which might have some curvature and shape, but not nearly enough for consistent geometry tracking. Parts of building structures are also good examples: window frames, doorways, corners, staircases, etc. Plain furniture might be yet another example: wardrobes, bedside tables, drawers, etc.

To scan in Marker Tracking Mode you will need to apply markers to the surface. In many cases, putting some markers around the object is also a good idea. A separate scenario is scanning small objects that fit in the frame entirely. In this case markers can be placed around the object.
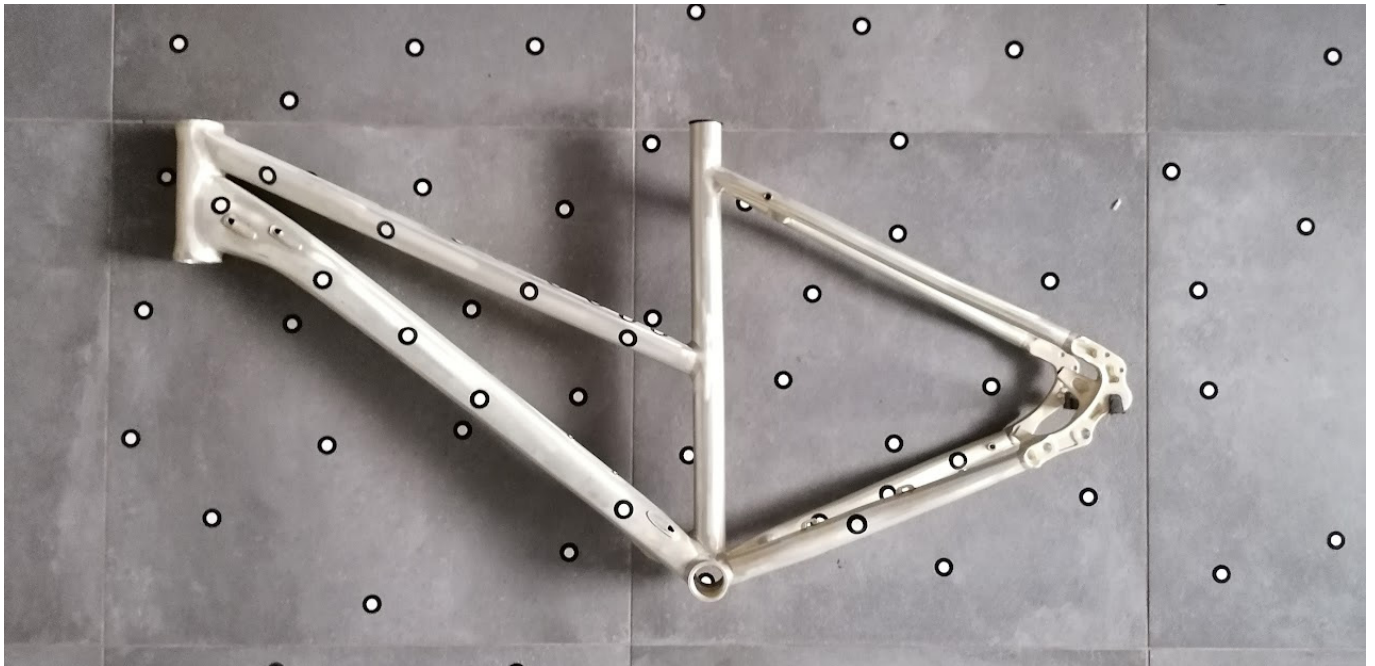
Makers are just white circles with thick black rim around them for better contrast. They are supplied with the scanner. Calibry comes with a pack of magnetic markers for metal surfaces and a sheet of sticker markers for any other surface. Calibry Mini comes with a pack of cut-out markers that can be placed around the object and a sheet of sticker markers that can be applied to the object itself. Neither Calibry nor Calibry Mini require retroreflective coating of the markers, therefore you can easily print more if needed. Markers can be printed out on ordinary or sticky paper using an office printer. The only limitation here is that the paper should not be glossy. If you're going to require more magnetic markers — please contact your Calibry reseller or reach out for Thor3D support.

Scan rate (fps) — 25   11   204 — Number of frames shot

Number of markers in the frame
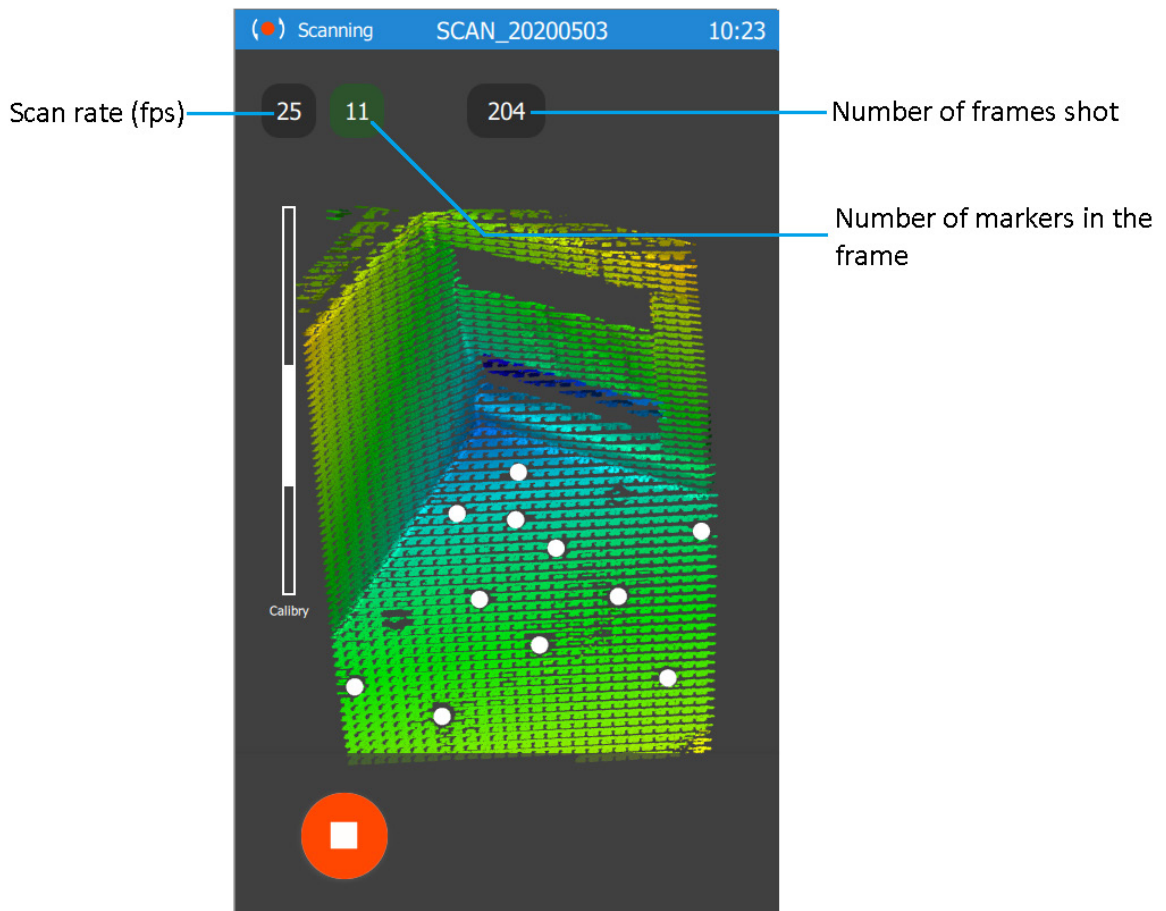
During scanning in Marker Tracking Mode at least three markers should be visible at all times, but the general recommendation is five and more. You can monitor the number of detected markers using the colored indicator on the screen (near FPS counter):

- 4 and less – critical (red indicator)
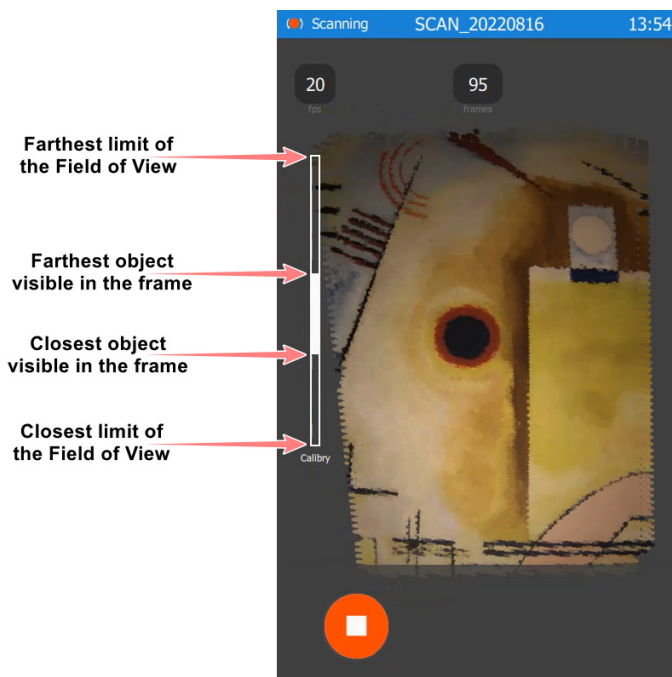- 5 – warning (yellow indicator)
- more than 5 – ok (green indicator)

When the number of markers in the frame is insufficient (less than 3), scanning will automatically stop and the scanner will return to preview mode. Adding some more markers to the area should help preventing loss of tracking.

Calibry

Scanning in Texture Tracking Mode

Scanning in Texture Tracking Mode can be useful if the object has a contrast and non-repetitive image. It is especially helpful when the object has little geometry (or if this geometry is repeating) and neither markers nor additional geometry can be used to facilitate scanning in geometry or marker tracking modes. The classic example of such an object is a decorative vase or a painting: if it is a museum exhibit, chances are you will not be allowed to use markers or put anything around it. Texture tracking might be a solution in this case.

When Texture tracking mode is selected, a scanner switches to the texture camera and shows the object in color. Preview mode gives you an idea of how good the brightness of the image is. It should be clearly visible, but not overexposed. Use Texture Brightness slider to pick optimal value (explained below).

Farthest limit of the Field of View

Farthest object visible in the frame

Closest object visible in the frame

Closest limit of the Field of View

When scanning in texture tracking mode without Live3D, a textured image is displayed on the scanner screen.

To keep the optimal distance use the scale on the left: it represents the entire field of view. The solid white bar in it represents the object in the frame — its closest area is the lowest part of the white bar, and the farthest area is the highest part of the white bar.

When scanning in texture tracking mode with Live3D, a textured image with distance overlay is displayed on the scanner screen. Try keeping the object mostly in the green zone to achieve the best results.
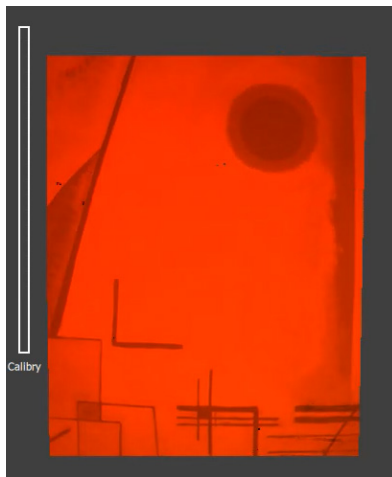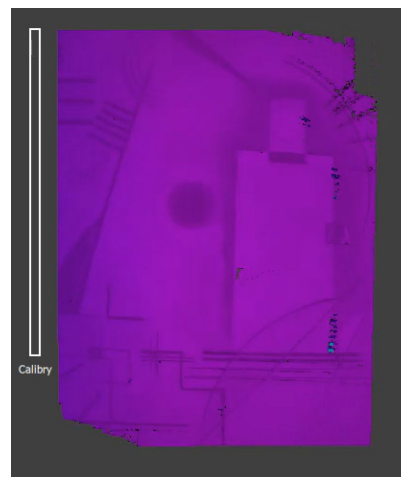

Too close
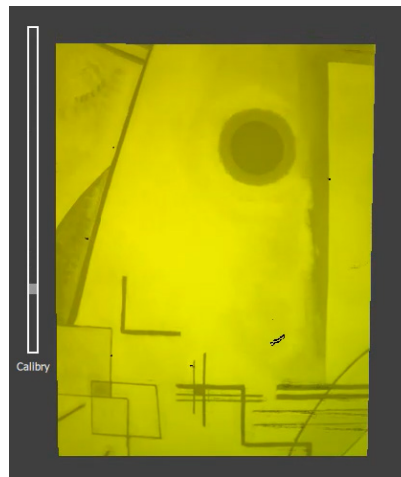
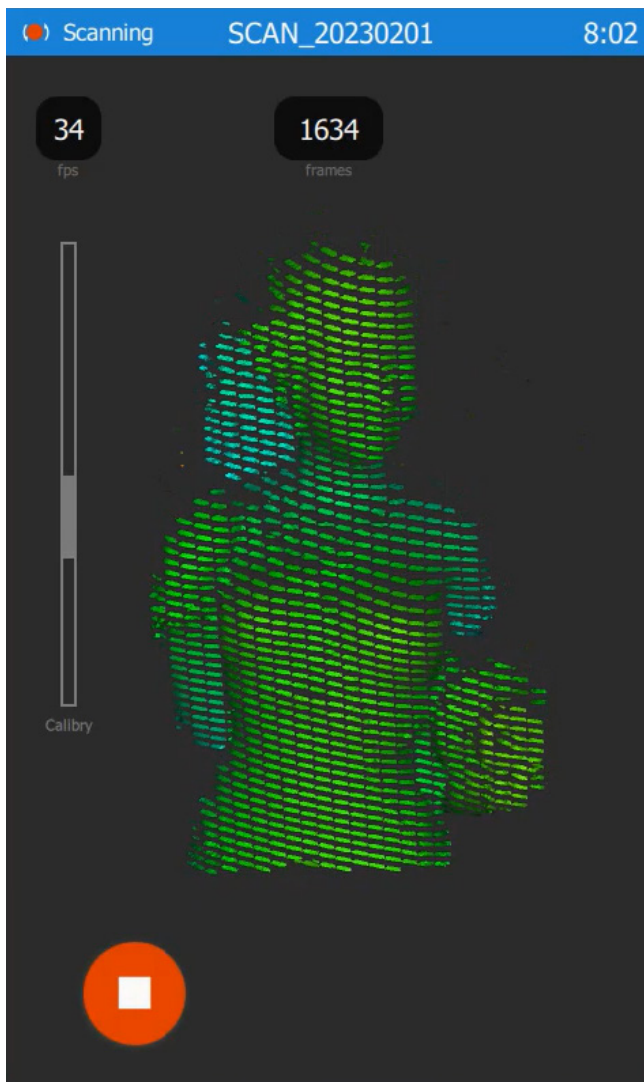
Close
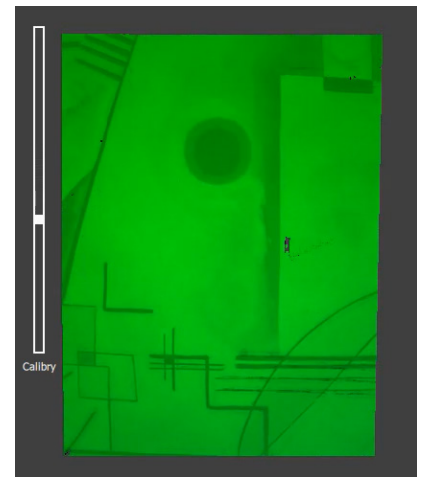
Normal distance

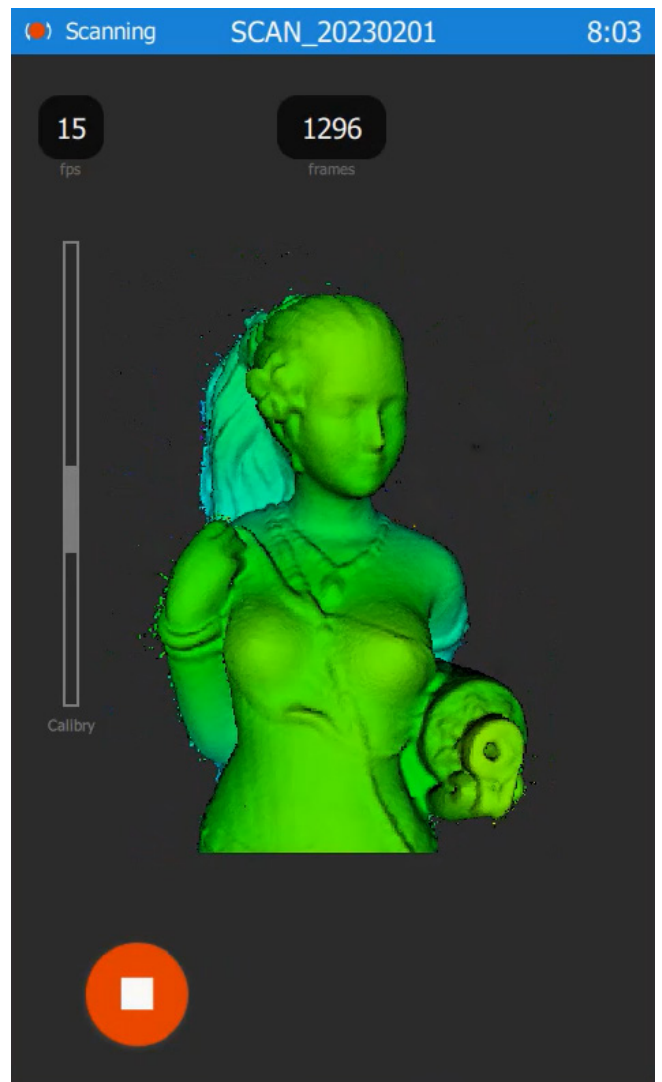Far

Too far

Calibry

Live3D Mode

While scanning without Live3D, only the current frames captured by the scanner are displayed on the screen. With Live3D on, scanner creates a temporary preliminary model of the object that helps better control the scanning process and clearly see which parts of the model require additional attention.

Live 3D Mode is switched off

Live 3D Mode is switched on

Slider Settings

There are four types of settings that can be changed using sliders:

- Texture Brightness   (0 by default)
- Frequency of Texture Frames   (20 by default)
- Frames on Screen   (18 by default)
- Frames per Second Limit   (35 by default)

These four sliders can be accessed in one of these three ways:
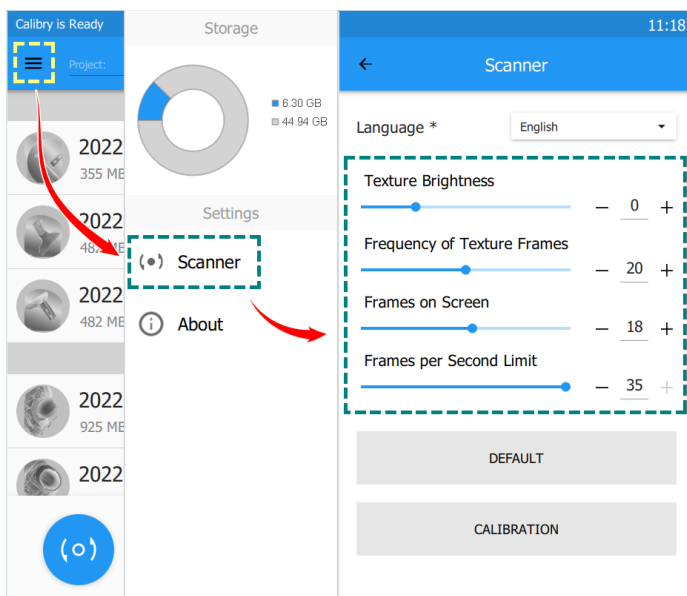
Option 1: Side Menu —> Scanner
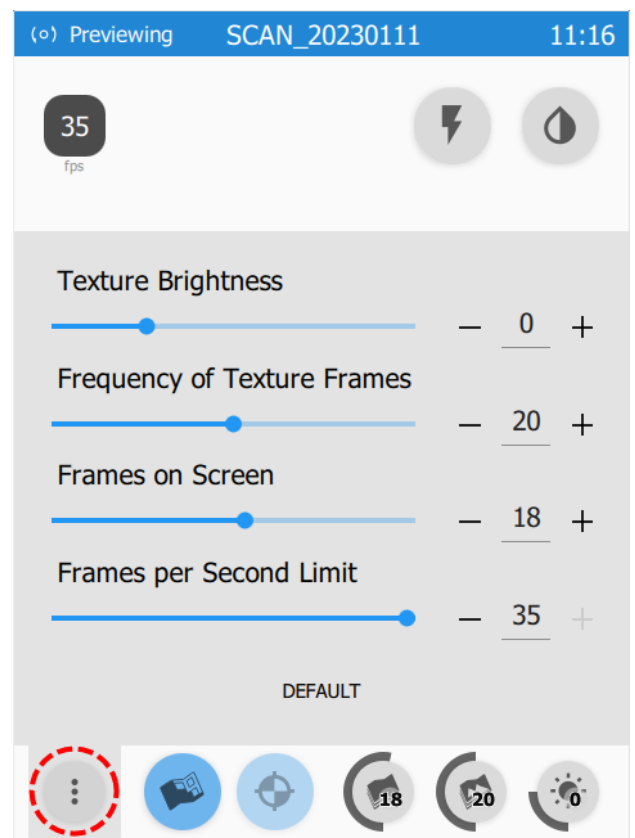

Option 2: Preview Mode —> Side Menu (three vertical dots icon)
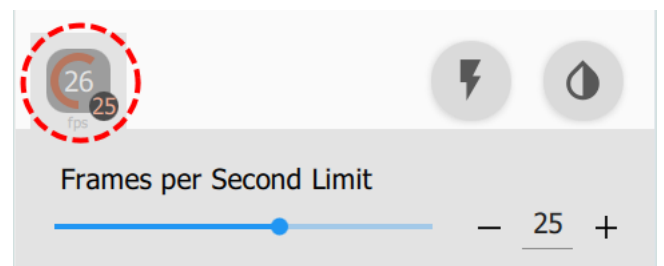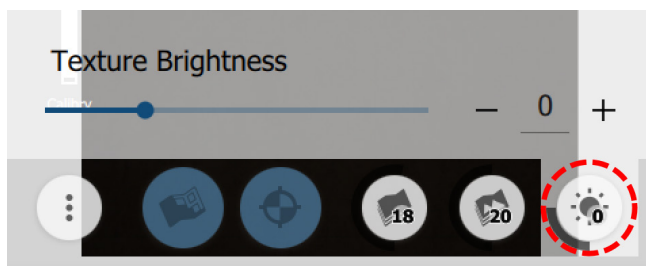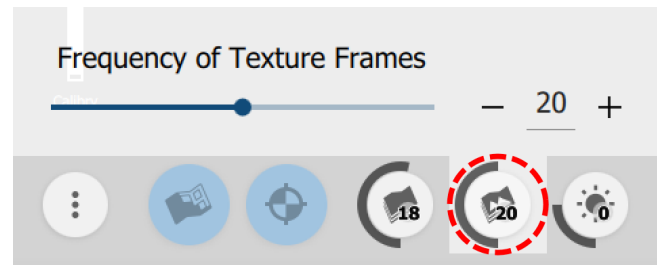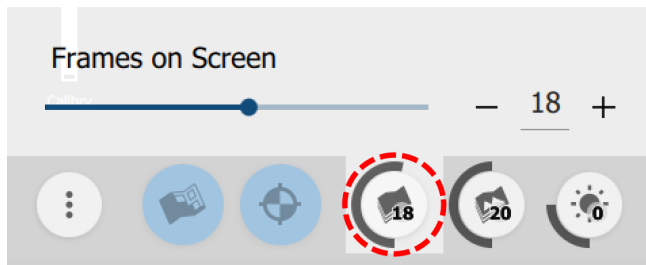
Option 3: Dedicated Preview Mode buttons with circular indicators

The Default button resets all four sliders to their default settings.

Following sections are describing these settings in more detail.

Frames on Screen

When scanning without Live3D, scanner just shows several last frames on the screen. By default, the last 18 frames are shown, but this value can be changed from 2 to 32 using Frames on Screen slider. This value does not affect the scanning and data acquisition, but rather changes the way scanned data is shown on the scanner screen.
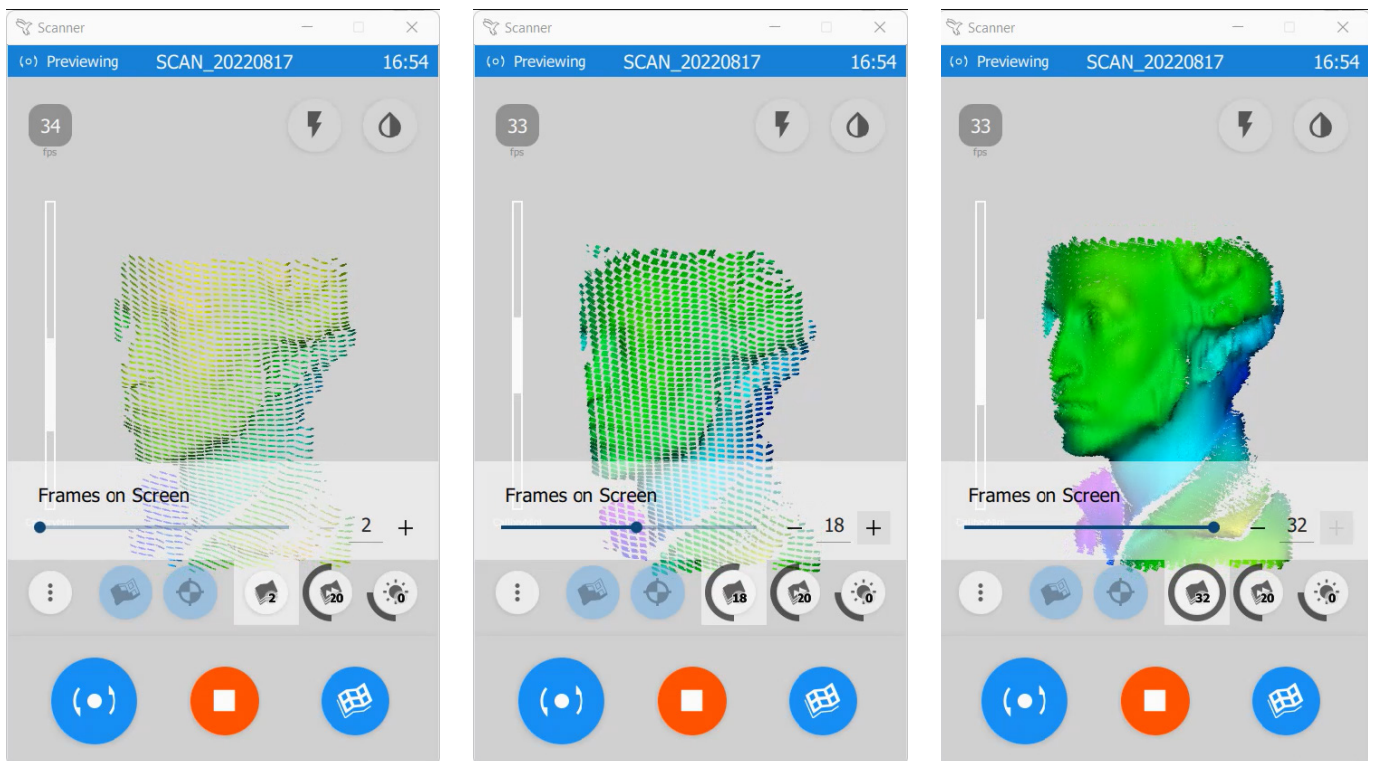
Frequency of Texture Frames

Frequency of Texture Frames is a slider that sets how often texture frames will be captured and saved. These texture frames can then be used for texturizing the model. This value sets the amount of geometry frames taken between every texture frame. So the bigger this value is, the smaller the amount of texture frames a scan will contain. For example, if the value is 20 and a scan contains 1000 frames, it means that every 20th frame will contain color-data and there will be 50 texture frames in total. If the value is 10 than the same 1000-frame scan will contain twice as many texture frames (100) because they will be captured and saved twice as often (every 10th frame).

The default value is 20, but you can pick any value from zero to 40 frames. However, in most cases there is no need to change this value.

The most common reason to change it, is setting it to zero when texture is not needed (when you're not planning to texturize the result).

It is important to note that this value is neither affected by nor affecting the type of tracking used. Any type of tracking can be used with any value of this slider. In Marker and Texture Tracking Modes a scanner is going to make a texture frame for every geometry frame anyway, but these frames are used only for tracking purposes and are discarded shortly after if they are not needed. So, if, for example, the value is 20 and Marker or Texture Tracking Modes are used, the scanner will make a texture frame for every geometry frame, but 19 out of every 20 texture frames will be discarded after tracking data has been extracted from them, and only one frame out of 20 will be saved for further texturing. In Geometry Tracking Mode, a scanner does not use texture camera for tracking purposes, so it just makes a texture frame for each 20th geometry frame.

Access to this setting is shown above, in «Slider Settings» section.

Texture Brightness

If you are planning to texturize a model or when Texture Tracking Mode is used, it is important that a scanner can clearly detect the color pattern on a scanned surface. If texture frames are too dark or, on the contrary, overexposed it could lead to bad texturing quality and texture tracking failures. To address that, it is possible to adjust texture brightness to current lighting conditions before scanning. To do that, tap Texture Brightness button in the Preview Mode to open the corresponding slider. The scanner will switch to texture camera view and you'll see what the scanner is seeing. If the object looks too dark on the screen, it means that Texture Brightness should be increased. If you see big areas painted in red, it means you have to decrease texture brightness. Ideally, you should see an evenly lit surface: not too dark, not too overexposed.
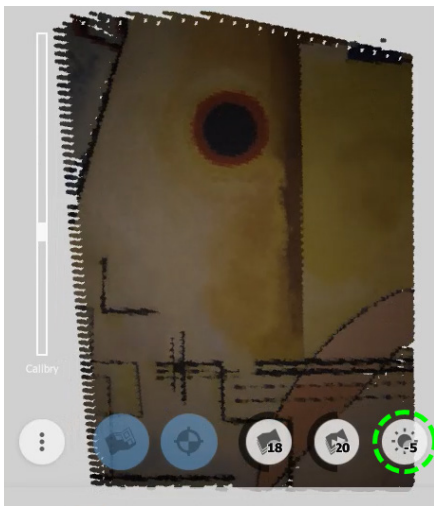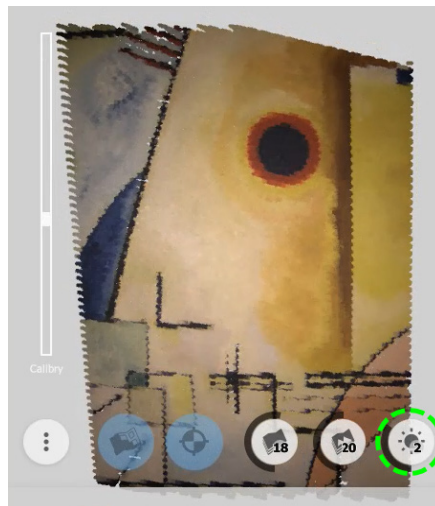
| Image is too dark | Adequate brightness | Image is overexposed |
| (texture brightness = -5) | (texture brightness = 2) | (texture brightness = 5) |

Red areas on the surface may also indicate the presence of glares. It may happen, for example, if the surface is too shiny. Changing the angle of scanning might also help to reduce glares. If not — decrease the texture brightness level until red areas disappear.

Frames per Second Limit

The amount of frames the scanner captures each second is called FPS (Frames per Second). This value depends on the performance of the PC/laptop the scanner is connected to. In most cases, the bigger this value — the better. But in some cases it may be useful to reduce it. Frames per Second Limit slider allows to reduce the scanning speed if needed. Access to this setting is shown above, in «Slider Settings» section.

Projector Capacity

The main idea behind 3D scanning is that a certain type of light grid is projected on the object and then get captured by the camera. Distortions of that grid form a 3D frame. But for this system to work reliably, the grid should be clearly visible on the object. That is why it might be difficult to scan darker things (light grid is getting absorbed by the object) and to scan in high-illumination conditions (bright ambient light makes it more difficult for the camera to detect the grid on the object). At the same time, if the grid is too bright and thick, it may cause additional noise to appear on the 3D frame, thus decreasing the quality of the result.

To alleviate this problem, Calibry scanners allow users to change the projector power thus changing the brightness of the grid projected on the object. There are three available modes which a user can pick depending on the scanning conditions:

Color Light (white droplet): this is a low-brightness state in which the light grid is thin and dim. It works best with white and other light objects and when scanning is performed in dark conditions (evening and night hours, dimmed lights, basements, caves, etc). Usually, it is only used if higher grid brightness levels make scans too noisy.

Color Normal (black and white droplet): this is a medium-brightness state and it is activated by default. It works well in most real-life scenarios and, as a rule, it is only changed if issues arise. The most common reason to change it is to scan dark objects and/or in high-illumination conditions — in this cases it is recommended to switch to Color Dark state (black droplet).

Color Dark (black droplet): this is a high-brightness state in which the projector produces bright and thick light grid, suitable for scanning dark objects and/or scanning in highly illuminated areas. It also can be used if two previous states do not provide good enough results.

Texture Flash Capacity

Set the Texture flash capacity to maximum (black lightning), medium (black and white lightning) or switched off (crossed out lightning). This value is set to maximum by default and rarely changed. It is better to start with texture brightness slider first. If the desired level of brightness is difficult to achieve, then changing this setting may help. This setting is only active in the Geometry Tracking Mode, since Marker Tracking Mode and Texture Tracking Mode are both using the texture camera for tracking purposes and Flash capacity is always set to maximum.

# 8. Post-Processing a Scan

Opening a Scan

After scanning is finished, all captured frames are saved in a file with an .ascan extension. These files are saved on a PC/laptop a scanner is connected to. These files can then be processed either on the same computer, or can be transferred to any other computer to be processed in Calibry Nest.

There are several ways of opening a scan in Calibry Nest:
1. By using Open button on the Main Toolbar
2. By choosing Open in a File Menu
3. By dragging a scan from a folder and dropping it into the Calibry Nest window
4. By double-clicking on a scan file in its location folder
5. By double-clicking on a scan in the list of scans on the Scanner Panel
6. By selecting a scan from the list on the Scanner Panel and clicking the Open button
7. By using Ctrl+O hotkey shortcut and picking a scan for processing
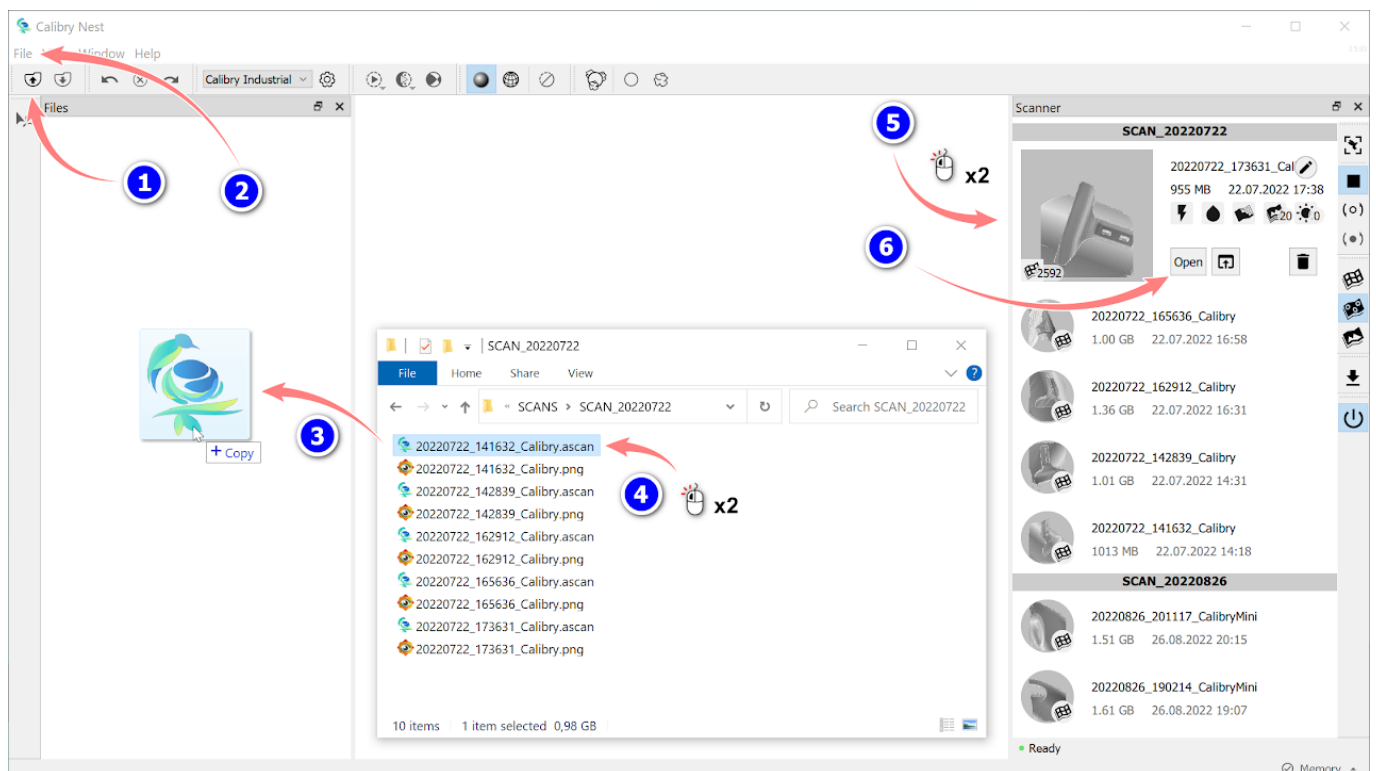
When a particular scan is opened, its name appears on the left-side panel (Files Panel) and so-called preview is shown. It is not a complete data set, but just 100 frames taken evenly throughout the scan to show its general structure. This preview is a lightweight representation of the entire point cloud. To see all the points of the scan — click frames. You can also expand the frames list and take a look at any single frame or select a group of frames. Every frame contains a small portion of the entire point cloud. Frames marked with a pink square also contain texture data.
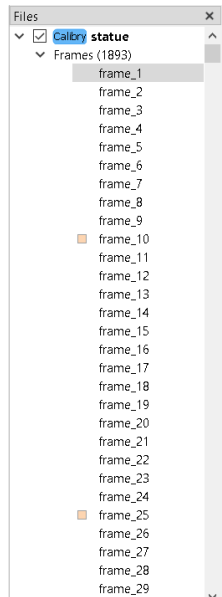
a single frame
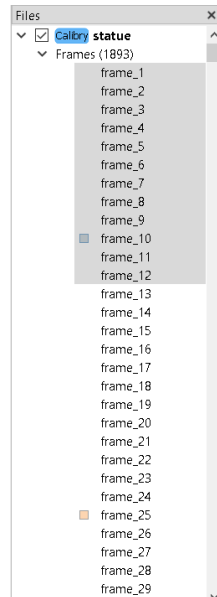
several frames
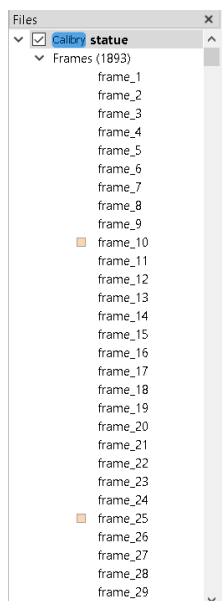
preview (100 frames)
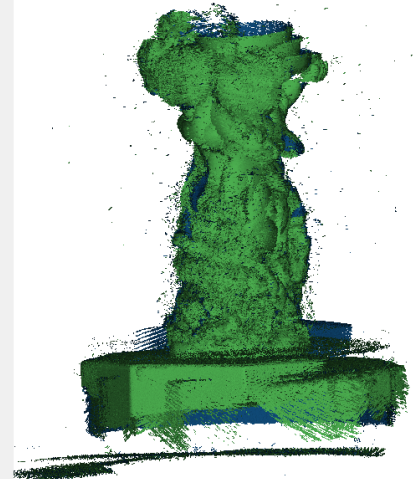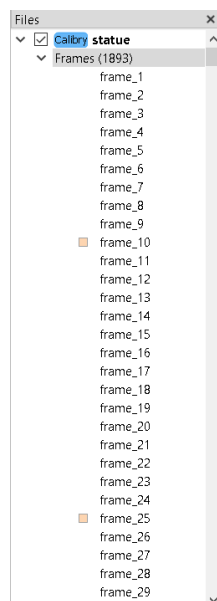
full point cloud

Navigation in Editing Area

- Moving: press and hold both right and left mouse buttons to move the model
- Rotation: press and hold left mouse button to rotate the model around the selected point
- Zoom in/out: scroll mouse wheel back and forth
- Sharp zoom in/out: press right mouse button and move mouse pointer up or down
- Changing the size of points: hold Alt and scroll mouse wheel (convenient when viewing a single frame)
- Fit to view: press middle mouse key (or a mouse wheel)

Presets

To turn a raw scan into a polygonal model, Registration and Finalization must be run. Presets are predefined sets of recommended parameters for these processes. You can pick an appropriate preset from the list depending on the type of object and the scanner used. These settings can be changed if need be and saved for further use if necessary.

These presets are particularly useful for new users as they provide safe and robust settings which will work well in most cases.

You can reach these presets either from Main Toolbar or by going to Nest Settings.
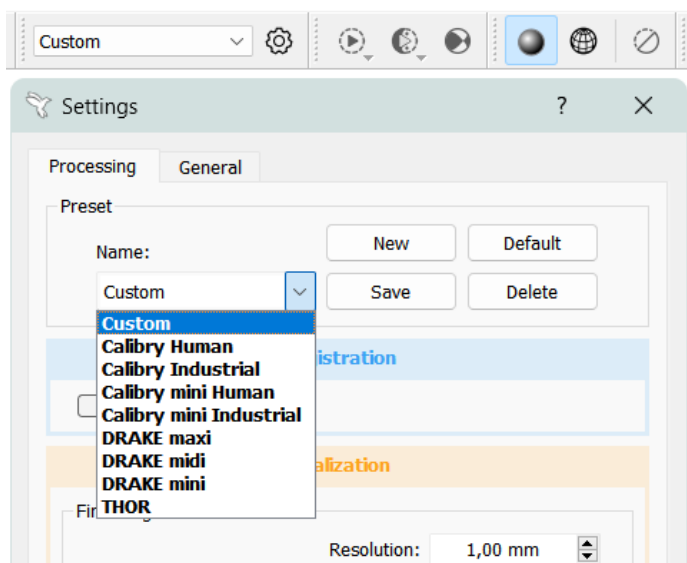
Registration

When unprocessed scans are opened in Nest, the data may look noisy and layered. It is totally normal, especially if the scan was made without activating the Live3D mode. Registration analyses the frames and tries to fit them together in the best possible way. Think of it as assembling a jigsaw puzzle.

Registration can be started in one of the following ways:
- Long-press Start Non-Textured button and select Registration from the drop-down menu
- Right-click Start Non-Textured button and select Registration from the drop-down menu
- Press Ctrl+1 hotkey shortcut (hotkey can be changed in Settings if needed)
- Go to Files —> Start —> Stages —> Registration
- Press Registration button on Process stages panel (This panel is hidden by default. Right Click Main Toolbar and pick Process Stages to see it.)
- Press Start Non-Textured button to run registration and finalization in sequence
- Press F5 to run registration and finalization in sequence
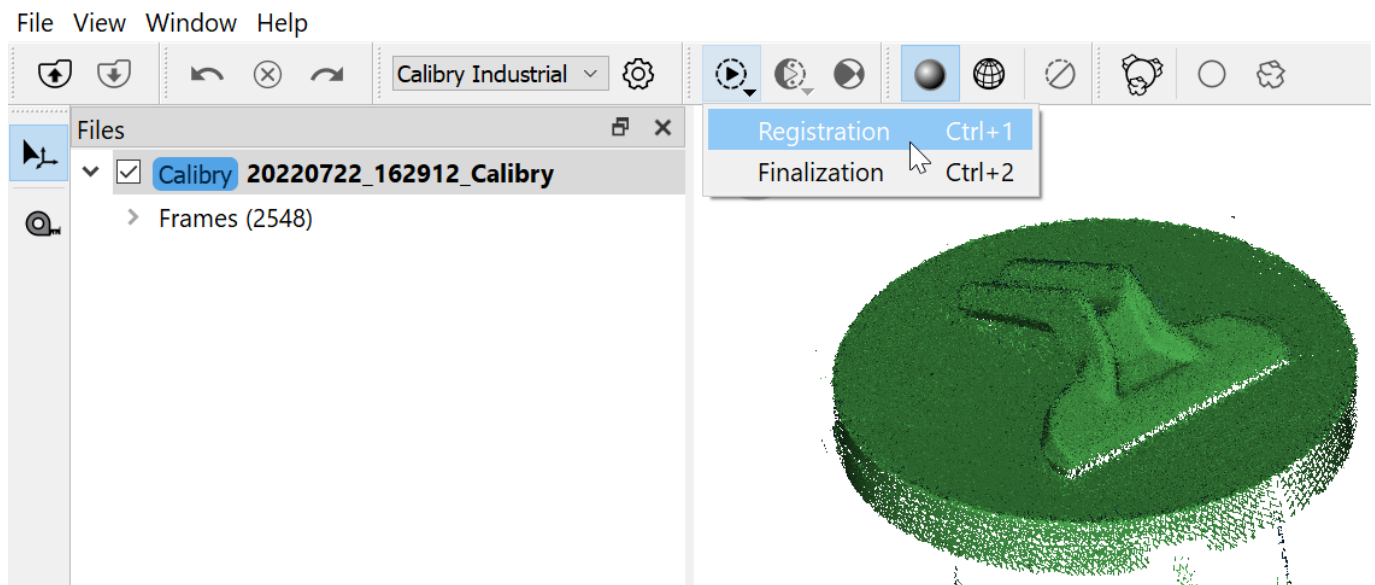
The result of registration is a new point cloud, the shape of which is much closer to the shape of a scanned object. In some cases the difference before and after registration may be barely visible, in some other cases it may be substantial and obvious. Generally speaking, both scans in the example below should look the same after registration, but the scan without Live3D usually takes longer to be processed.
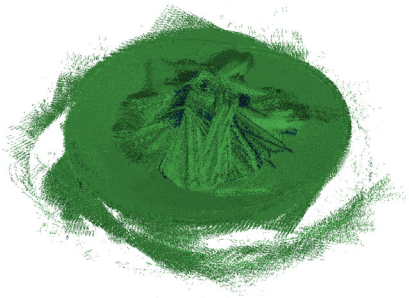
A scan made without Live3D before registration
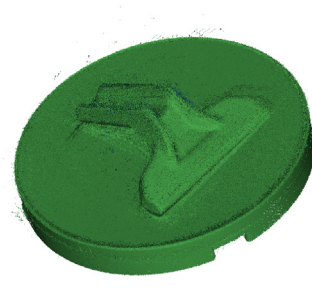
A scan made with Live3D before registration
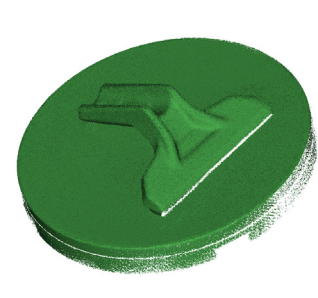
Scans after registration and cleaning

Preliminary Cleaning

Unprocessed scans may contain certain amount of noise picked up during scanning. This noise may appear due to glares, reflections or poor calibration. In most cases it is recommended to clean scans during registration. It is done by default, but cleaning may be deactivated in Settings if desired — just uncheck Preliminary cleaning before starting registration. It may be useful when scanning hair, because it creates a lot of noise and filtering may delete substantial part of useful data. Deactivating Preliminary cleaning may also be helpful when the object has deep indentations or if the surface is generally difficult to scan — it will preserve more points, but the result may end up having a rough surface.
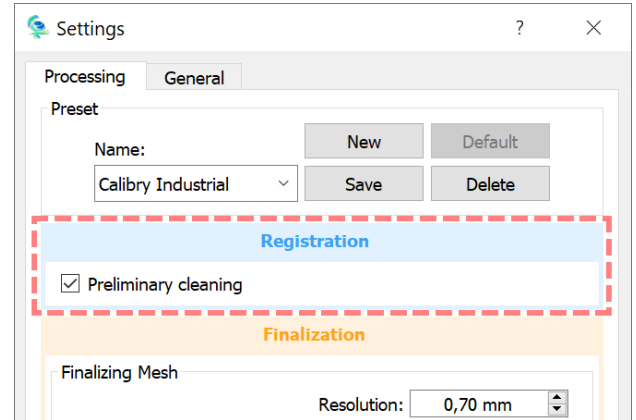
This example shows how outlines of the object become clearer after filtering, but poorly scanned or hard-to-reach areas may lose parts of their data. In this case it is especially prominent on the rim of the table, but this area is not the focus of the scan and it will be marked as irrelevant data anyway.
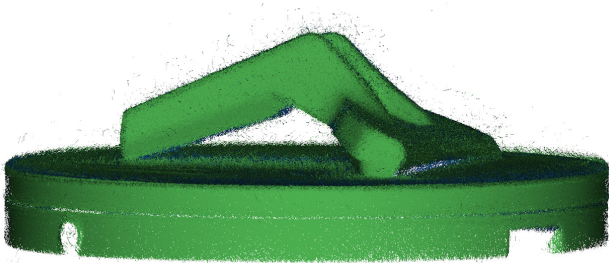
Preliminary cleaning OFF
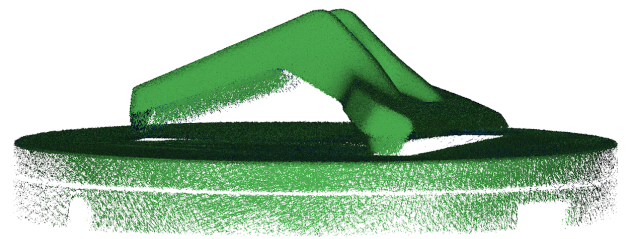
Preliminary cleaning ON

Priority Mode

Most scans contain areas that are not intended to be scanned, like floors, tables or additional geometry. Priority Mode is a simple way to mark such areas as irrelevant to avoid finalizing them, thus saving post-prosessing time and making further multi-scan processing easier. Of course, needless data can just be deleted from the point cloud, but it is better to keep it intact to preserve internal consistency and cohesiveness of a scan. This is especially important when a final model is assembled from several separate scans.

To activate Priority Mode, click the corresponding button on Main Toolbar. The entire data set will change color from green to golden. It means that all points are considered important by default.
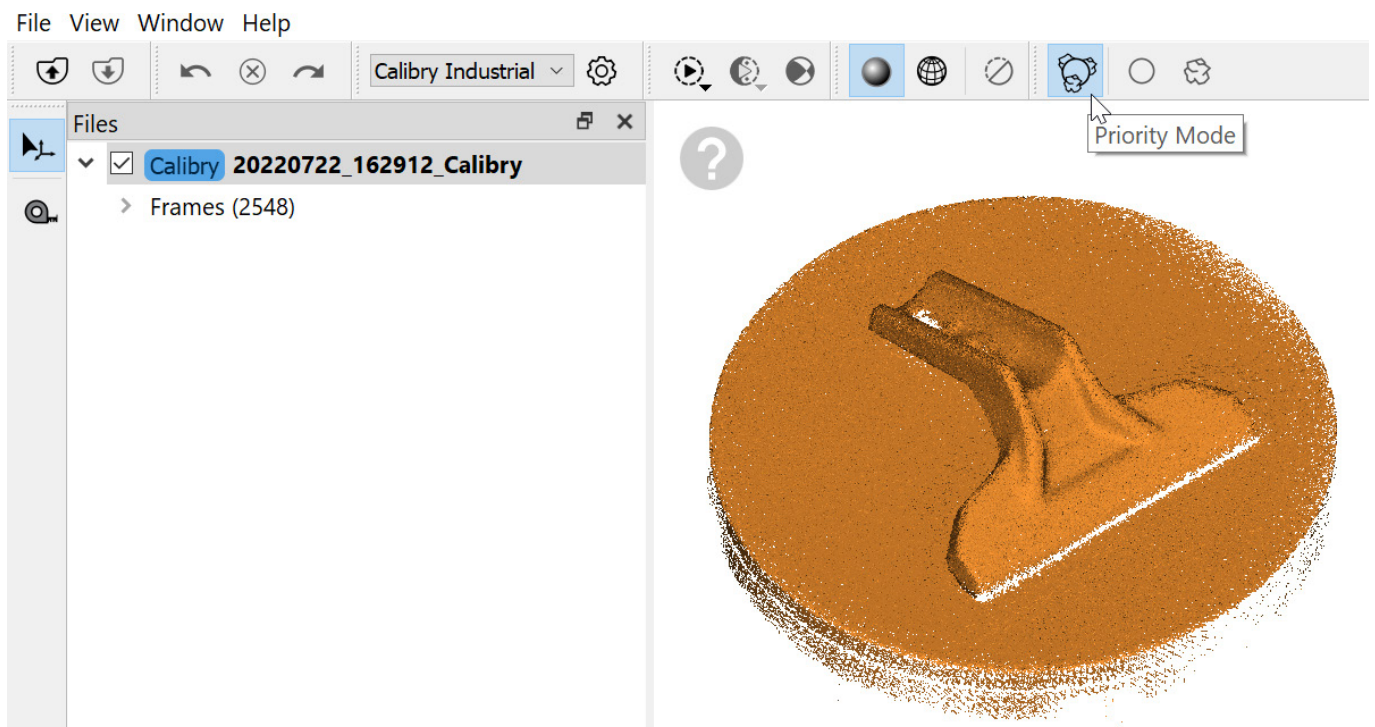
After that, either needless areas can be selected and marked as Support Geometry, or the areas of interest can be selected and marked as an Object. As a result, needless areas will change color to semi-transparent green, whereas useful data will remain golden. On the finalization step only golden data will be finalized. Priority selection can, of course, be edited at any moment or Priority Mode can just be deactivated. In this case all data will be finalized.

To select a certain area, click on Frames to switch from preview to entire point cloud and then use selection tools from Side Toolbar to highlight a certain region. Highlighted area then can be marked either as Object or as Support Geometry with the use of corresponding buttons on the Main Toolbar:

Follow these steps to select and mark an area as the Object:
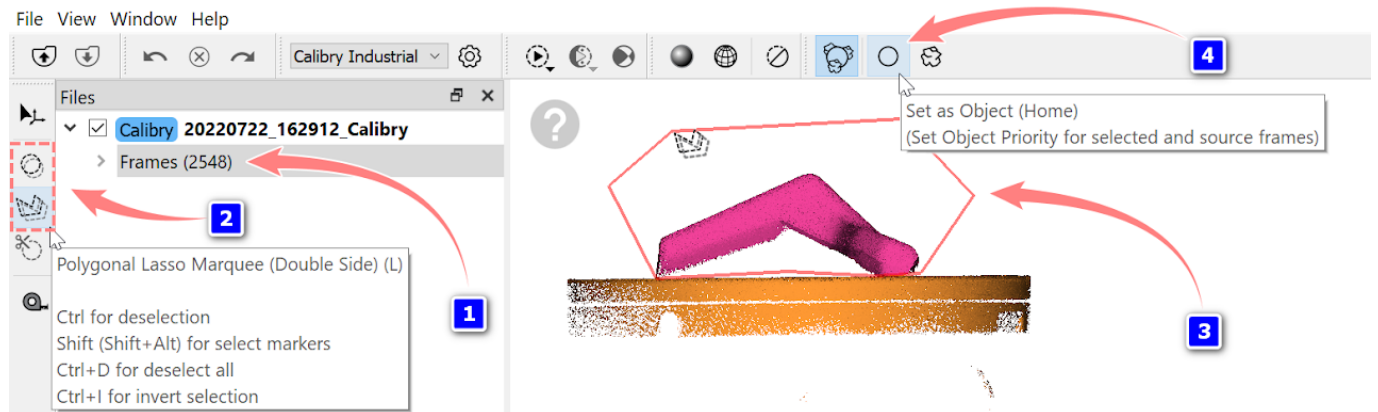
Follow these steps to select and mark an area as Support Geometry:
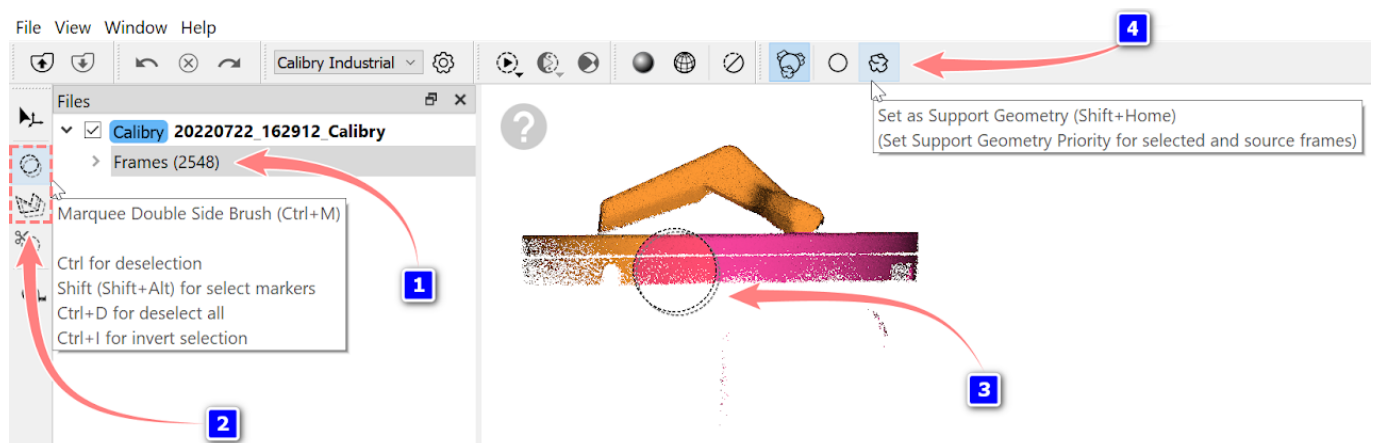
The final result of Priority Mode mark-up should look like this (with object of interest being golden and all the rest being semi-transparent green):
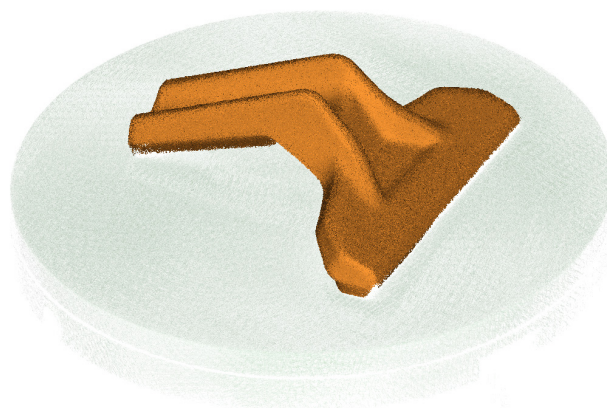
This example shows Priority Mode selection on a point cloud, but it is also possible to mark priority regions on a finalized result.

Finalization

Finalization creates a polygonal mesh based on a point cloud and finalization parameters.

Before starting finalization, it is usually a good idea to check its settings. They include:

- Resolution
- Hole filling
- Sharpness
- Marker removal
- Filtering by size
- Simplification

These settings are covered in more details below.
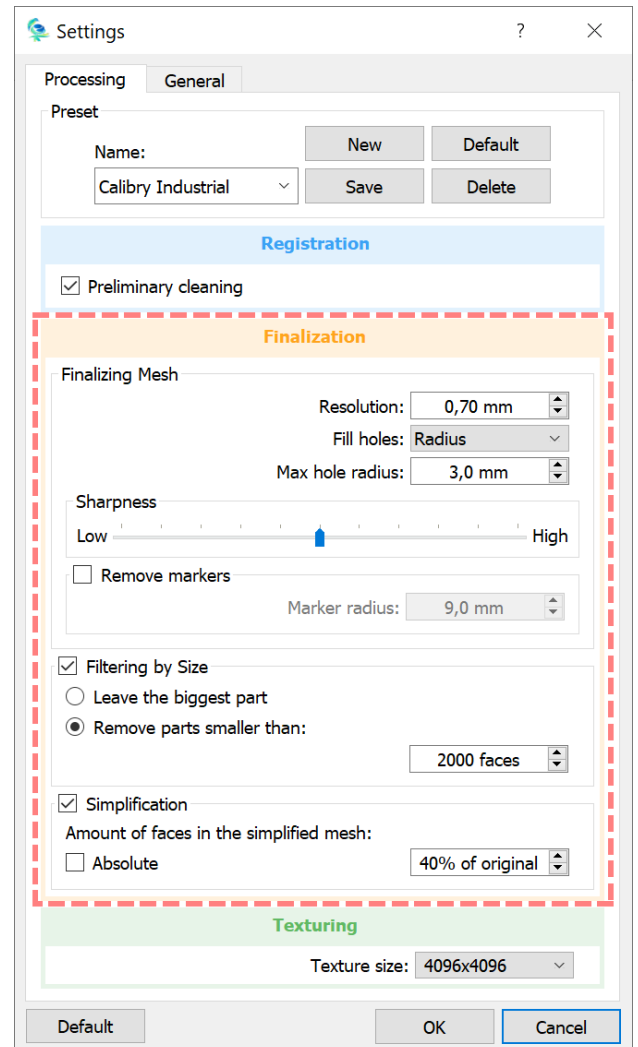
Finalization can be started in one of the following ways:

- Long-press Start Non-Textured button and select Finalization from the drop-down menu
- Right-click Start Non-Textured button and select Finalization from the drop-down menu
- Press Ctrl+2 hotkey shortcut (hotkey can be changed in Settings if needed)
- Go to Files —> Start —> Stages —> Finalization
- Press Finalization button on Process stages panel (This panel is hidden by default. Right Click Main Toolbar and pick Process Stages to see it.)
- Press Start Non-Textured button to run registration and finalization in sequence
- Press F5 to run registration and finalization in sequence
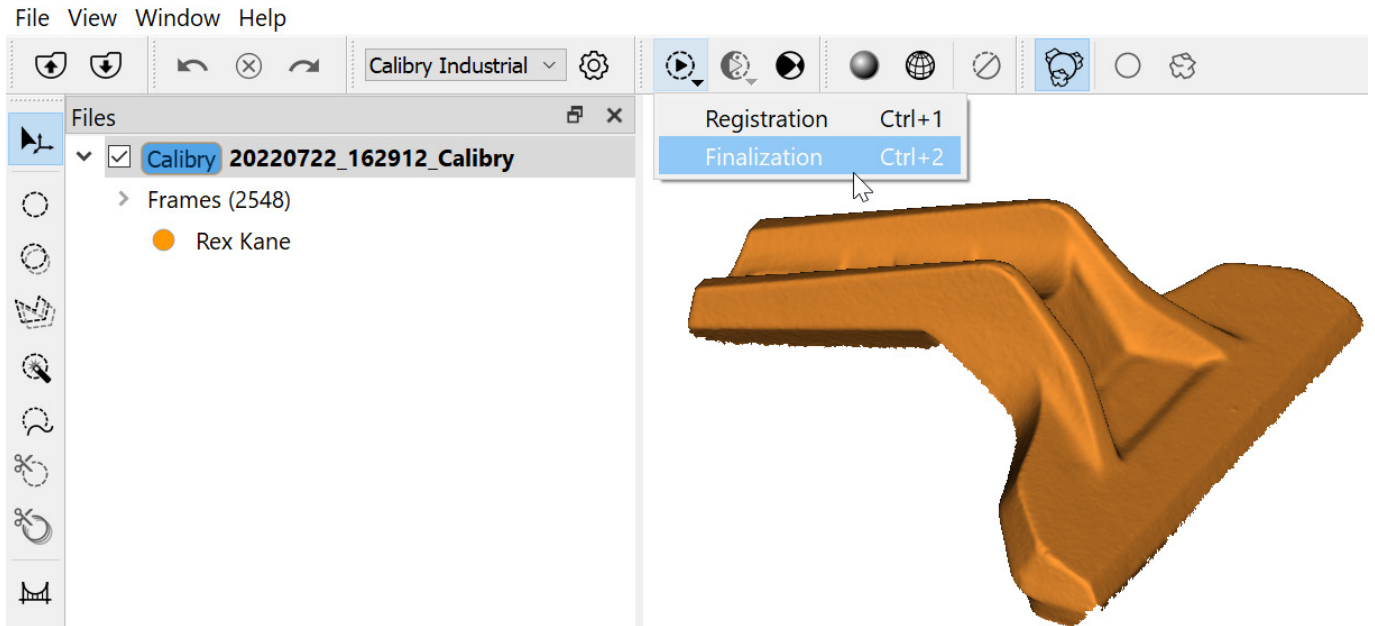
The finalized result is shown on the Files Panel as an orange circle with a random name. If a mouse pointer hovers over the name of the result, a pop-up window appears with points and faces (triangles) counters.

There may be many results, because it is possible to finalize the same point cloud multiple times with different setting to see what works best. There is no need to run Registration again if you only want to tweak some finalization parameters.
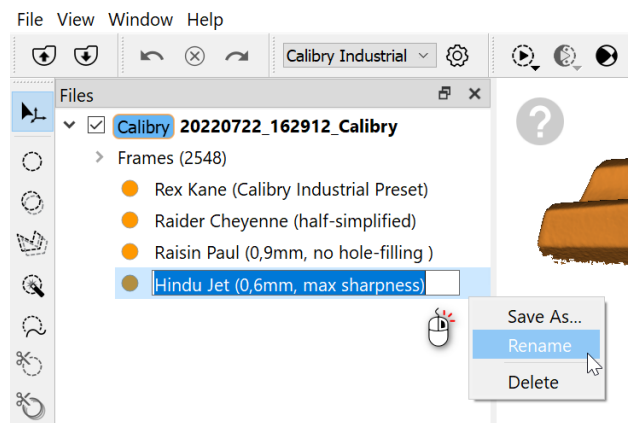
If the name of the scan is selected, the newest available result is shown instead of a point cloud preview. To see the particular result, click on it. The name of the result can be changed by using the Rename command in its context menu. It might be useful to add comments to the names as shown below.

Following sections cover each finalization parameter in more detail.

Resolution

Resolution defines how detailed the resulting polygonal model will be. Its value is defined in millimeters or in fractions of a millimeter. The smaller this value is, the more detailed the final result will be. But it also means that this result will be comprised of more polygons (i.e. triangles) and thus will take longer to generate, may be more difficult to work with and will require more memory to store. Plus, there is a reasonable limit after which setting a higher resolution just doesn't increase the quality of a model, but only makes it needlessly bulky and unpractically difficult for a computer to process and manipulate.

So, the lower this value is, the higher the resolution of a model.
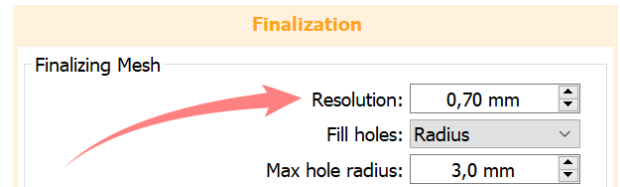
The highest recommended resolution for 3D-models made with Calibry is 0.6mm. But if this value is set for a large object like a car, the model will be unpractically heavy. So for bigger objects this value is usually set in the range of 1-3mm.
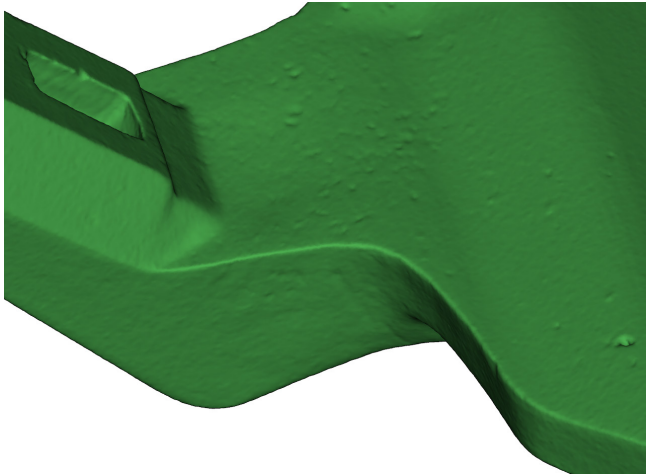
Calibry, resolution 0.6mm
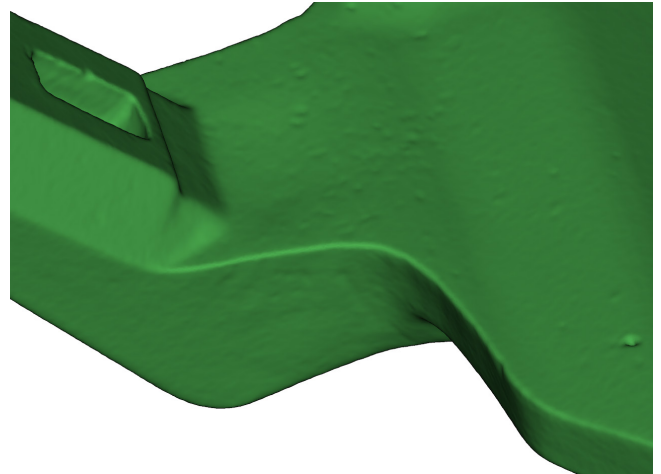
Calibry, resolution 1.0mm

With Calibry Mini, the highest resolution is 0.15 mm, but using this value for objects larger than 10cm is usually unpractical. For objects of about 10-30cm in size the recommended value is 0,2mm. For objects larger than 30cm resolution of 0.4mm is usually optimal.

Calibry Mini, resolution 0.2mm
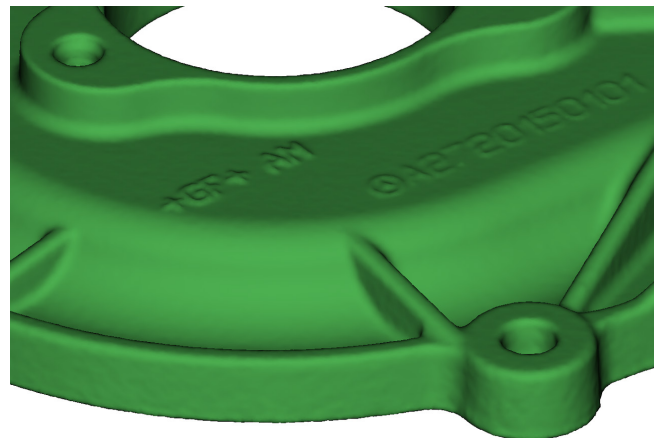
Calibry Mini, resolution 0.4mm

Hole Filling

In many cases it can be difficult to scan the entire object from all possible angles and capture all folds, mounting holes, and indentations. So, the final result may contain holes.

Quite often some of these holes may be filled automatically by extrapolating the data using the edges of the hole. It works especially well on organic shapes like statues, humans or free-flowing surfaces, but sometimes can give a decent result even with industrial parts, especially if holes are relatively small and are not situated in the areas of abrupt geometrical changes.
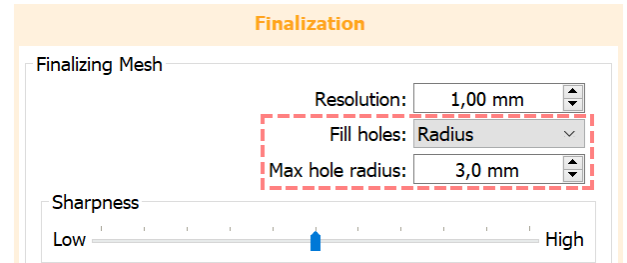
In Nest holes can be filled either during finalization, or after finalization. Usually the best strategy is to fill small holes during finalization and then decide what to do with the bigger ones — you can either try to fill them too, or make another scan if the missing areas are critical and substantial in size.

The following example shows the difference between filling no holes during registration, filling holes smaller than 5mm, and filling all holes:
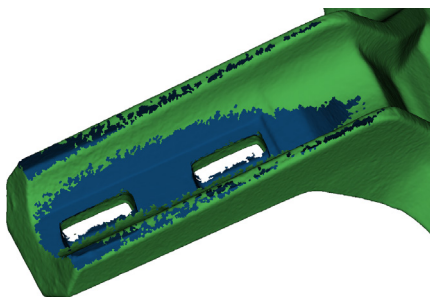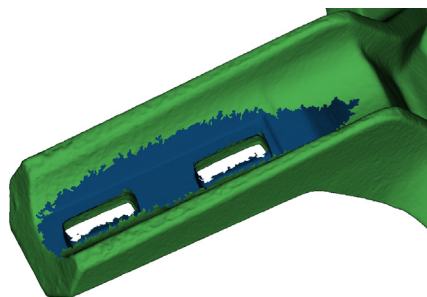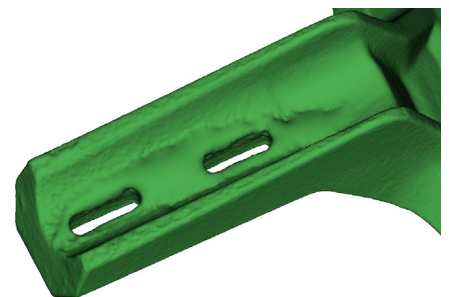
On large holes with irregular and rugged edges the appearance of artifacts during hole-filling is more likely. In such cases making an additional scan is preferable.

Sharpness

Apart from resolution, the final look of a model depends on sharpness settings. It is a slider in finalization options that defines how smooth or rough the surface of the model will be. Keep in mind that the default position of this slider is in the middle and it is recommended to keep it there in most cases. Still, setting it to a lower value may help to make the result less grainy if the point cloud is noisy or not dense enough. On the other hand, increasing sharpness can make corners and edges more pronounced.
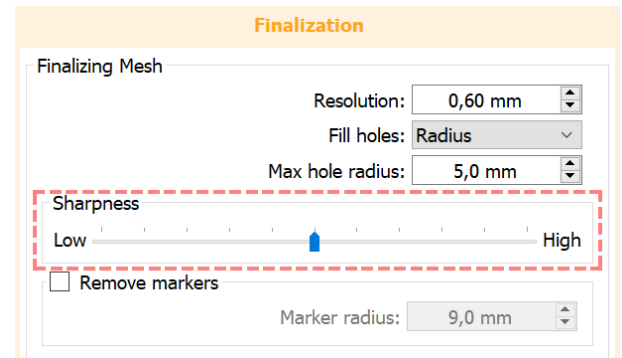
Lower sharpness levels are mostly used for organic shapes like statues or humans. Higher sharpness levels may prove useful for industrial parts with sharp edges. Nonetheless, it is recommended to start with medium sharpness first.
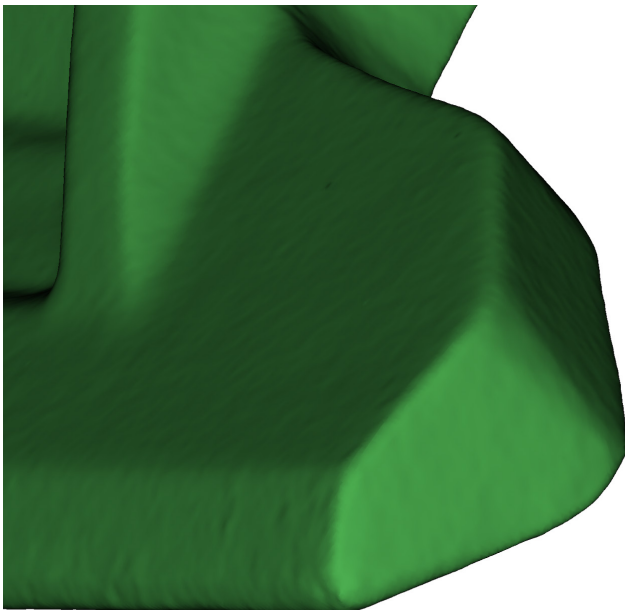
Low sharpness
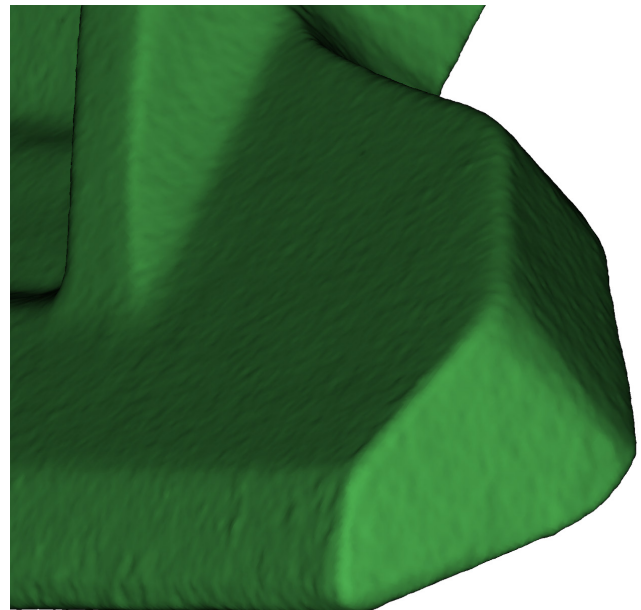
High sharpness

Markers Removal

When scanned with markers, a surface of a model can end up having small bumps in places where markers were applied. It is especially true with magnetic markers, because they are thicker than sticky markers. For many industrial applications, like reverse engineering, it doesn't play a big role and these bumps may be ignored. Still, for some other purposes and for aesthetic reasons these bumps can be removed during finalization. For this to happen, Remove markers checkbox has to be activated in finalization settings and marker radius should be specified.

It is important to emphasize that this value is a radius of the entire marker, including its rim. Plus, if you're using square marker stickers, the radius should be equal to half the diagonal of the square. It is also usually a good idea to increase the radius 1mm just to make sure a marker is safely in the cutting boundaries. So, for example, if a marker is 22 mm in diameter (including the rim), 12mm radius value should be set (11mm radius of the marker + 1 mm safety gap).

SMALLER RADIUS (NO STICKER SQUARE)

BIGGER RADIUS (TO INCLUDE THE STICKER)
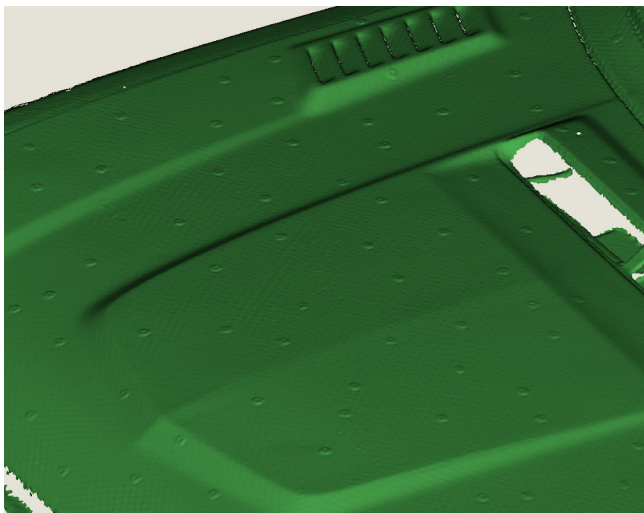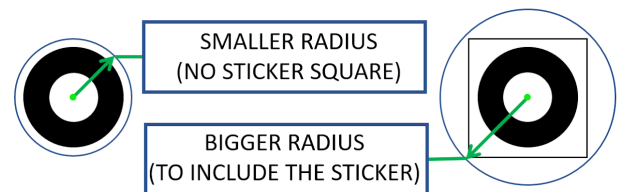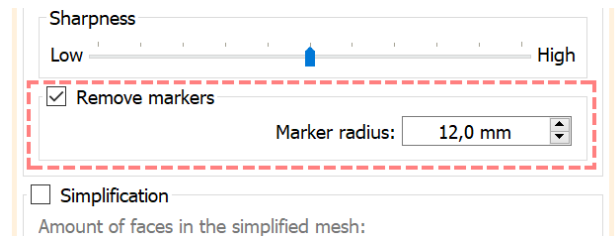
A surface without markers removal

A surface with markers removal

Since marker removal algorithm just cuts holes and then fills them, it is recommended not to apply markers to the edges of the object or to the areas of high curvature, otherwise artefacts may appear during markers removal:
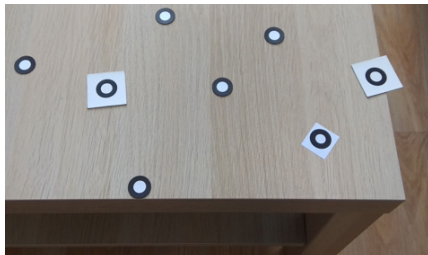
An example with different types of markers
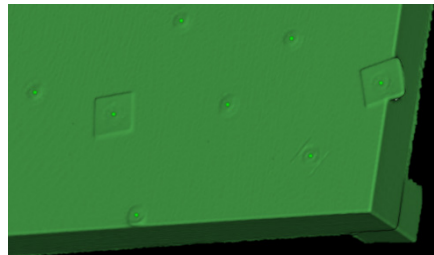
The result without markers removal
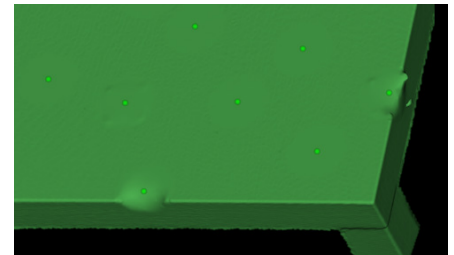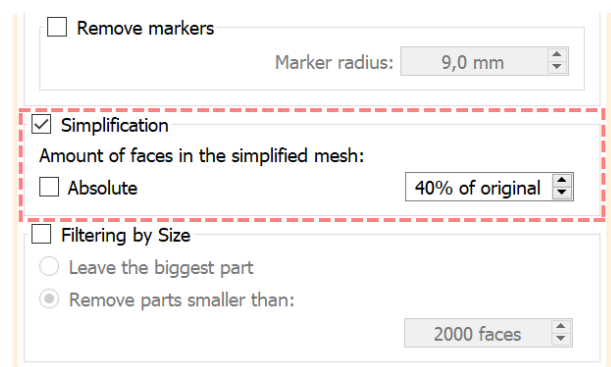
The result with markers removal (12mm)

In the example above both round and square markers are shown with some of them being on the edge. The marker removal radius used in this example worked great with round markers, but wasn't sufficient for square markers, hence the corners of square markers are seen after markers removal. Plus, markers removal on the edge spoils the geometry of the object.

Simplification

After finalization is complete, it may turn out that the result consists of unpractically big number of triangles. In many cases it is possible to rebuild the model by replacing groups of smaller triangles with equivalent bigger ones, thus reducing complexity of a model without sacrificing its quality.

It is especially true for parts with lots of smooth surfaces and planes where geometry doesn't change much. The algorithm tries to simplify such surfaces first, while leaving more triangles on corners and bends to better preserve them. This adaptive property makes simplified models more optimized, with a denser mesh where it is needed and a lighter mesh where the shape is relatively featureless and plain.

In Calibry Nest simplification can be run either as a part of finalization or after finalization is complete (with a separate tool on the Side Toolbar). The settings and algorithms are the same in both cases, so the choice is yours. With simplification during finalization it is impossible to see the result before simplification.

You can either choose the percentage of simplification, or set a specific number of triangles you want to get as a result. For example, if a model consists of ten million polygons, simplifying it to 40% of the original will reduce the number of triangles to four million. With the same effect, the Absolute checkbox can be set and the desired value of polygons can be entered. Note that the actual amount of triangles can be slightly different, but it will not be bigger than the limit.

Filtering by Size

During finalization small polygonal fragments may appear around the object. It is especially true if preliminary cleaning was deactivated during registration: small clusters of stray points often cause the appearance of these artifacts. In most cases they are not touching the main object and can be easily filtered out.

Another case is when Priority Mode selection was incomplete and some parts of additional geometry end up on the final result.

Also, if an object can only be scanned on a place where it is installed, needless parts of the mechanism or machinery may also get into the field of view of the scanner and become parts of the scan. They can either be marked as needless geometry during Priority Mode selection, or can be filtered out during finalization or during later stages of post-processing.

There are two options available with the filtering tool. Leave the biggest part deletes all parts of a model except from the biggest one. It works great when it is obvious that all floating parts are needless and the object is much bigger than all other elements. Use caution when a model is on a table or a floor — sometimes the surface around the object may turn out to be bigger than the object itself. In such cases this command will leave the table/floor, but delete the object. Another option is to remove parts smaller than the specified amount of triangles. It helps to remove parts smaller than the specified margin, while leaving bigger parts which may be useful.
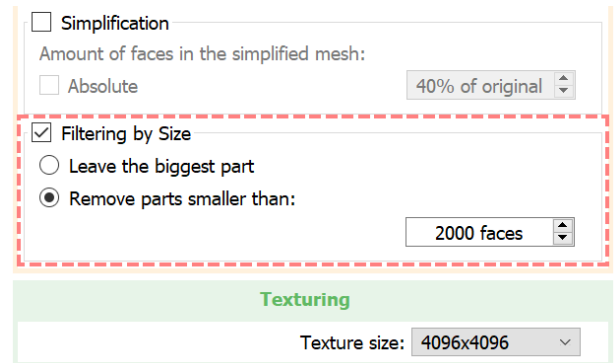
A model with rims of a turntable. None of the stray parts are touching the object.
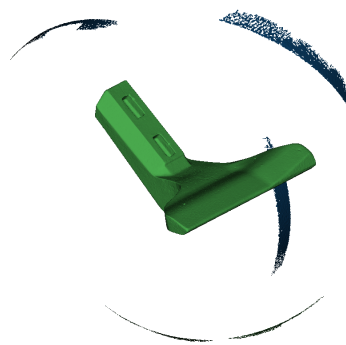
The same model with parts smaller than 2000 polygons being filtered out.
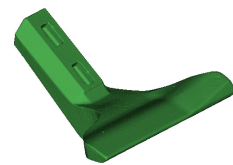
The same model after filtering with Leave the biggest part option activated.

Filtering can also be done separately with the help of a tool of the same name situated on the Side Toolbar, described in Chapter 10: Tools and Toolbars.

Texturing

If during scanning texture frames were captured and saved, texturing can be done after finalization. By default, every 20th frame contains texture data for that purpose. This value is not related to the type of tracking. Calibry scanners are capable of capturing color data in all three tracking modes.

The only parameter available in the settings regarding texturing is the dimensions of the texture atlas. It is a PNG-file stored with a model, that contains all the color data. The values of 1024x1024, 2048x2048, or 4096x4096 pixels can be chosen. Since this parameter does not affect the time it will take to texturize, in most cases maximum value is recommended, though the size of such an atlas may reach up to 50MB.
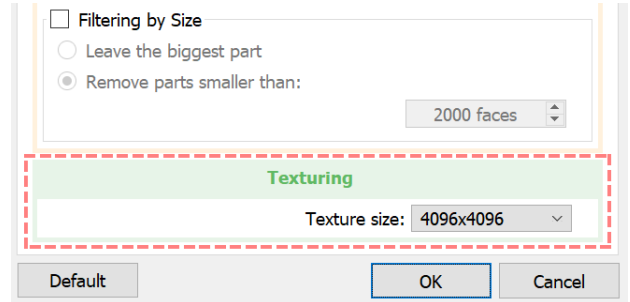
To start texturing, pick the result you want to texturize, click Texturing or use hotkey F6. If there are several results in a scan and a scan name is selected, the newest result will be used for texturing by default.

If the result picked for texturing contains more than 700 000 polygons, the hint will be displayed that it may be a good idea to simplify the model before texturing. In most cases it is recommended to confirm simplification, otherwise texturing may take a long time. The original result will not be simplified, though. Nest will make a copy, and then simplify and texture the duplicate.
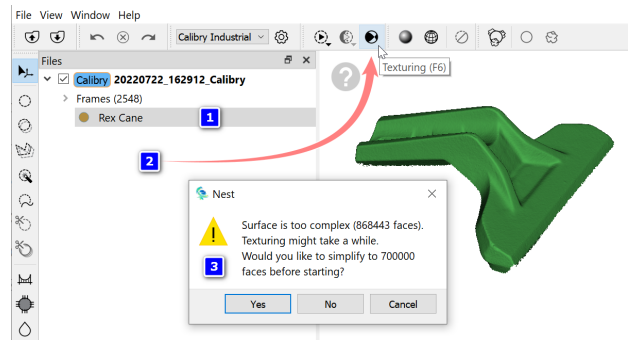
This prompt also shows the amount of polygons in the model. If it is not very far from 700 000 polygons, the simplification step can be skipped. In most cases texturing models with more than 1 million polygons is impractical: it takes longer, but doesn't give much in terms of quality.
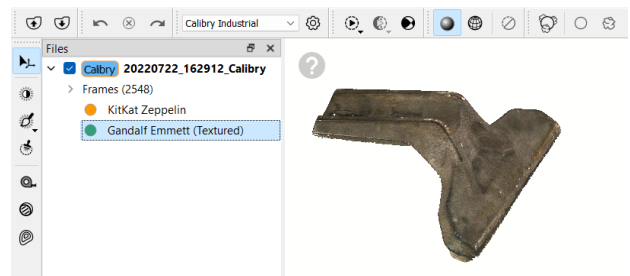
As a rule, industrial objects are almost never texturized and only a shape of the object is needed. But texturing can be useful for art objects, human scans (to make CGI editing easier) and some merchandize. Here are several examples of texturized models:

Editing Texture

Calibry Nest has several tools for editing texture. These tools are available on the Side Toolbar when a texturized result is selected.

- Adjust Texture — helps change brightness and contrast of a texture atlas, plus edit the color balance for each of three base colors
- Luminosity Brush — helps change brightness locally in certain areas (both increase or decrease)
- Magic Clone Stamp — helps edit texturing defects by replacing them with the adjacent texture

These tools are shown in detail in Chapter 10: Tools and Toolbars.

Saving the Results

Please keep in mind that processed scans and results are not saved automatically. It is done to prevent accidental overwriting of unprocessed data with processed data. Preserving the original scans intact is vital and helps to start anew in case of a mistake.

If needed, a scan (or a group of scans), a point cloud or any result (with or without texture) can be saved at any stage of post-processing.

To save the entire scan with all the frames, results, edits and textures select the scan(s) on the left-side panel and pick Save project as... in the context menu. Choose the path and the name for a file. The scan will be saved in .ascan format. It is not recommended to overwrite the original scans before the projects is complete and the desired result is achieved.
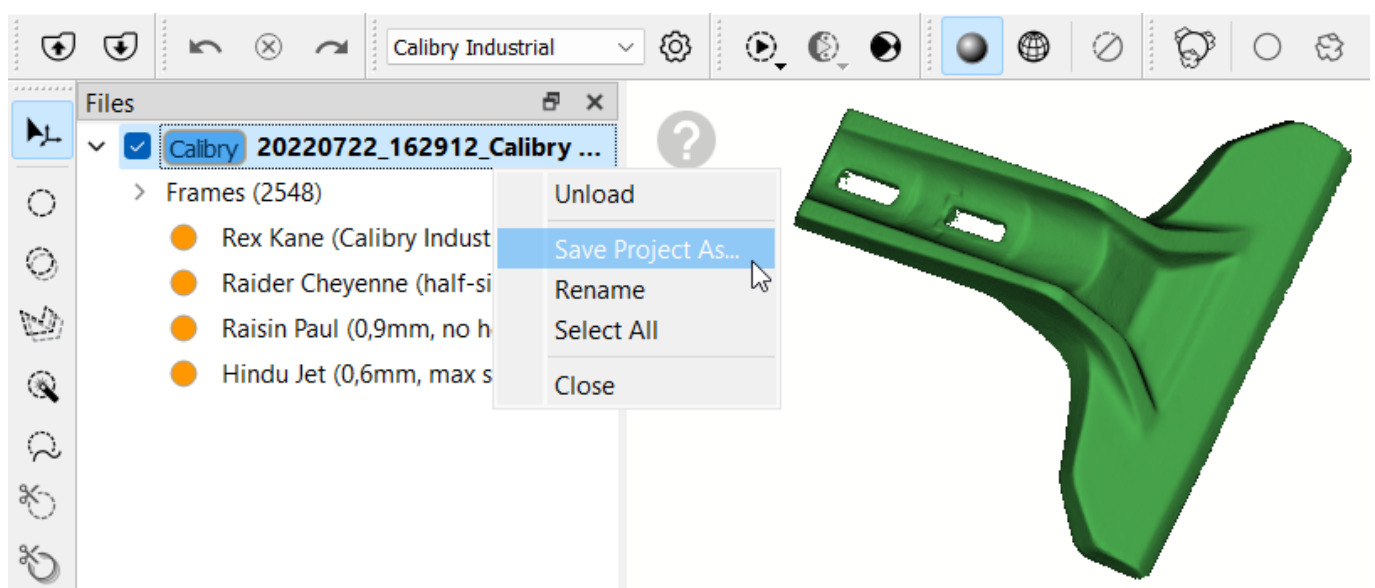
It is also possible to save a point cloud. To do that, right-click Frames and choose Save as. The point cloud will be saved as .ply.
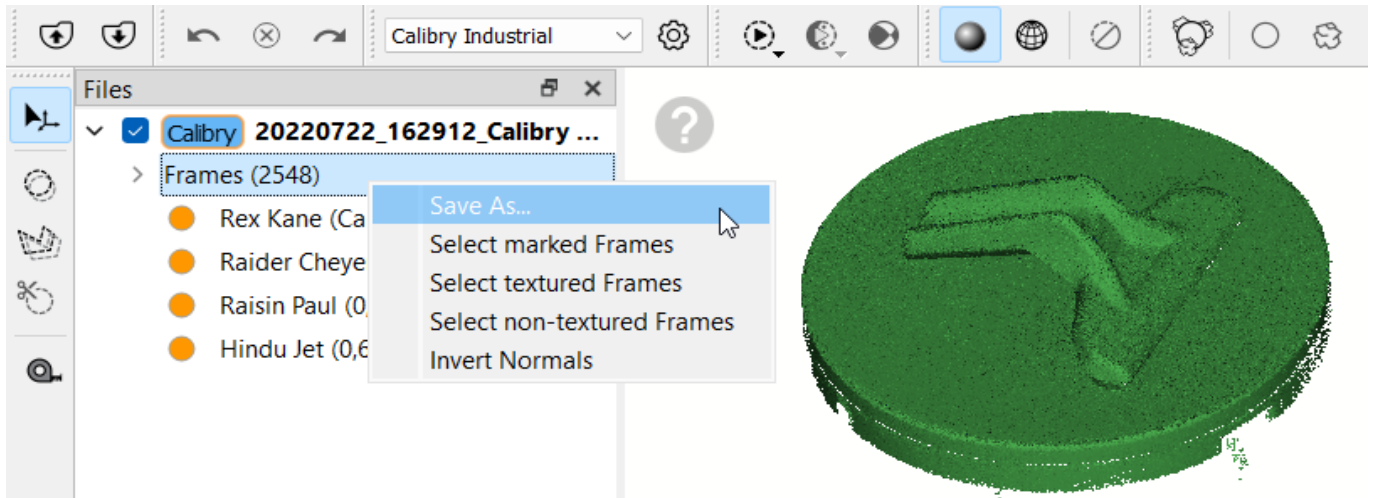
To save a polygonal result (with or without texture), right-click on it in the list of results and choose Save as..., then specify a folder, a name and a format. Available formats are .obj, .stl, .ply, .3mf, .wrl. But if texture is needed to be saved, use .obj or .3mf. If texturized result is saved as .stl, .ply or .wrl, the texture data will be discarded.
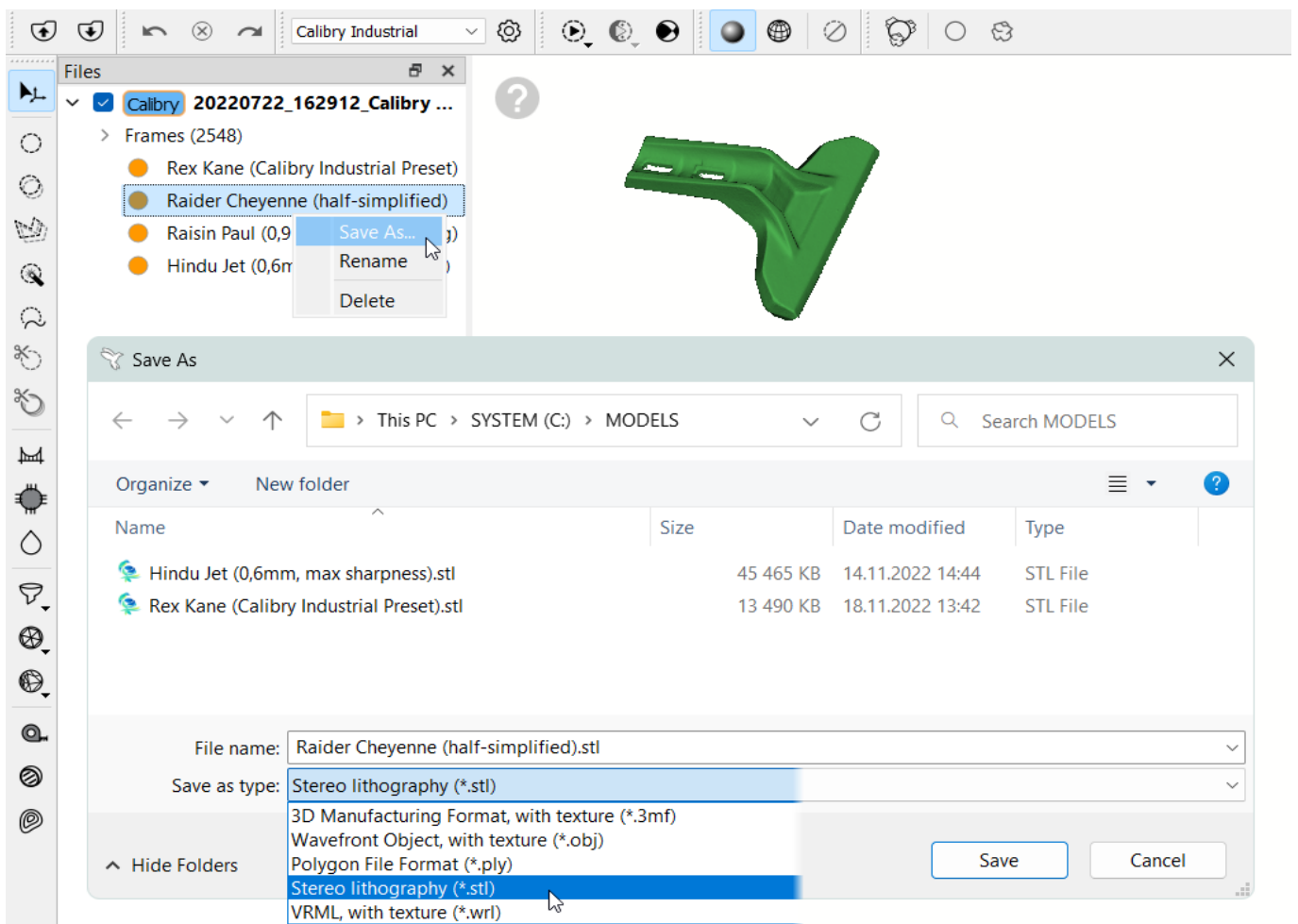
9. Assembling a 3D Model from Several Scans

Assembling a 3D Model from Several Scans

In many cases it is impossible to scan an object in one go. It may be due to its large size or because it has to be scanned from different sides and has to be flipped at some point. In such cases, several scans of the object are made and then combined to create a 3D model. It is important for these separate scans to overlap in order for them to be merged together in a consistent way.

Preparing Scans

Before merging a group of scans, they all have to be processed separately as described in Chapter 8: Post-Processing a Scan. Open the scans, register them, mark priority areas and finalize. Make sure that all separate scans look good. If some of the scans have noticeable defects, it is usually better to rescan corresponding areas. Poorly scanned zones may potentially spoil the entire model.

Alignment of Separate Scans

Since all the fragments were scanned separately, their position in respect to each other will be random. After all separate scans are processed, it is time to align them.

To start the alignment, select the scans needed to be aligned. After that, click Align by Points button or press A. For this button to appear, all selected scans should contain valid results:
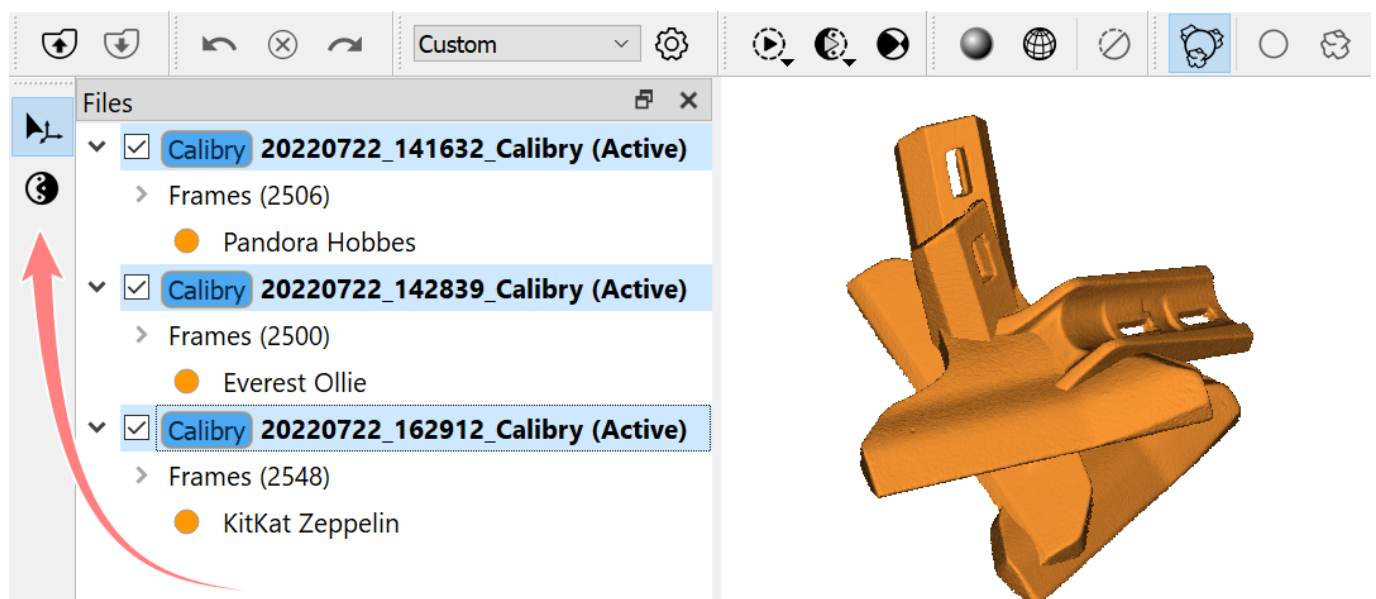
The alignment mode will be activated. There are four sections in the alignment window:

1. Meshes for Alignment. It is a list of all the results needed to be aligned. One of them is marked as Base.
2. Base is a stationary scan, in respect to which all other scans will be oriented.
3. Align is a scan that is currently being aligned to the Base.
4. Preview section shows how Base and Aligned scans are positioned in relation to one another.
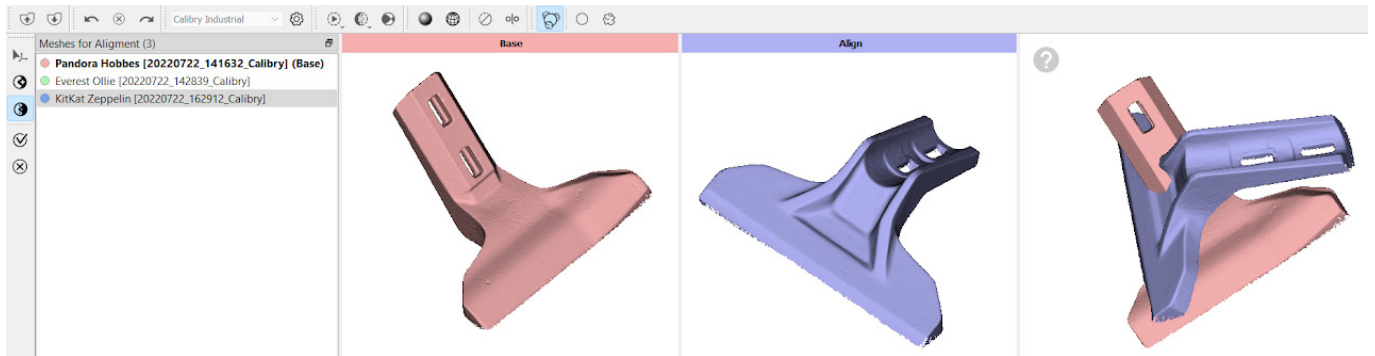
In the Meshes for Alignment section the Base scan can be changed, if needed. By default, the first result in the list is marked as Base, but any other mesh can be set as Base by right-clicking on its name in the list and selecting Set Base. It is usually recommended to use either the biggest scan or the closest to the middle as Base.
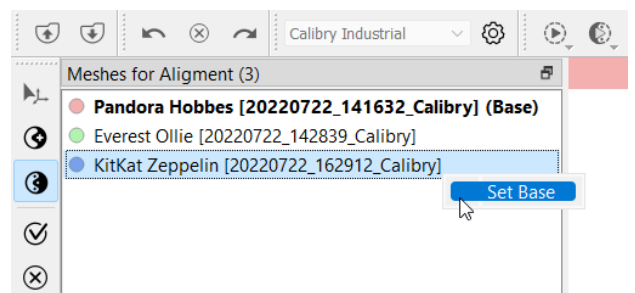
To align a scan with the Base, pick a scan from the list. It will appear in the Align section.

If it is more convenient to place the scans one under another instead of side by side, it is possible to do with the Align Layout button, which allows to toggle between vertical and horizontal views of Align window. Also, the list of Meshes for Alignment can be detached by grabbing it by its header and placing it in any other convenient place on the screen.
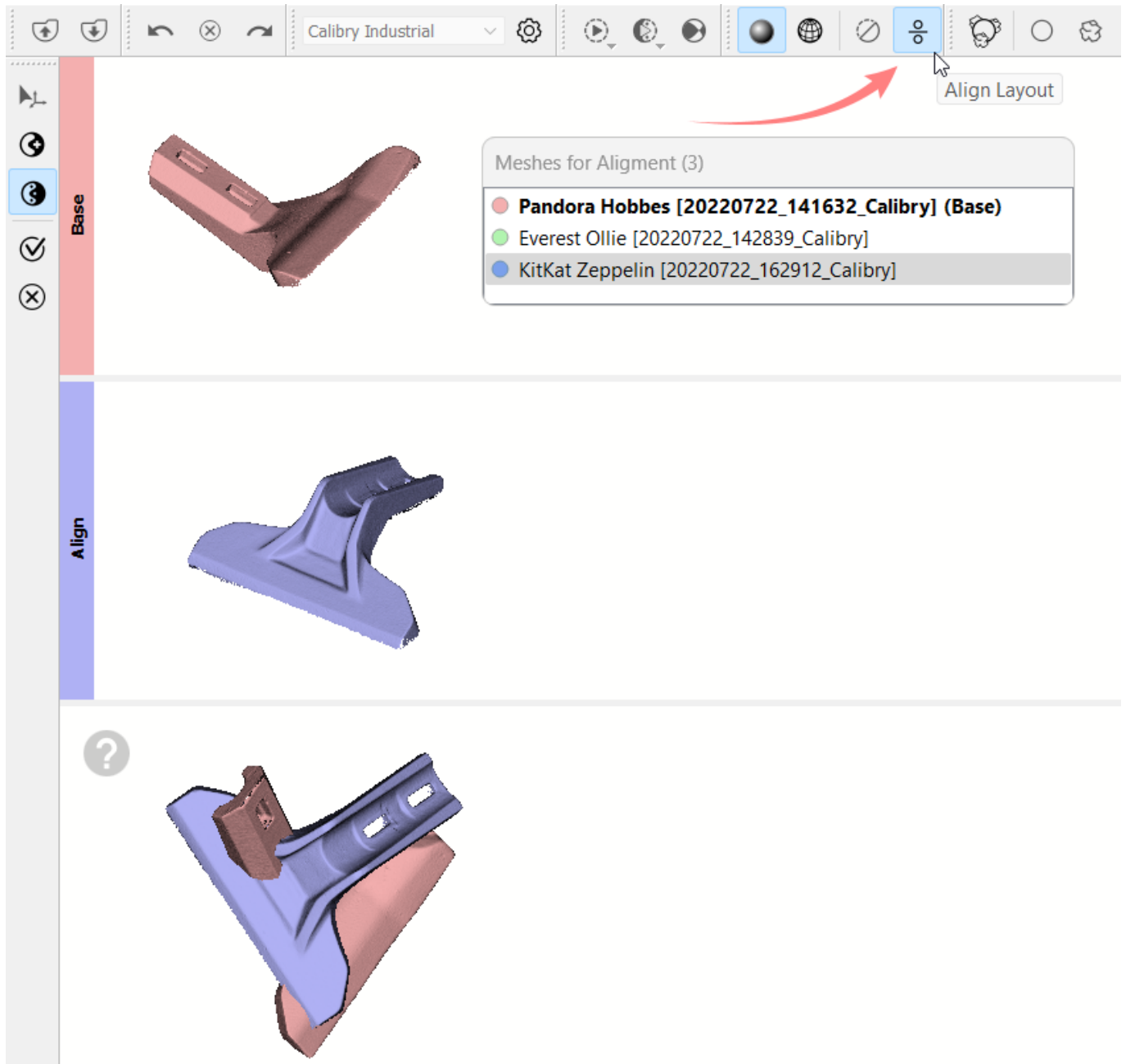
To align a scan with the base, specify at least three points that this scan and the Base have in common. It is better to pick easily identifiable spots as common points. There is no need to be very precise. These are just reference points. To set a point, double click on the desired spot. To move the point, hold ctrl while drag it. Double-click the point to remove it. Set the same points on both the Base and the Aligned. Keep in mind that the sequence matters: if the points are the same, but their numbers differ on the Base and on a scan — the alignment will not be correct. Also:

• Do not put point too close to each other;
• Do not put points along the same line;
• Do not put points too close to the fringes of scans.

After a third point is selected on both the Base and the Aligned, the Preview will change. It will continue changing with each next point selected, but there is rarely a need to pick more than three or four points.

When a scan is aligned with the Base as necessary, press Add Aligned to Base. It runs best-fit algorithm, that finds the best possible position for aligned scan.
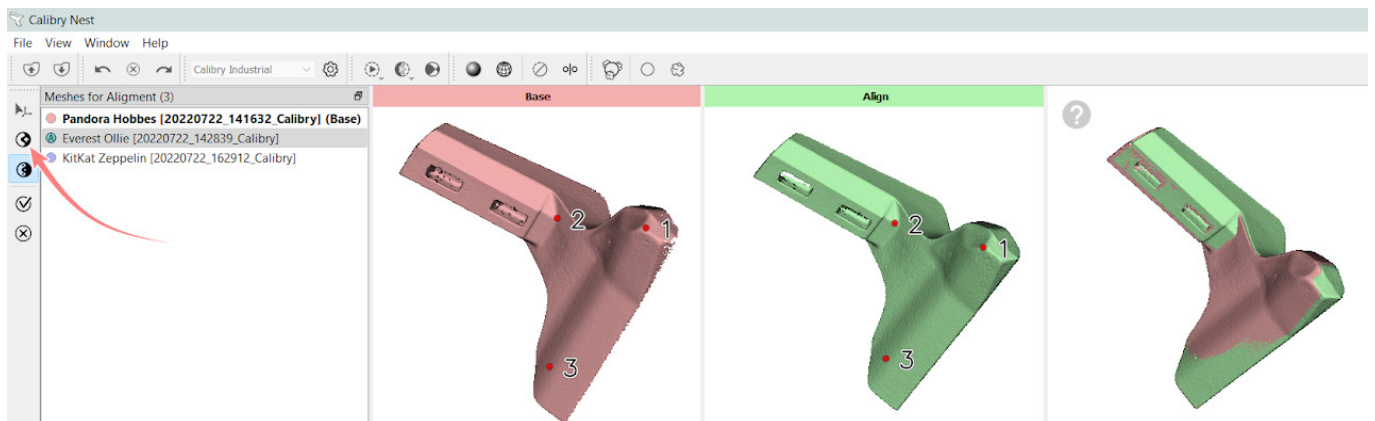
After Add Aligned to Base command is completed, the aligned scan will disappear from the list and Base will be shown as a sum of all aligned scans. Choose next scan to align and repeat the procedure. If all scans are added to the base, click Accept changes (or press Ctrl+F) to save new orientations of scans. If Cancel is clicked, the alignment will not be changed.
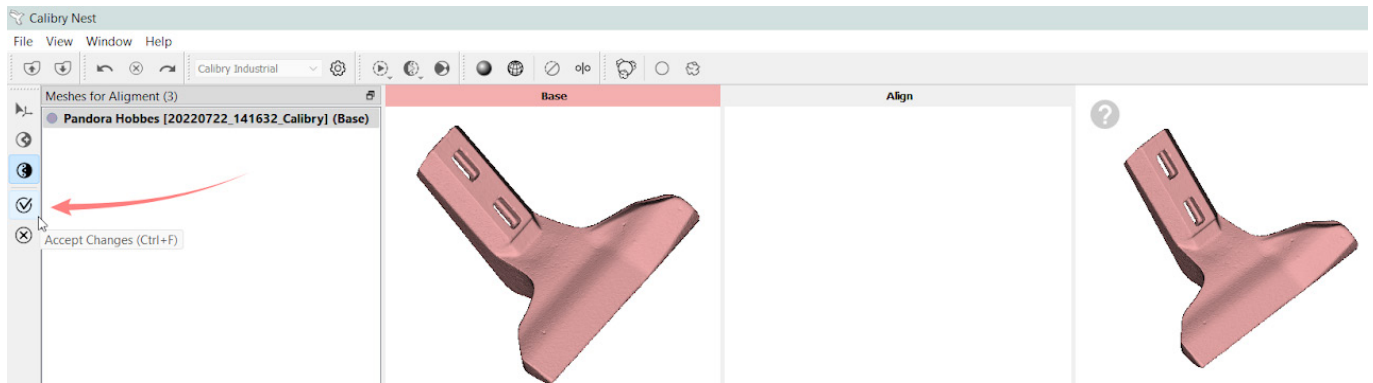
After alignment is complete, all aligned scans may look merged, but they are still separate scans:
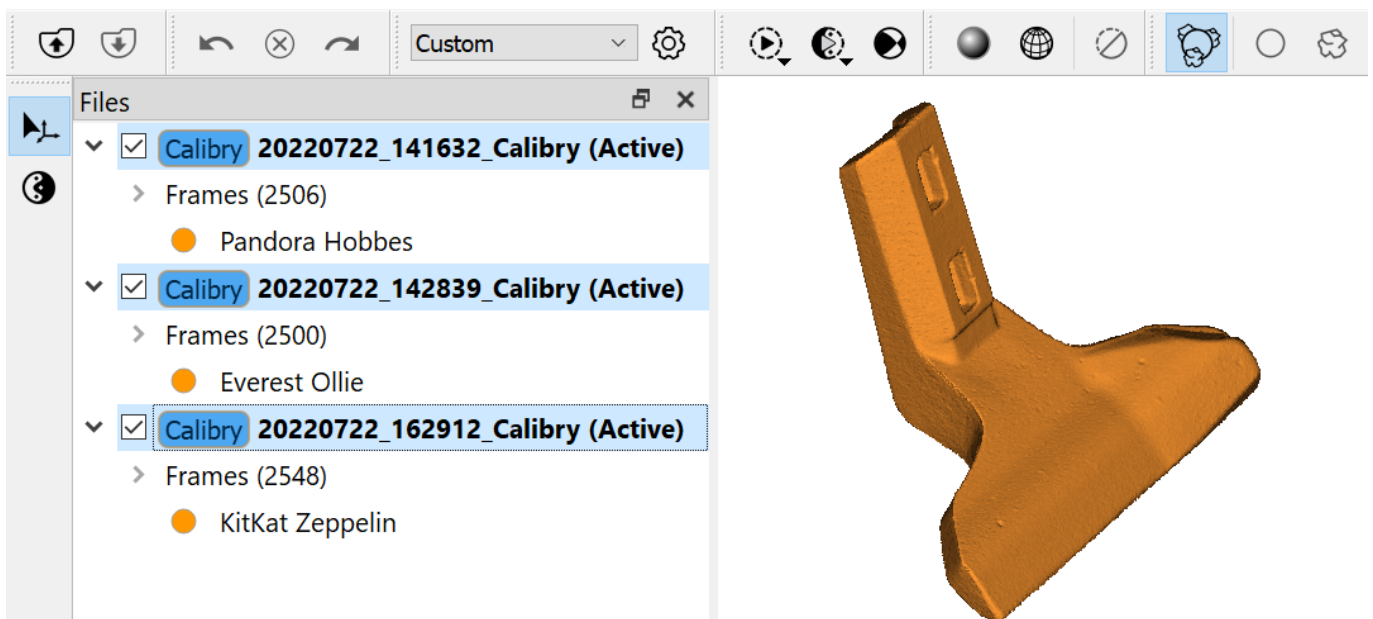
It is vital to understand that «aligned» does not mean «combined». To merge all the scans into a final model, multiprocessing should be run. The idea is the same as with single scan processing: registration and finalization should be run, but this time a group of scans will be processed as one. To process selected scans as a single dataset, use Multiple Registration and Multiple Finalization.

Marker-Based Alignment

A special case is an alignment of scans made in Marker Tracking Mode. If following conditions are met, such scans can be aligned without specifying common points (markers themselves will be used for this purpose):

•   Marker positions should not be changed during the entire scanning session
•   Scans marked for alignment should have reasonable amount of common markers (usually ten or more)
•   If some of the markers were placed near the object and the object was moved or flipped between making separate scans, these additional markers should be either deleted or marked as irrelevant using Priority Mode tools.
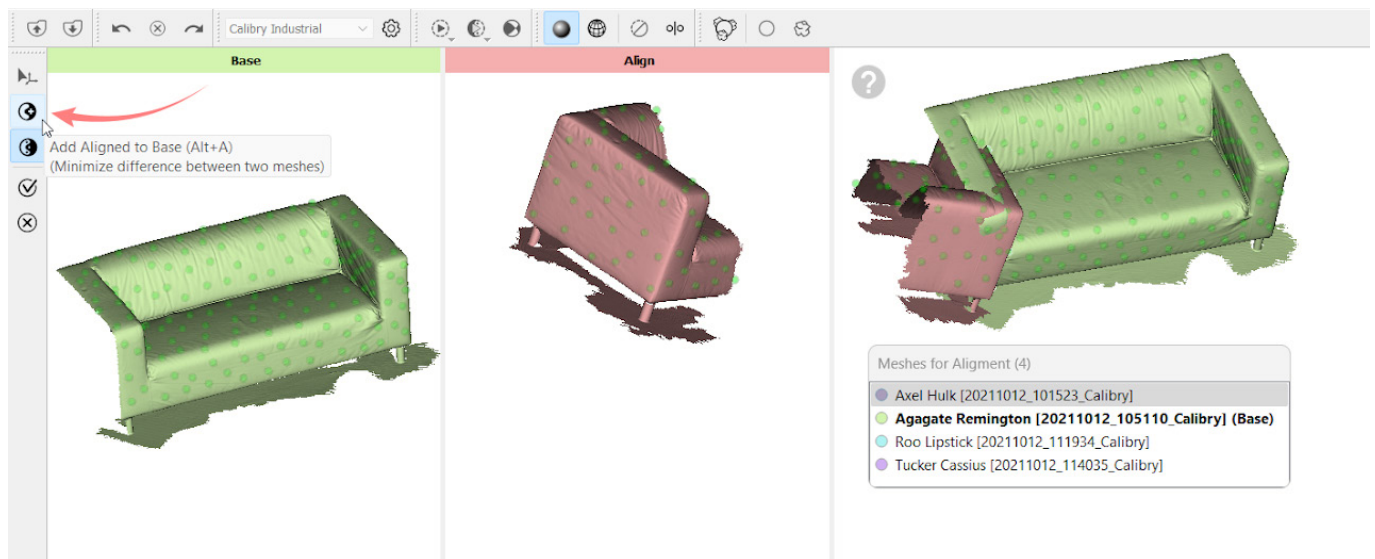
After selection of Base scan, just pick another scan that has enough overlap with the Base and click Add Aligned to Base. Adding common points is unnecessary, but still possible. The main condition here is a healthy amount of common markers (overlap) between Base and aligned scan. After marker-based alignment is complete, pick another scan and repeat the procedure.
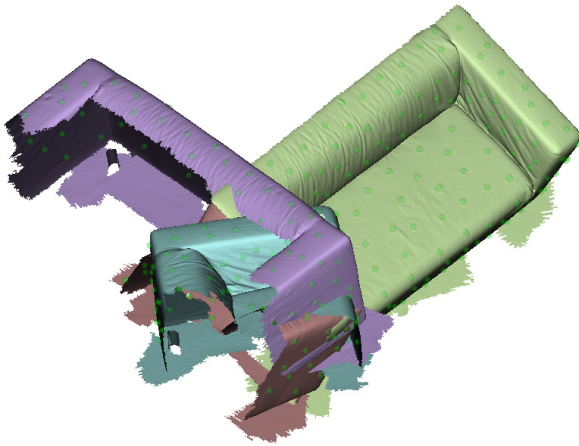
Marker scans before marker-based alignment
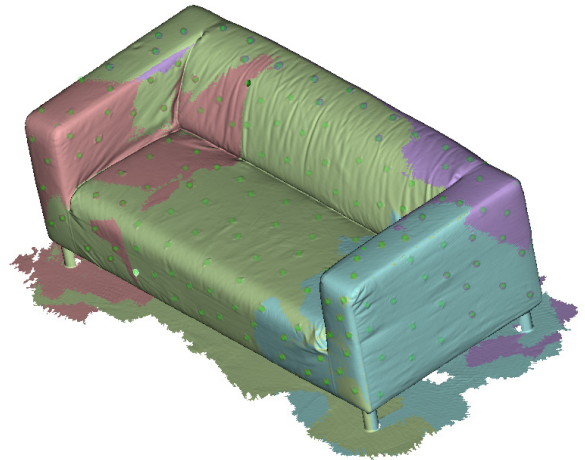
Marker scans after marker-based alignment

If some of the scans made with Marker Tracking and some with Geometry Tracking or Texture Tracking, they still can be aligned. Use marker-based or point-based alignment for marker scans and point-based alignment for geometry or texture scans.

After marker-based alignment scans still need to undergo multiple processing to get the final result.

Multiple Registration

After an alignment is complete and all the results are positioned properly, Multiple Registration can be run. It uses separate point clouds as a single data set and analyses it to achieve the most cohesive and precise result possible.

There are several ways of starting Multiple Registration:
- Long-press Start Multiple Non-Textured button and select Multiple Registration from the drop-down menu
- Right-click Start Multiple Non-Textured button and select Multiple Registration from the drop-down menu
- Press Ctrl+Shift+1 hotkey shortcut (hotkey can be changed in Settings if needed)
- Go to Files —> Start —> Stages (Multiple) —> Multiple Registration
- Press Multiple Registration button on Process Stages panel (This panel is hidden by default. Right-click Main Toolbar and pick Process Stages to see it.)
- Press Start Multiple Non-Textured button to run Multiple Registration and Multiple Finalization in sequence
- Press Ctrl+F5 to run Multiple Registration and Multiple Finalization in sequence
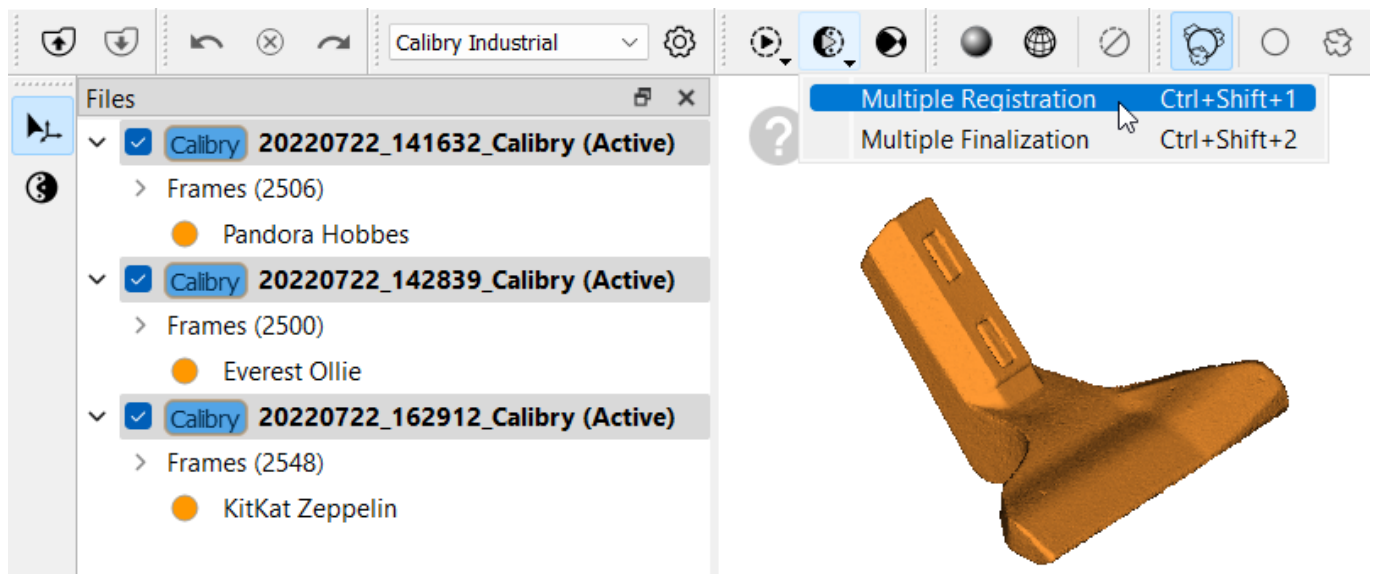
During Multiple Registration frames of each selected scan will be slightly adjusted to better fit frames of other scans. Because of that, previous results will no longer correspond to their respective point clouds and will be marked as invalid: the circle representing them will change color to brown and the names will be marked with asterisks. Plus, since there are no valid results, the preview of each selected scan will be shown, making irrelevant areas visible again as semi-transparent areas (parts of a table are seen on the example below):
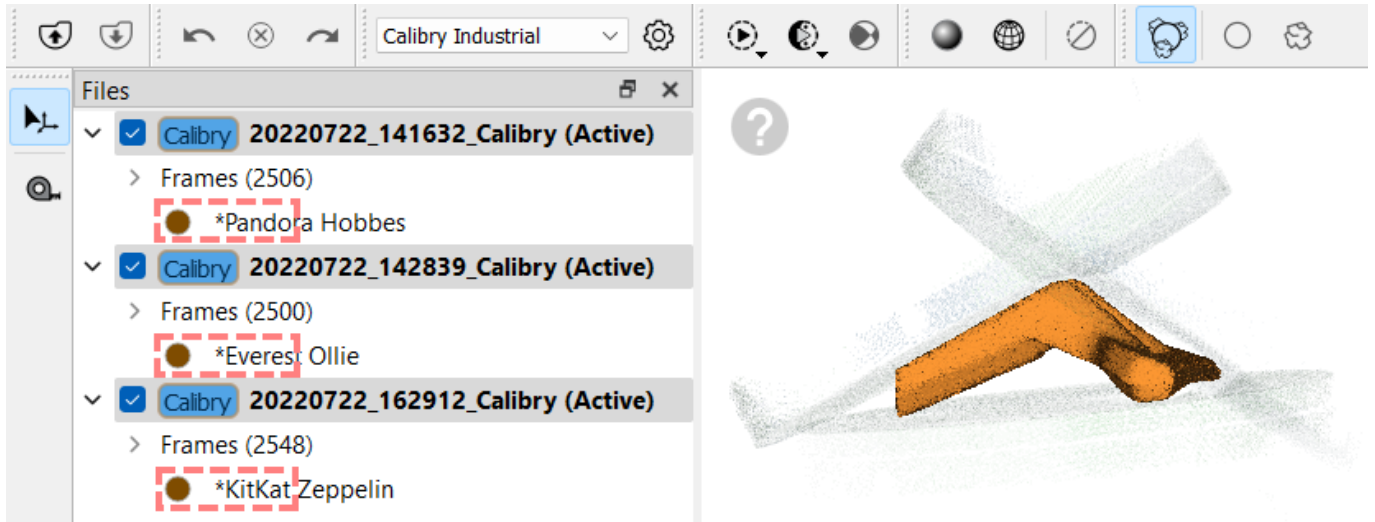
Multiple Finalization

As with finalization of separate scans, Multiple Finalization generates a polygonal mesh based on a point cloud and finalization parameters chosen in Settings. The difference, of course, is that Multiple Finalization uses several point clouds from selected scans as a single data set, thus creating a combined final result.

Select the scans needed to be merged, check the Settings (as described in Chapter 8), and then run Multiple Finalization:
- Long-press Start Multiple Non-Textured button and select Multiple Finalization from the drop-down menu
- Right-click Start Multiple Non-Textured button and select Multiple Finalization from the drop-down menu
- Press Ctrl+Shift+2 hotkey shortcut (hotkey can be changed in Settings if needed)
- Go to Files —> Start —> Stages (Multiple) —> Multiple Finalization
- Press Multiple Finalization button on Process Stages panel (This panel is hidden by default. Right-click Main Toolbar and pick Process Stages to see it.)
- Press Start Multiple Non-Textured button to run Multiple Registration and Multiple Finalization in sequence
- Press Ctrl+F5 to run Multiple Registration and Multiple Finalization in sequence
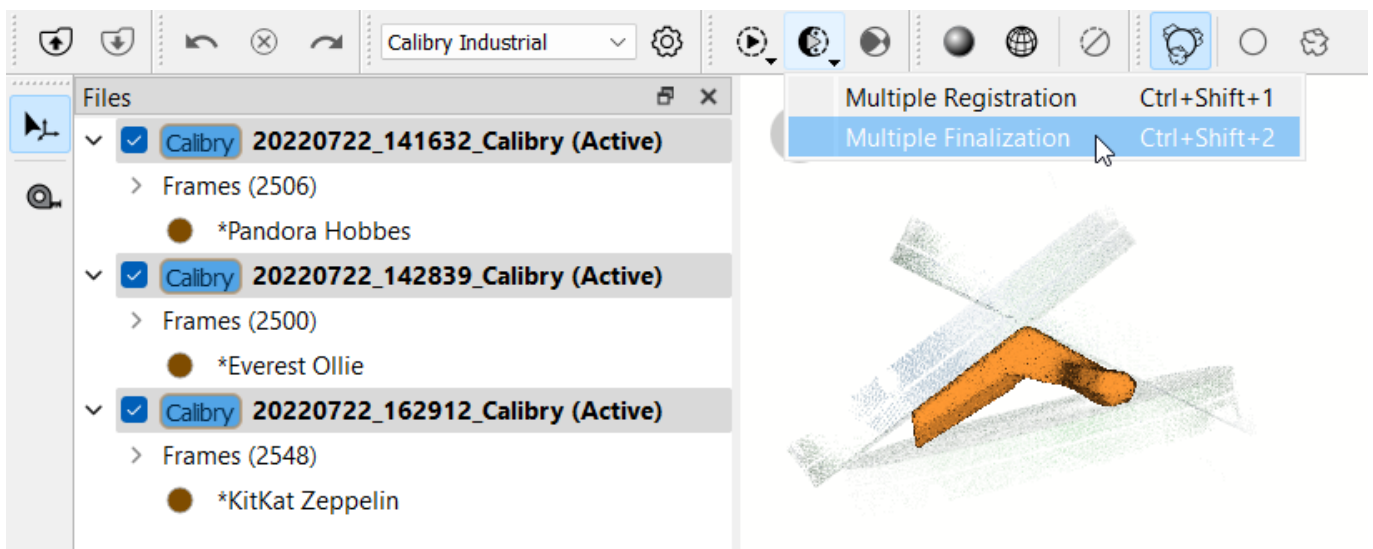
After Multiple Finalization is complete, the result will be shown as a separate project, marked with green Result label:
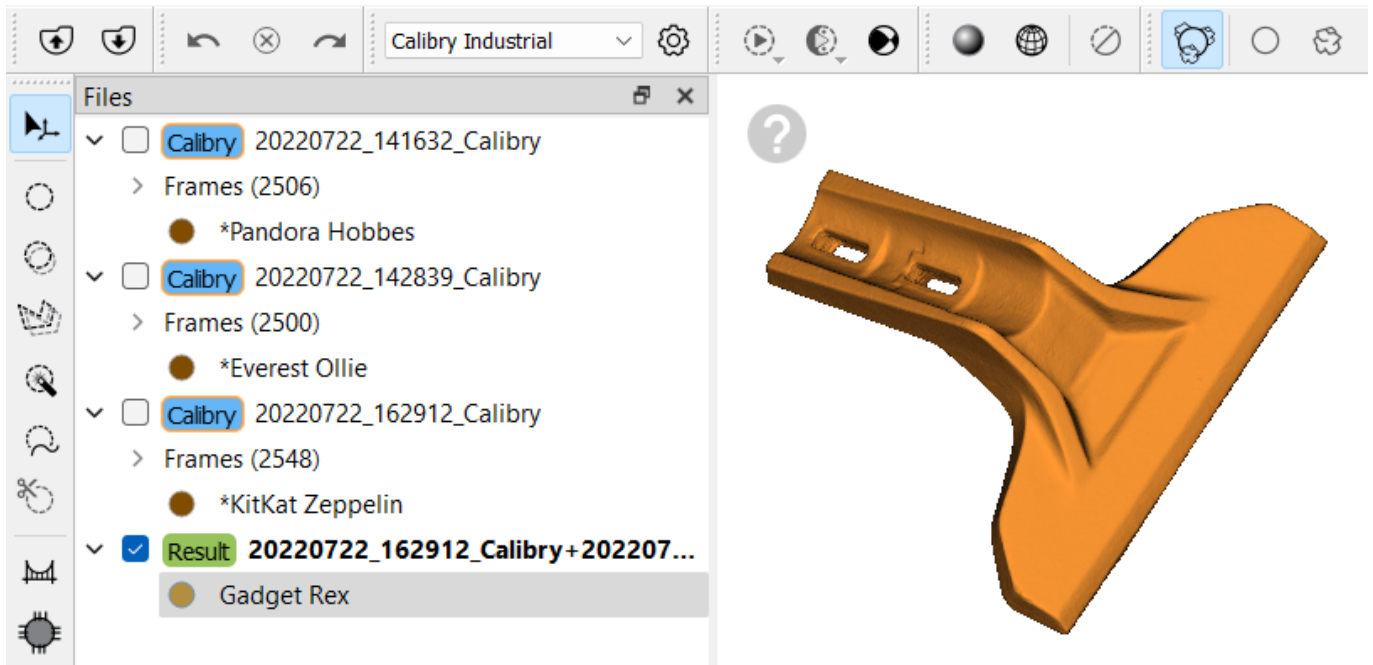
The result can then be edited with the tools Nest provides, such as hole-filling, bridging, smoothing, simplification, remeshing, filtering and others. These tools are covered in more detail in Chapter 10: Tools and Toolbars.

Texturing

Texturing a final model made of several scans is analogous to texturing a single-scan result: select the result to texturize and click Texturing button or press F6. If the model is comprised of more than 700 000 polygons, the prompt will appear suggesting simplifying the model before texturing. It is possible to decline this suggestion and texturize the model without simplifying it, but it may take an excessive amount of time to complete without returning much in terms of quality. Than is why it is recommended to simplify the model.
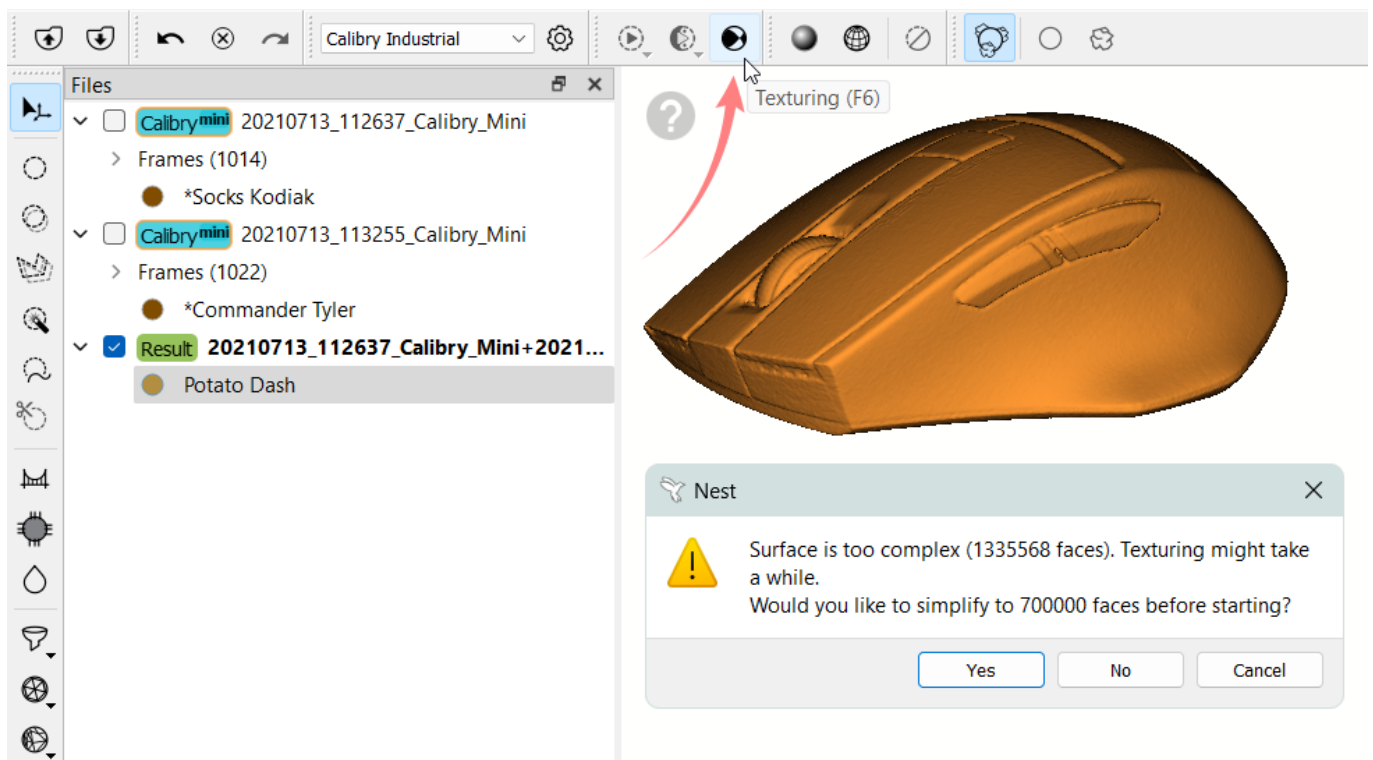
The original model will be preserved and another copy will be made for simplification and texturing. It will appear below the last result as a green circle with a random name with (textured) added to it:
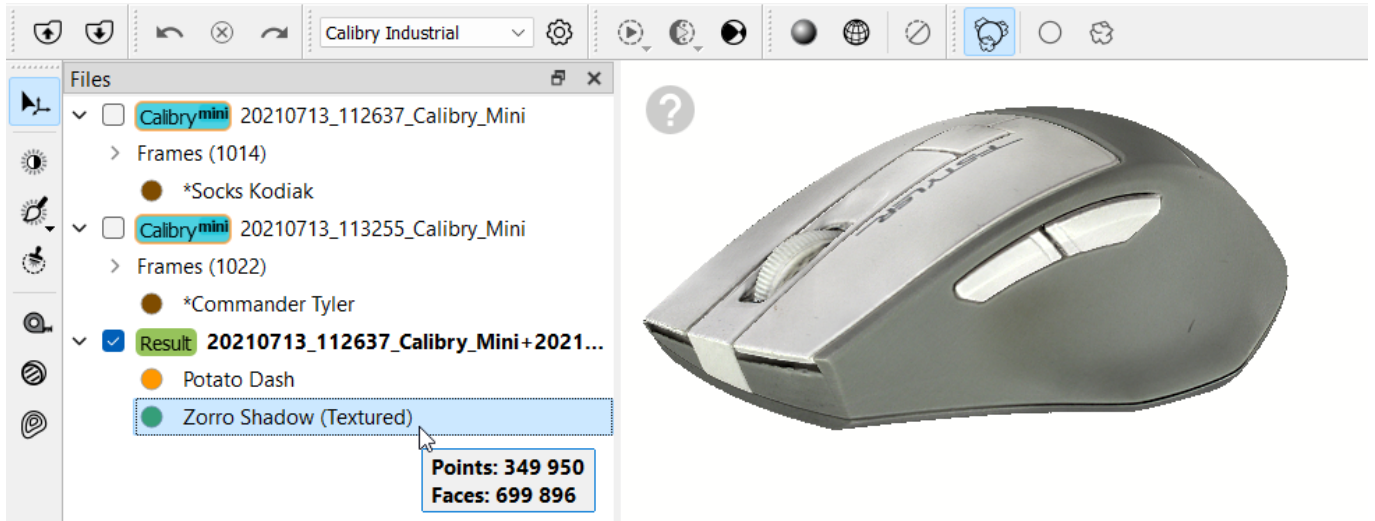
After that, texture may be edited using texture editing tools: Adjust Texture, Luminosity Brush, Magic Clone Stamp. These tools are described in Chapter 10: Tools and Toolbars.

Saving the Results

Saving the model made of separate scans is analogous to saving a single-scan result: right-click it and pick Save as..., then choose a path, a name and a format for the model. These results can be saved as .obj, .stl, .ply, .3mf or .wrl. Texture can only be saved in the .obj and .3mf formats. If saved in other formats, the model texture will be discarded.
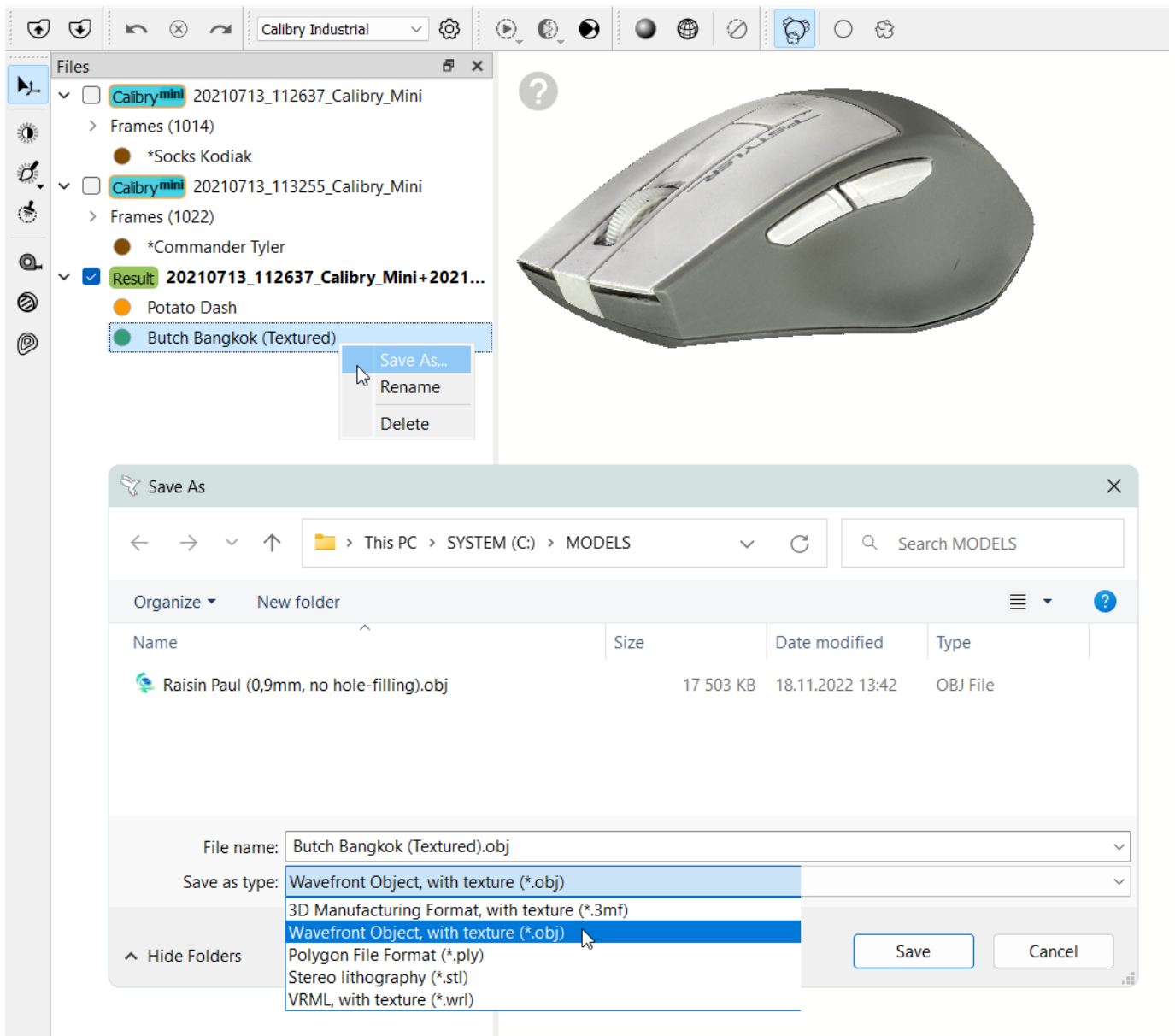
It may also be useful to save all the scans with all the changes to a separate folder, in case there will be a need to reassemble the model with other parameters. Select all the scans needed to be saved, right-click on one of their names and pick Save Project As..., after which select a folder to save all selected processed scans.
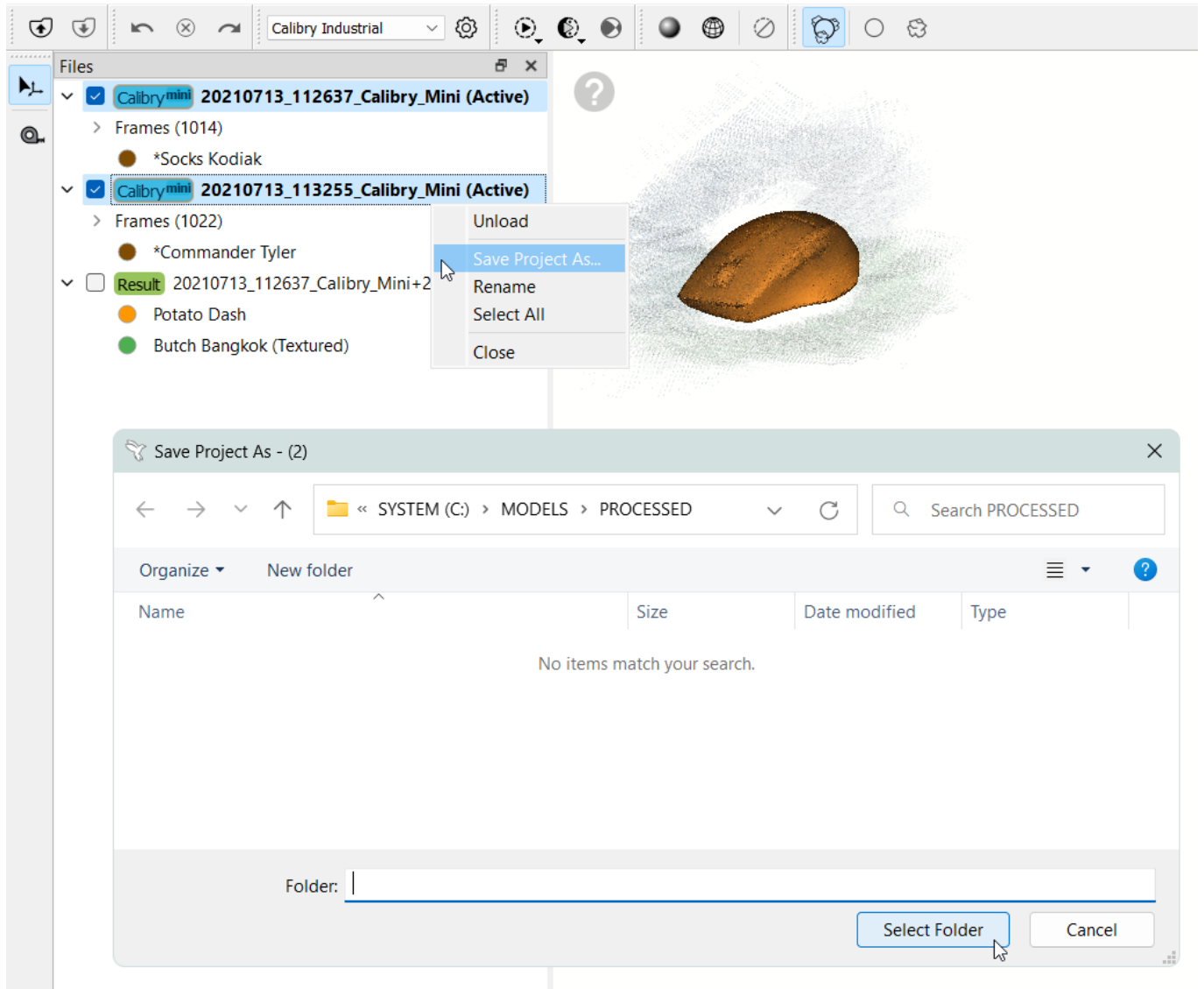
10. Tools and Toolbars

Main Toolbar

Main Toolbar provides quick and convenient access to main tools, functions and modes of Calibry Nest.

Main Toolbar consists of separate groups, which can be detached, moved, or hidden. The list of these groups can be accessed either via «Window» menu or by right-clicking empty space on the Main Toolbar itself.

Side panels Scanner, Files, and Tools are switched on by default. The Main Toolbar itself consists of File, Edit, Settings, Process, View, and Points Priority groups.

The Process Stages group is deactivated by default, but can be shown at any moment if needed.

The groups of tools included in Main Toolbar are described in following sections.
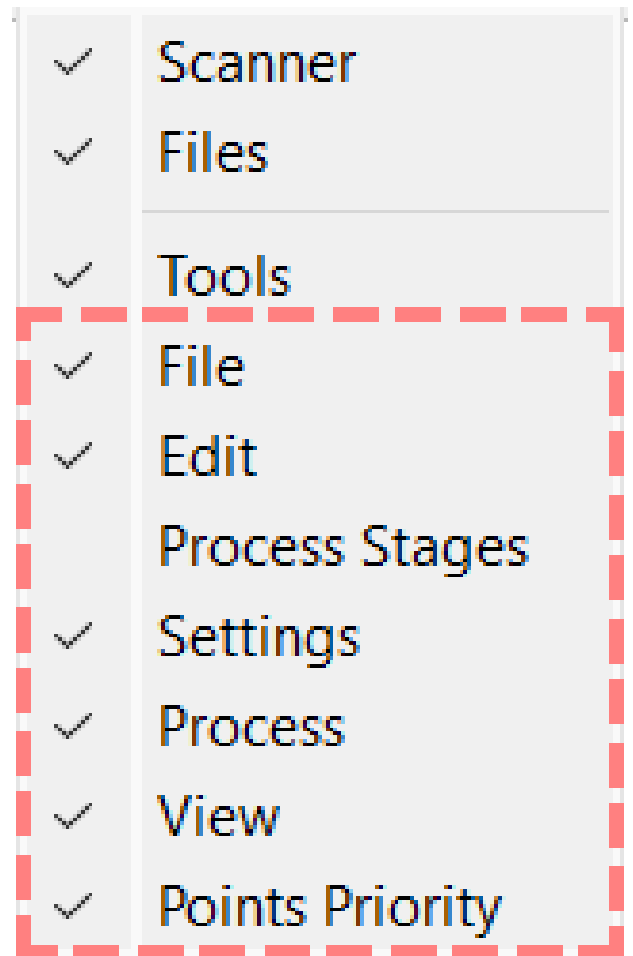
File Group

File group consists of the following buttons:

- «Open» (Ctrl+O) — Opens scans and models in Calibry Nest.
- «Save results as...» (Ctrl+S) — saves processed scans, results and models. Desired path, name, and format can also be specified here.

Edit Group

Edit group consists of the following buttons:
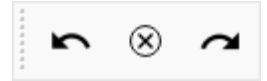
«Undo» (Ctrl+Z) — cancels the last action (or a sequence of actions if pressed multiple times).

It is impossible to undo actions affecting the entire data set (registration, finalization, simplification, remesh) as well as actions of tools which have their own editing modes (eg. hole filling, bridges, smoothing).

«Clear history (release RAM)» — purges history of changes and detetes all previous states of a model. After using this function, cancelling previous actions becomes impossible.

«Redo» (Ctrl+Y) — returns cancelled edit (or a sequence of edits if pressed multiple times).

Settings Group

Settings group consists of the following buttons:
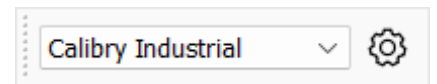
Templates list — allows to quicky switch between different predefined templates containing recommended settings for different scanners and situations, including user-defined templates.

Settings (F10) — opens Settings window where Nest and post-processing options can be changed. These settings are covered in Chapter 3: Calibry Nest Interface and Chapter 8: Post-processing a Scan.

Process Group

Process group consists of the following buttons:

- United Start Non-Textured button (F5) starts registration and finalization for a separate scan. If several scans are selected, this button runs registration and finalization for each one separately.

Right-click or long left-click on Start Non-Textured button opens a menu with Registration and Finalization shown as separate operations along with their corresponding hotkeys.
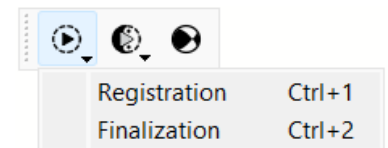
- United Start Multiple Non-Textured button (Ctrl+F5) starts multiple registration and multiple finalization for selected scans.

Right-click or long left-click on Start Multiple Non-Textured button opens a menu with Multiple Registration and Multiple Finalization shown as separate operations along with their corresponding hotkeys.
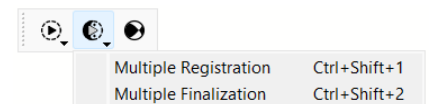
Texturing button (F6) starts texturing of a model. It can be a result of a separate scan, or a multiple result of several scans.
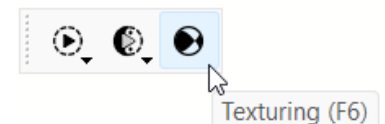
All the tools of Process group are covered in detail in Chapter 8: Post-processing of a Scan and Chapter 9: Assembling a 3D Model from Several Scans.

Process Stages Group

If desired, the Process Stages group can be displayed, where all the same functions as on Process group are shown as separate buttons:

- Registration
- Finalization
- Multiple Registration
- Multiple Finalization
- Texturing

View Group

Tools of View group help change the current view of a polygonal model.

- Shaded View (Alt+1) shows a polygonal surface without showing a polygonal grid (triangles lines).
- Wireframe View (Alt+2) shows both a polygonal surface and a polygonal grid (triangles lines).
- Hide Selected (Alt+M) allows to temporarily hide parts of a model for easier inspection and editing.
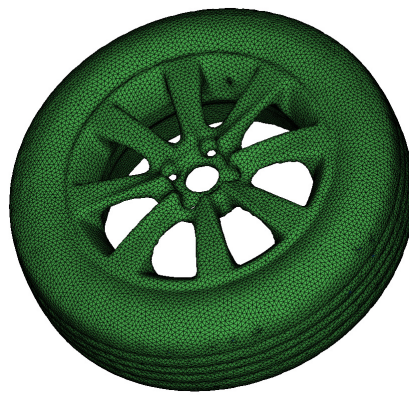
Shaded View   Wireframe View   Hide Selected View
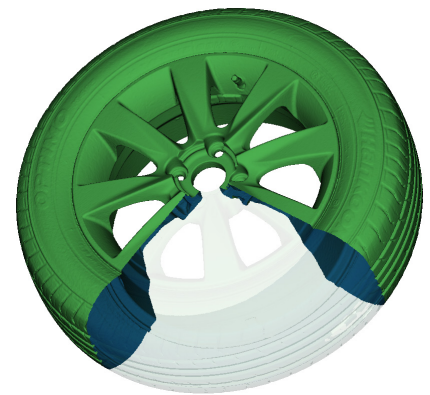
To hide a part of a model, use any selection tool to select a region to be hidden, and click Hide selected:
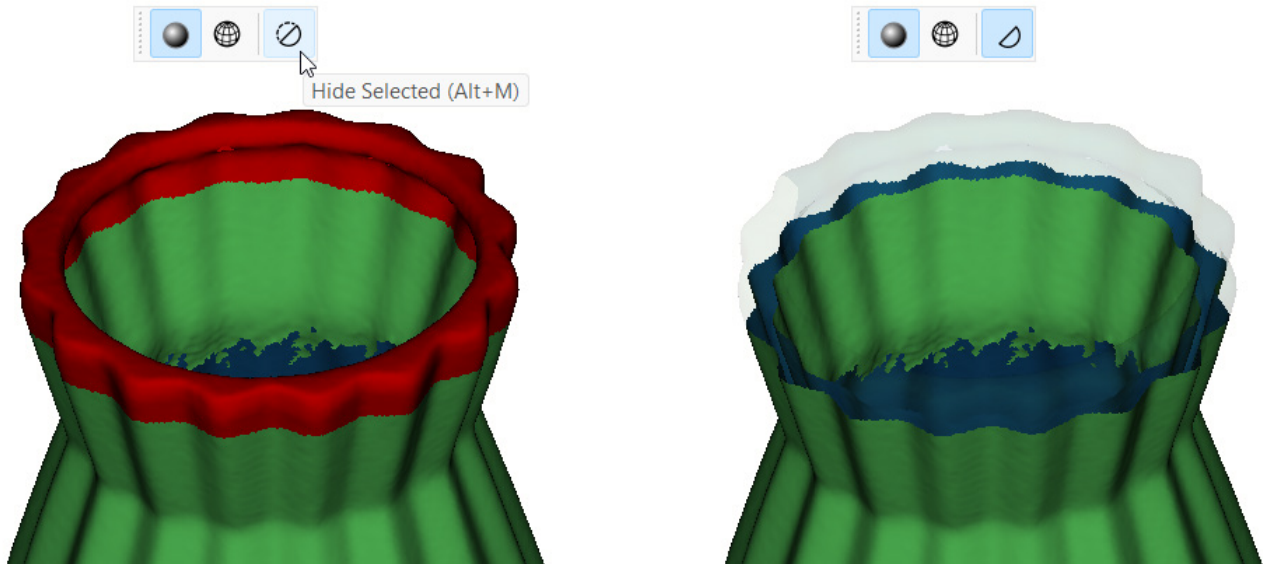
Hiding parts of a model may be done incrementally, step by step. After hiding certain parts, select next part and click Hide selected again — new area will be added to the already hidden one:
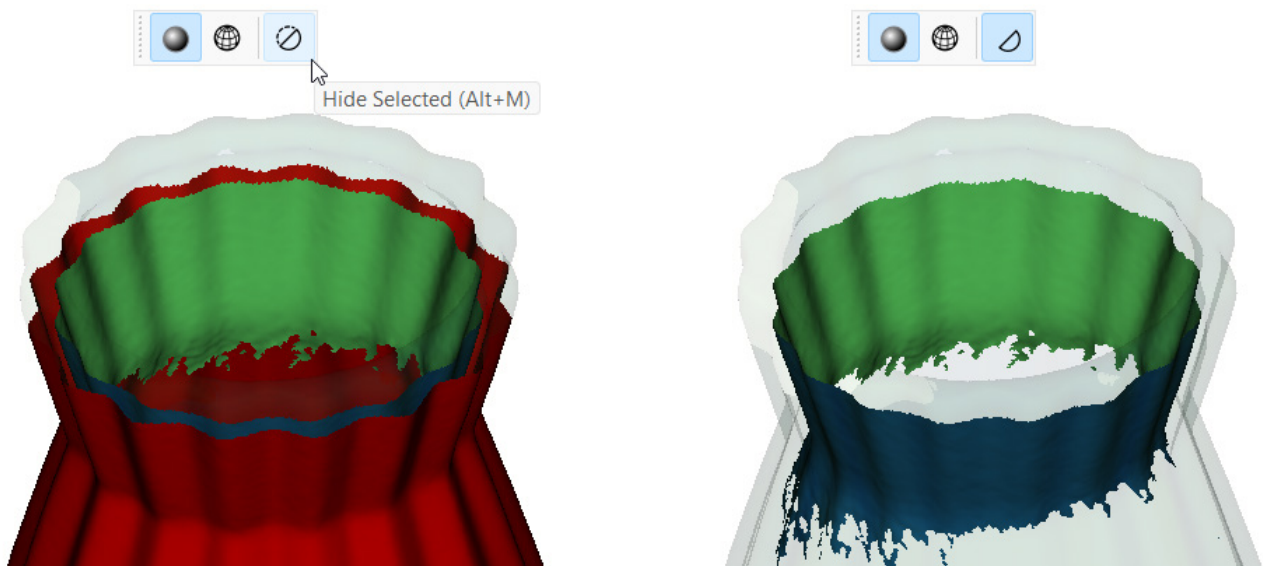
Doing so can give access to hard-to-reach areas for easier editing. For example, it helps remove this rough edge of this vase inner surface:

+ delete

If nothing is selected on the model, the button Hide selected changes its shape and function to Show hidden — click it and all hidden surfaces will be shown again:

Show Hidden (Alt+M)
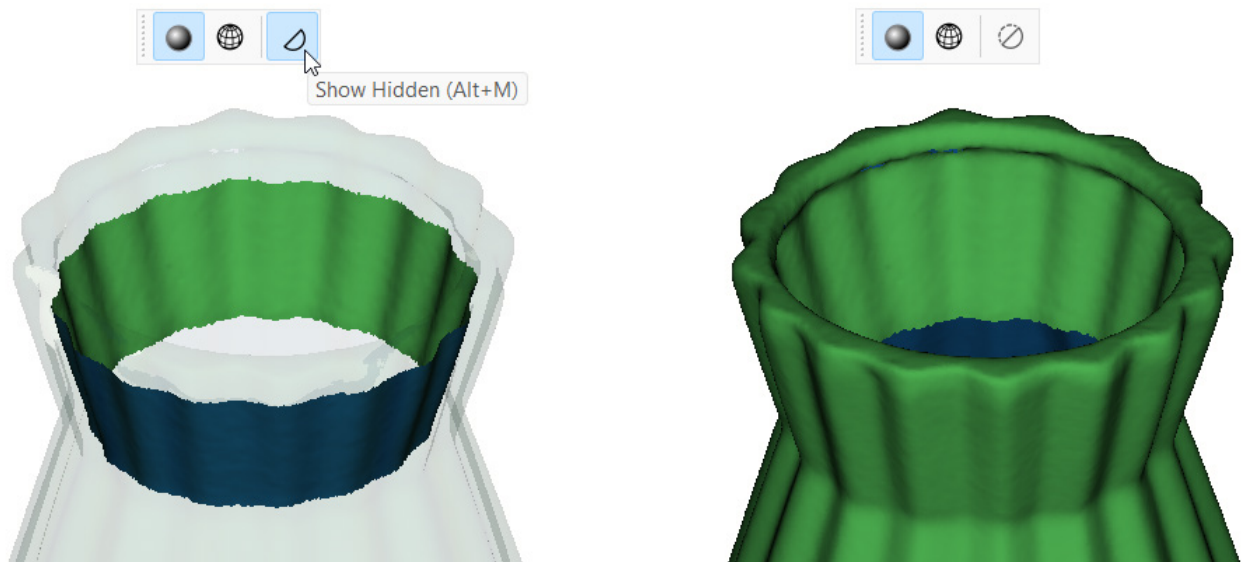
Points Priority Group

Tools of Points Priority group designed to mark some parts of data as support geometry without deleting them, but also without including them into a final model. Priority Mode is described in more detail in Chapter 8: Post-processing of a Scan and Chapter 9: Chapter 9: Assembling a 3D Model from Several Scans.

Points Priority group consists of the following buttons:
• Priority Mode switch on/off — toggles between showing Priority Mode mark-up or showing the entire data set
• Set as Object (Home) — marks selected data as important
• Set as Support Geometry (Shift+Home) — marks selected data as additional geometry that will not be part of a final model
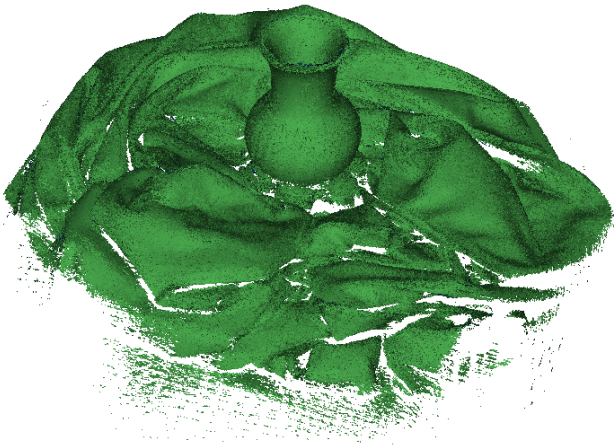
Point cloud before Priority Mode selection   Point cloud after Priority Mode selection
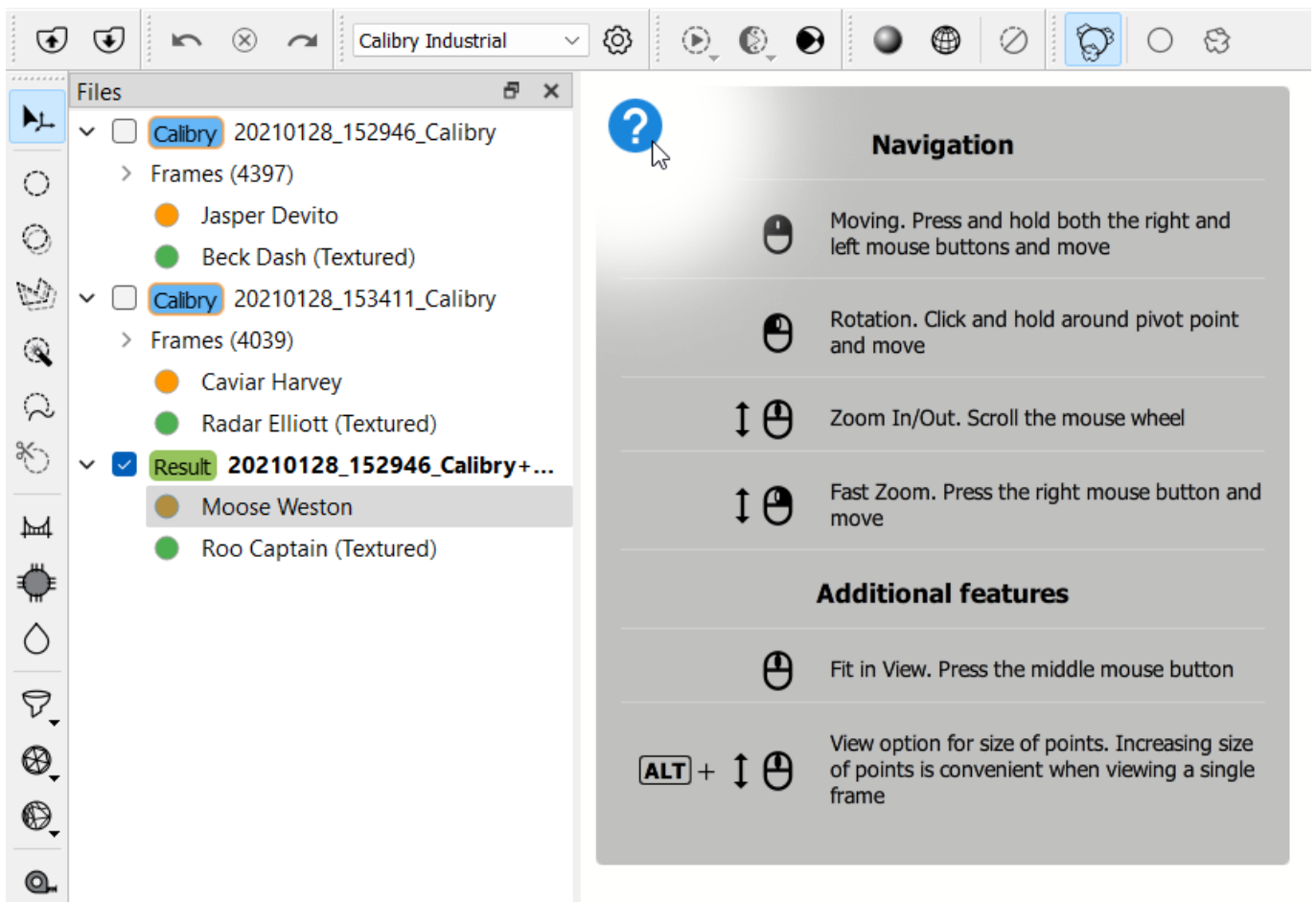
Side Toolbar

Depending on the post-processing stage and elements selected in the project list, different tools are displayed on the Side Toolbar. These tools help edit both point clouds (including separate frames) and polygonal results (textured or not). Some tools are available only if multiple elements are selected in a project tree.

Please do not forget about the Quick Help button. It shows what kind of actions are available in current mode or with a given tool:

Navigation

Navigation tool helps move and rotate objects in the editing area. It works with all elements in the project tree. It can be activated by clicking the Navigation button on the Side Toolbar or by pressing V on a keyboard.

Also, Navigation tool can be temporarily activated by pressing and holding spacebar. It is convenient when using other tools — to rotate the object and continue editing.
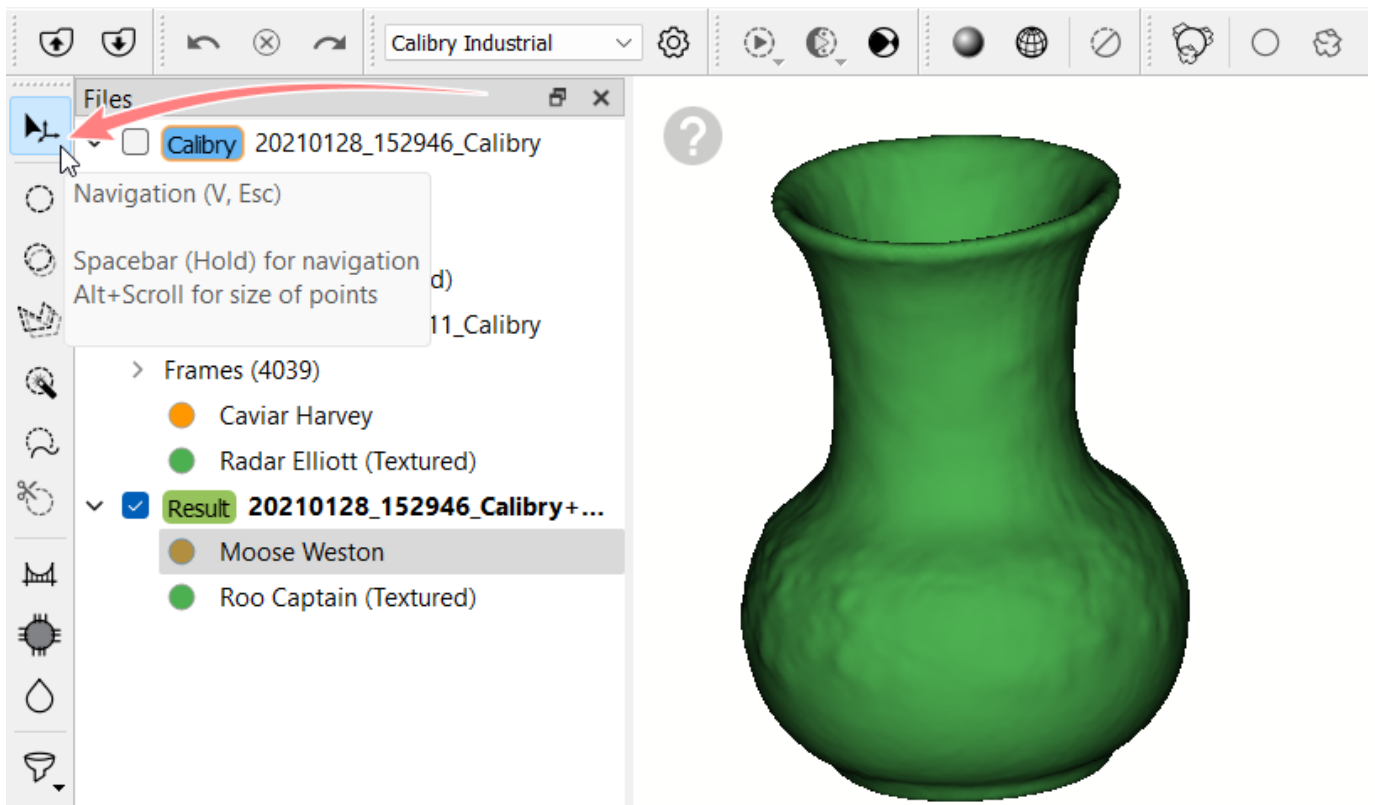
Marquee Brush (One-sided)

Marquee Brush is a selection tool available when working with an untextured polygonal mesh. To use the tool, select it on the Side Toolbar or press M.
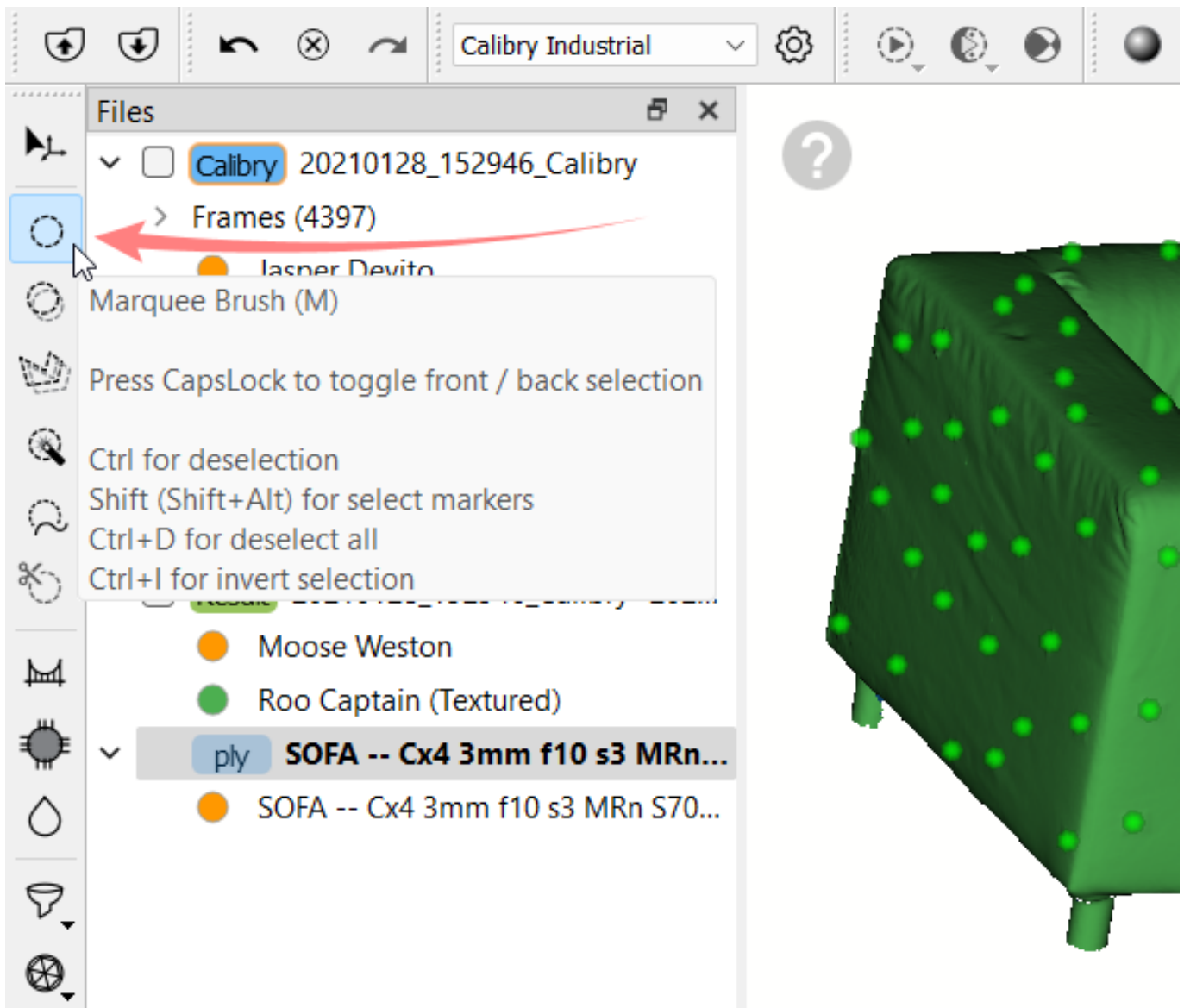
Scroll the mouse wheel to change the size of the brush. Select the region of interest by left-clicking over it. To deselect a region, hold Ctrl when using the tool. If used with Shift, only markers will be selected. If used with Shift+Alt, both surface and markers will be selected. Press Ctrl+I to invert selection. Press Ctrl+D or Esc to cancel selection.
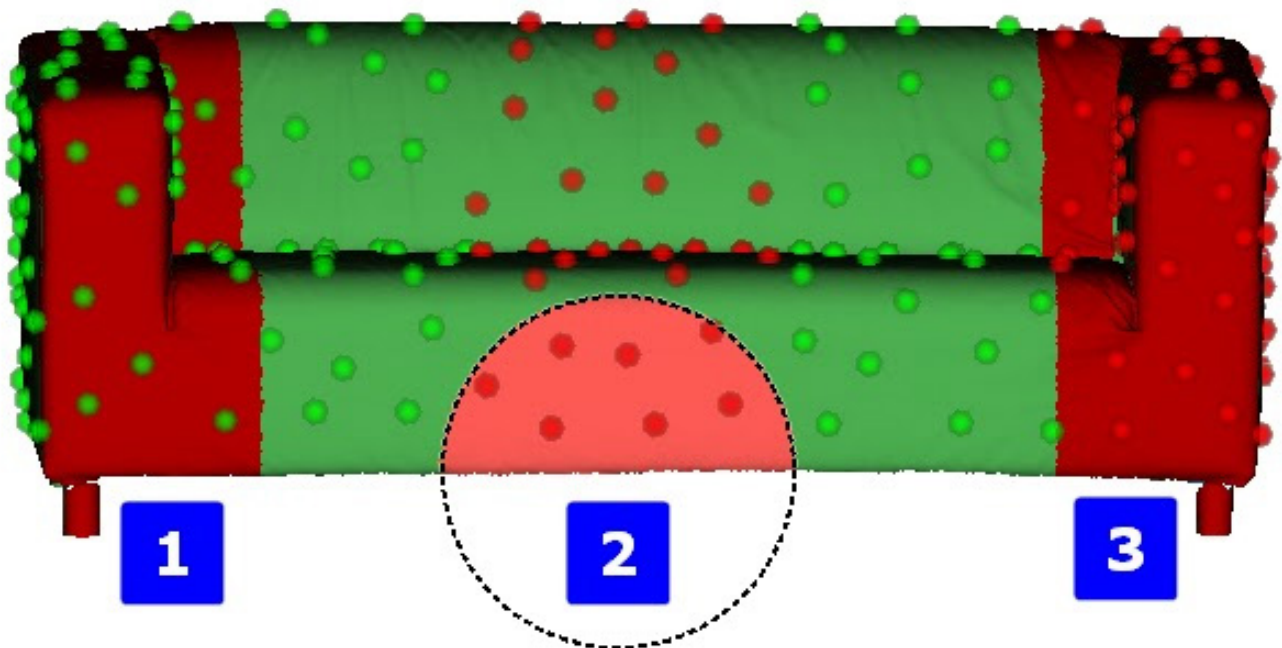
1 — left-click selection (surface selection only)
2 — left-click + Shift (selection of markers only)
3 — left-click + Shift+Alt (surface and markers selection)

Marquee Brush is one-sided, meaning it only selects what is visible. If parts of a model are obscured by other parts — they will not be selected.
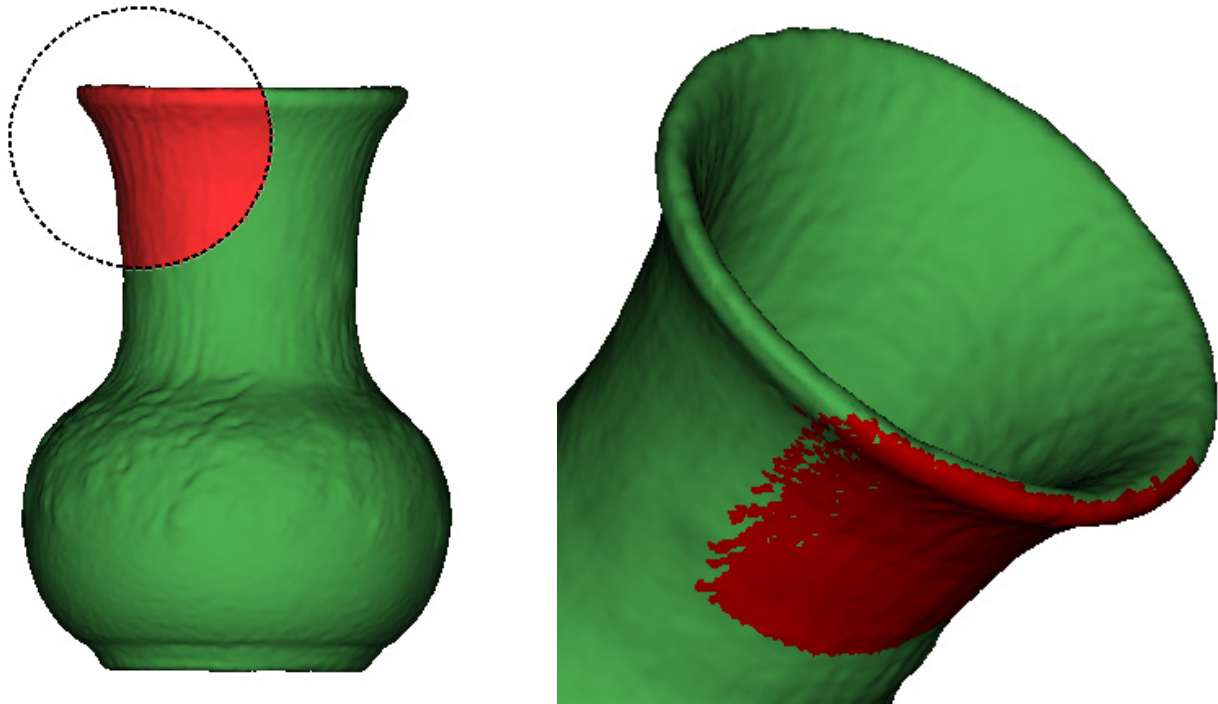
Also, by toggling Caps Lock, it is possible to switch between selection of only inner or only outer surfaces:
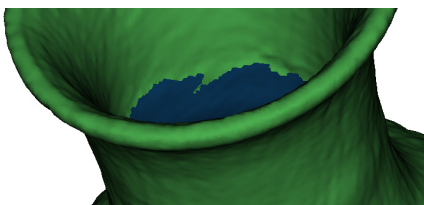
A region where both inner and outer surfaces are visible
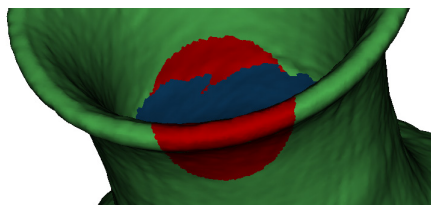
Caps Lock is off: only outer surfaces are selected
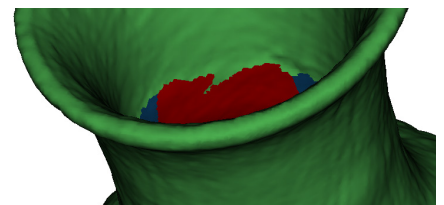
Caps Lock is on: only inner surfaces are selected

Marquee Double Side Brush

Marquee Double Side Brush is a selection tool available when working with a point cloud or an untextured polygonal mesh. To use the tool, select it on the Side Toolbar or press D.
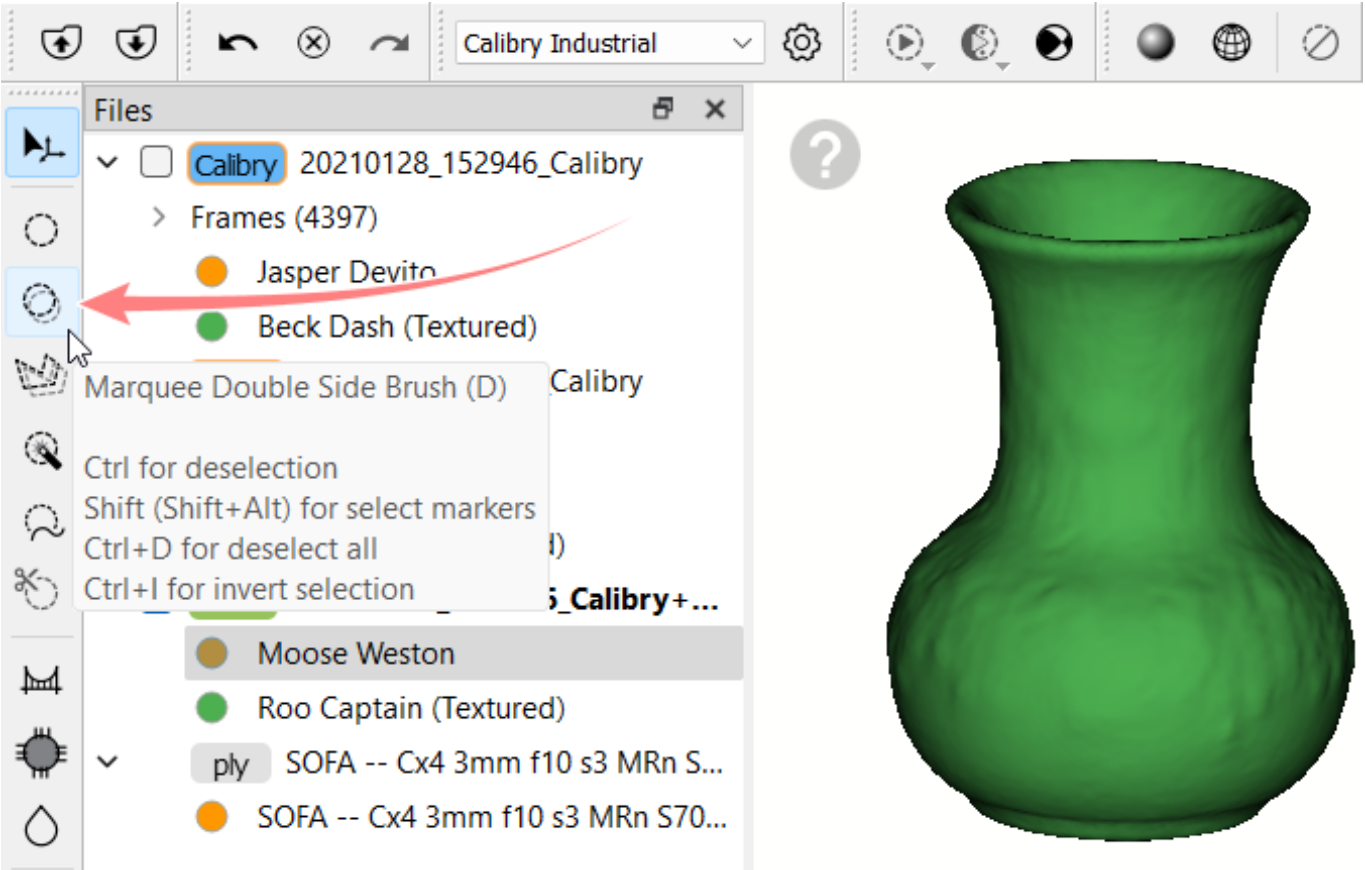
Scroll the mouse wheel to change the size of the brush. Select the region of interest by left-clicking over it. To deselect a region, hold Ctrl when using the tool. If used with Shift, only markers will be selected. If used with Shift+Alt, both surface and markers will be selected. Press Ctrl+I to invert selection. Press Ctrl+D or Esc to cancel selection.

As opposed to One-sided Marquee Brush, this brush selects not only visible areas, but also all areas underneath:
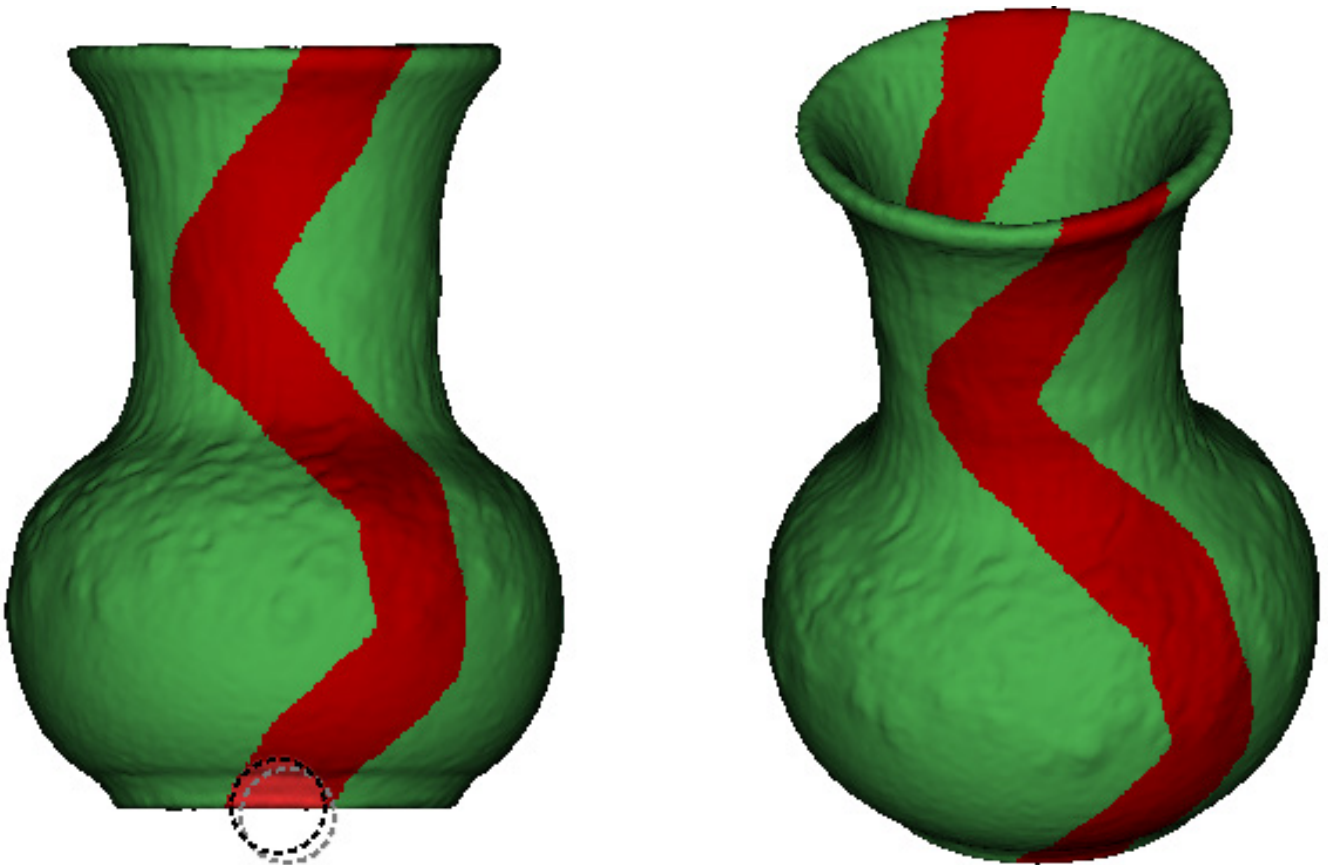
Markers selection is done similar to the One-sided Marquee Brush, but all markers under the brush are selected, regardless of their visibility.

Polygonal Lasso Marquee

Polygonal Lasso is a selection tool available when working with point cloud or an untextured polygonal mesh. It works like Double-sided Marquee Brush, but the selection area is defined by drawing a polygon. To use the tool, select it on the Side Toolbar or press L.
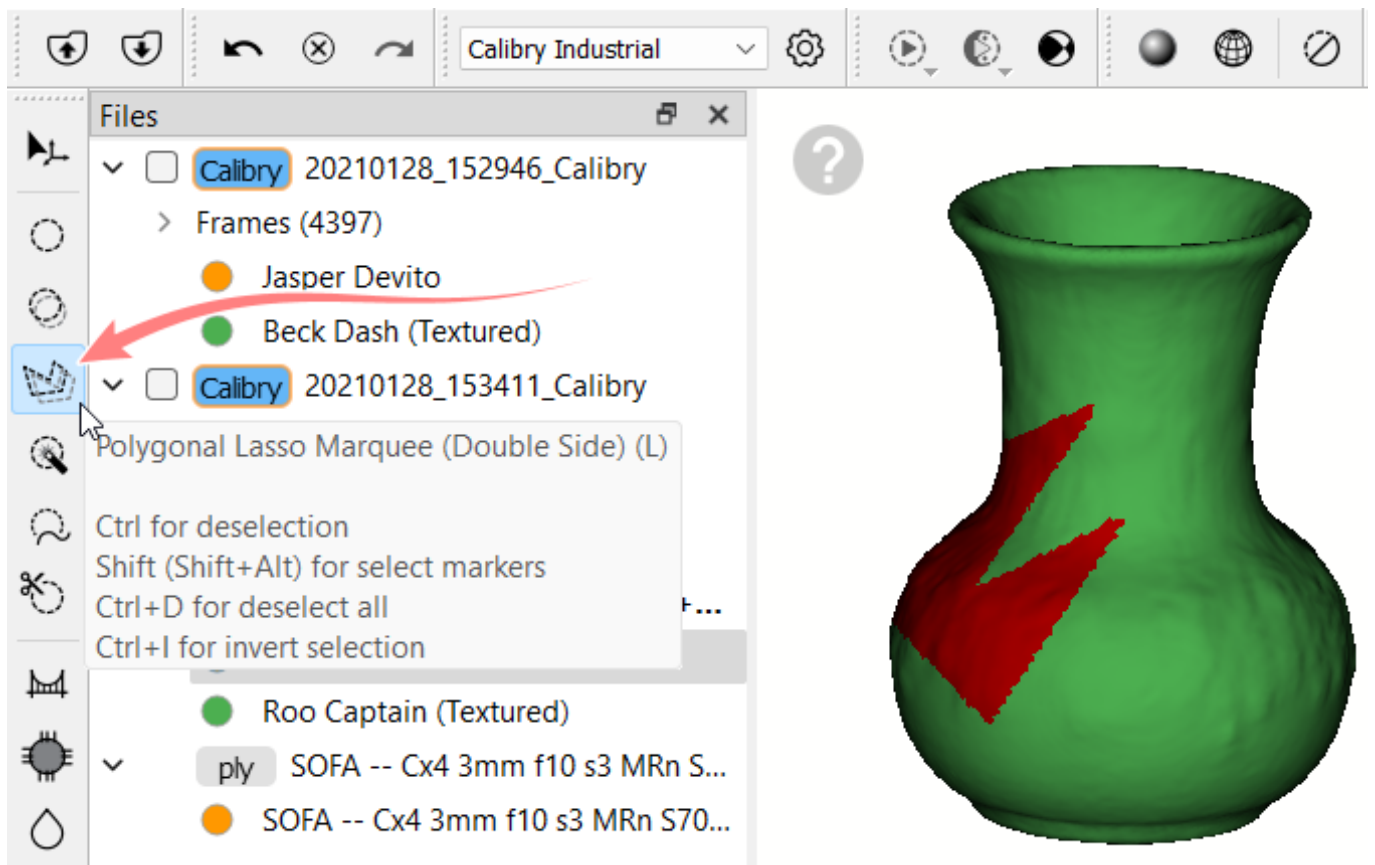
To define a selection area, left-click on a point and move the mouse to another point and left-click again. Repeat until the area of interest is enclosed in a polygon. Right-click to finish selection. To deselect a region, hold Ctrl when using the tool. If used with Shift, only markers will be selected. If used with Shift+Alt, both surface and markers will be selected. Press Ctrl+I to invert selection. Press Ctrl+D or Esc to cancel selection.
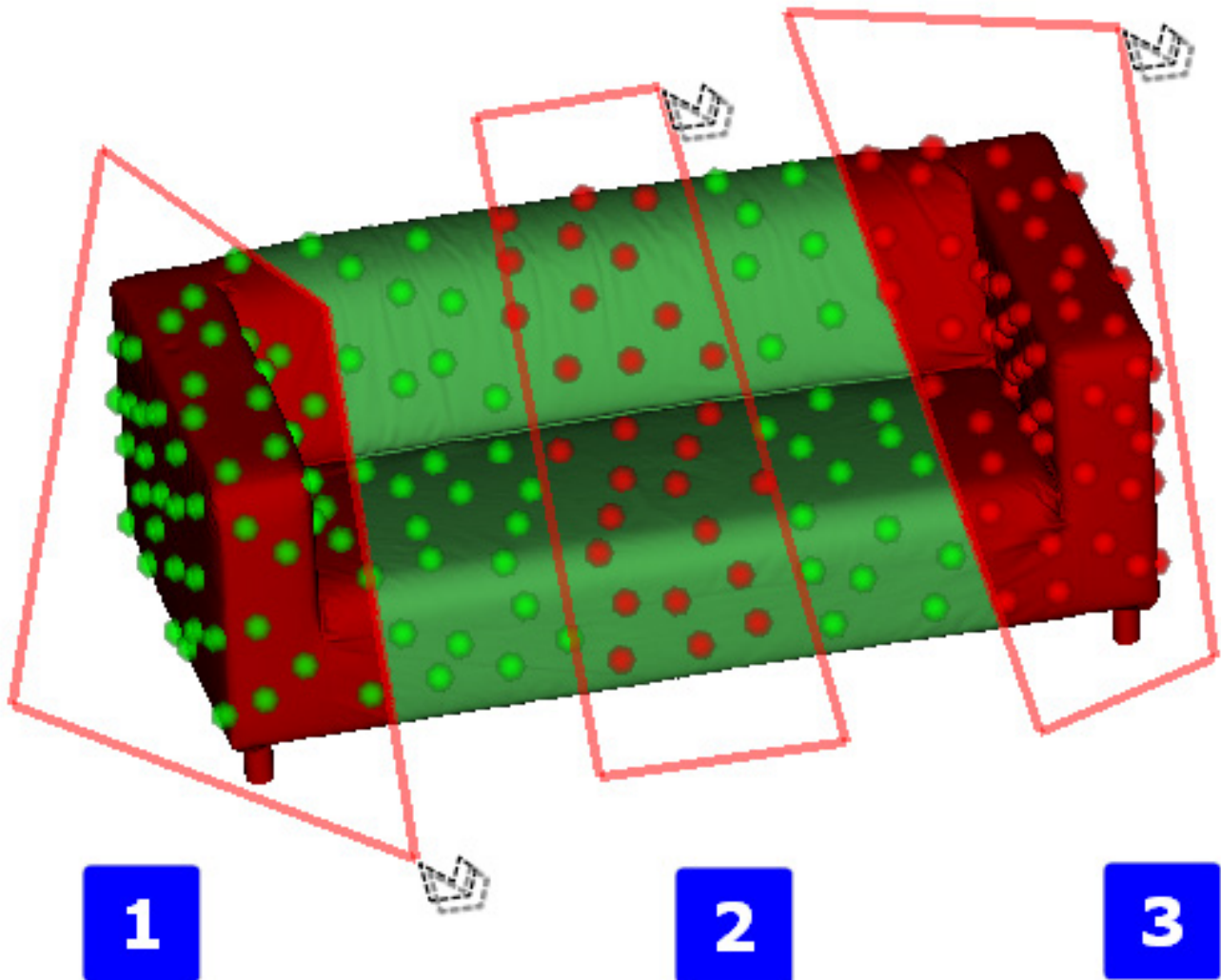
1 — mouse selection (surface selection only)
2 — mouse selection + Shift (selection of markers only)
3 — mouse selection + Shift+Alt (surface and markers selection)

Magic Wand

Magic Wand is a selection tool available when working with an untextured polygonal mesh. It allows selection of separate mesh elements that aren't connected. To use the tool, select it on the Side Toolbar or press W.
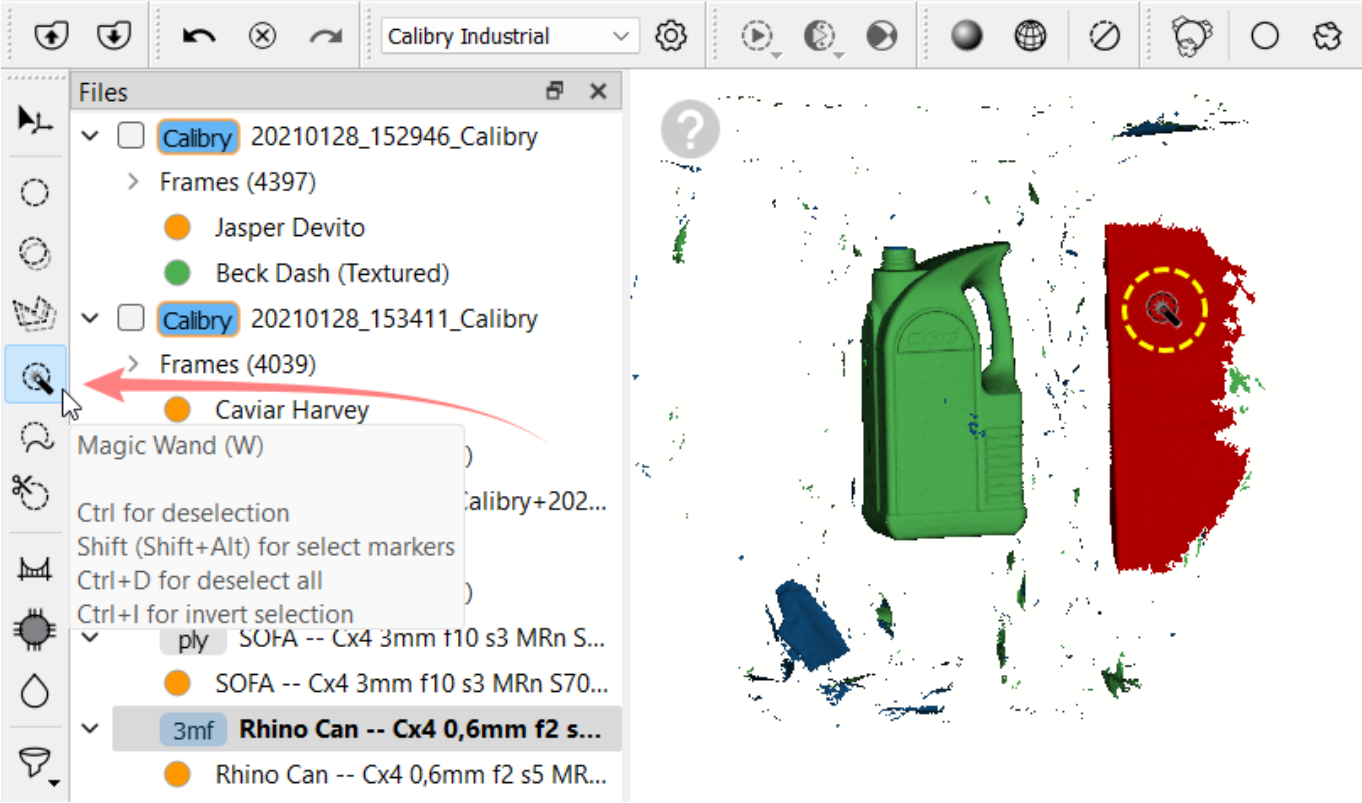
Magic Wand may be particularly useful in combination with inversion of selection (Ctrl+I). Main object can be selected first, then selection can be inverted by pressing Ctrl+I. If no useful parts are selected after that — just press delete to remove all the needless elements of the mesh:

Select the main object with Magic Wand

Make sure that no stray objects are selected

Invert selection (Ctrl+I)

Press Delete to remove needless elements

Same effect can be achieved with Filtering by Size tool (explained below), but keep in mind that the biggest element is not always the most important. Plus, the method described above allows visual control of elements marked for deletion (they will be selected first).

Curvature Selection

Curvature Selection tool allows to select certain areas of a model based on their curvature. This tool may be useful both for deleting needless parts or for leaving only specific parts of the model for further processing in third-party applications (e.g. for reverse engineering). To use the tool, select it on the Side Toolbar or press C.
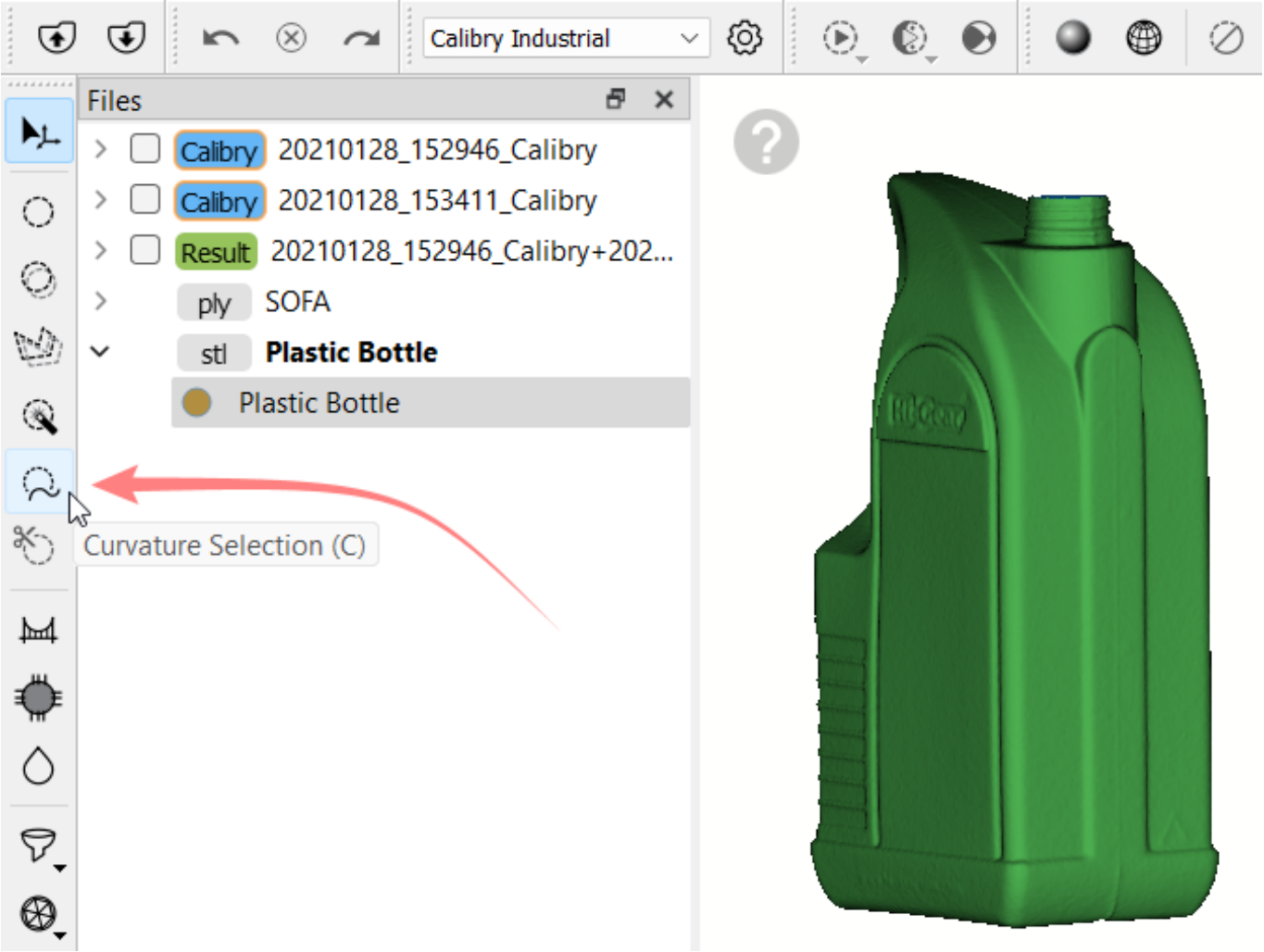
Before curvature-based selection can be performed, it is necessary to set the Filter Size and to analyze the model. Filter Size is a value from 2 to 10 that determines the sensitivity of the tool to changes in curvature. The higher the value, the lower the sensitivity of the tool to local curvature differences. After Filter Size is set, click Calculate Mean Curvature to begin the analysis:
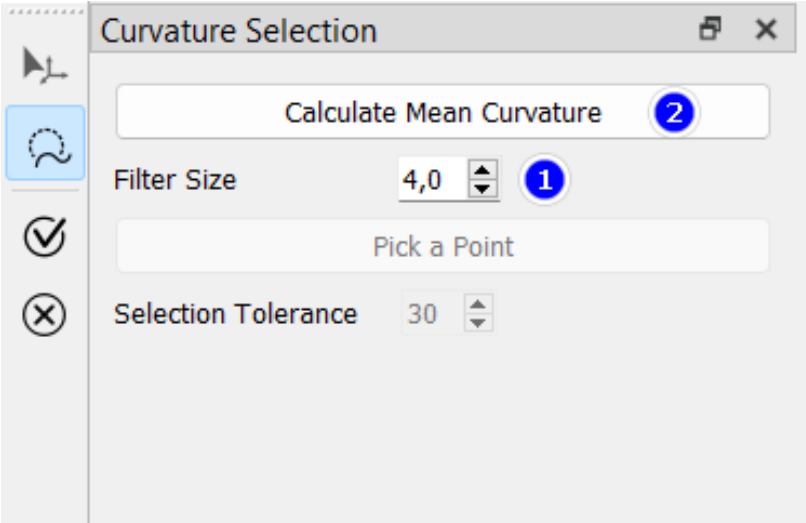
After the analysis is complete, the model will be presented as a color map of curvature changes. Smooth and subtle changes in curvature are marked displayed in green, medium-level curvature changes are displayed in blue, and the most significant changes in curvature are displayed in red. Set a Selection Tolerance, click Pick a Point button and choose the point on the area needed to be selected.
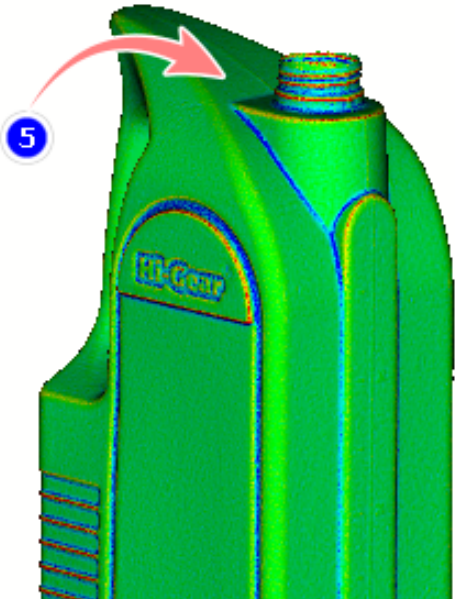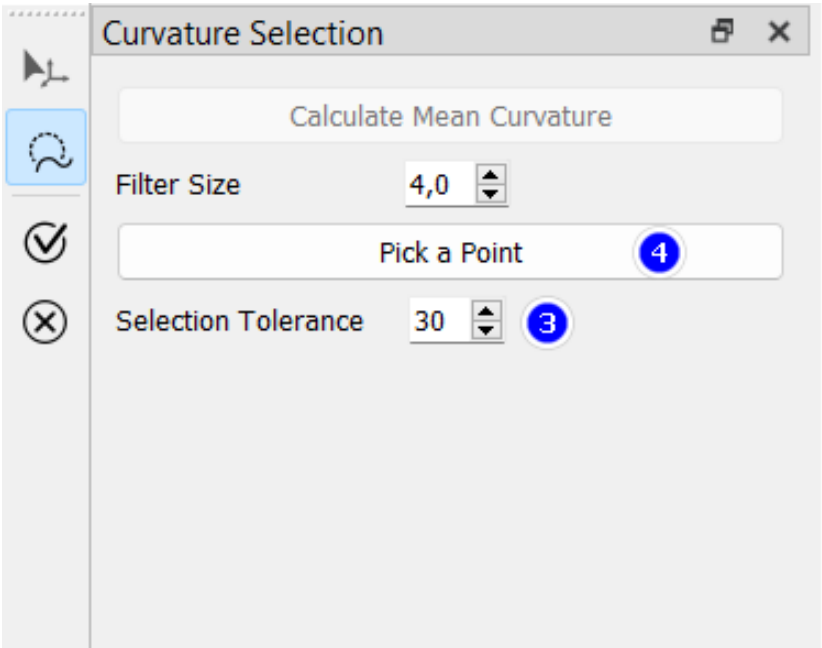
Adjust Selection Tolerance in such a way that the area of interest is selected as fully as possible, but without selecting adjacent areas:
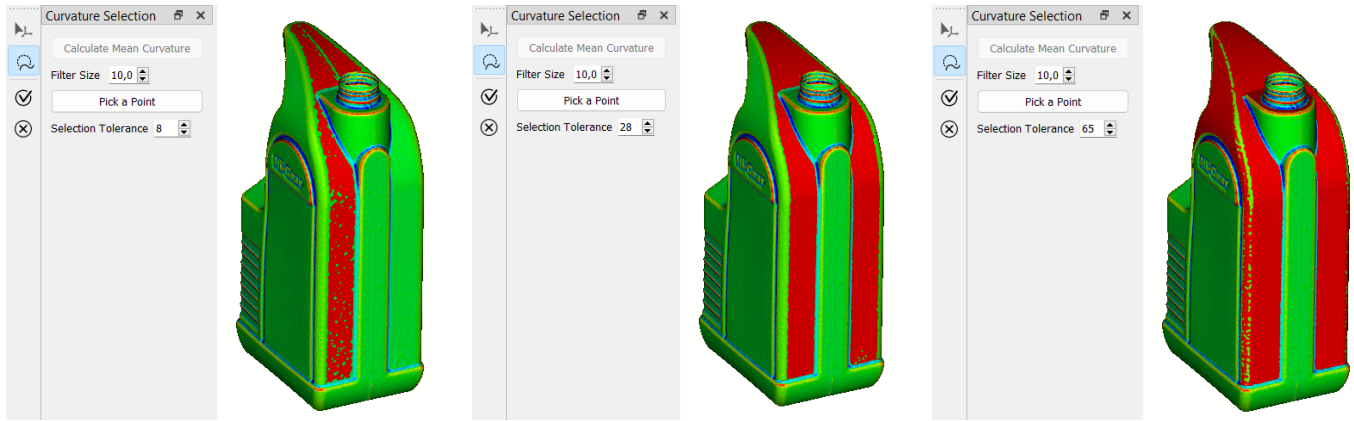
Tolerance value is too low: the desired area is not selected completely

Tolerance value is optimal: the desired area is almost completely selected

Tolerance value is too high: adjacent areas are included in the selection

After optimal values of Filter Size and Selection Tolerance are found, click Accept Changes or press Ctrl+F:
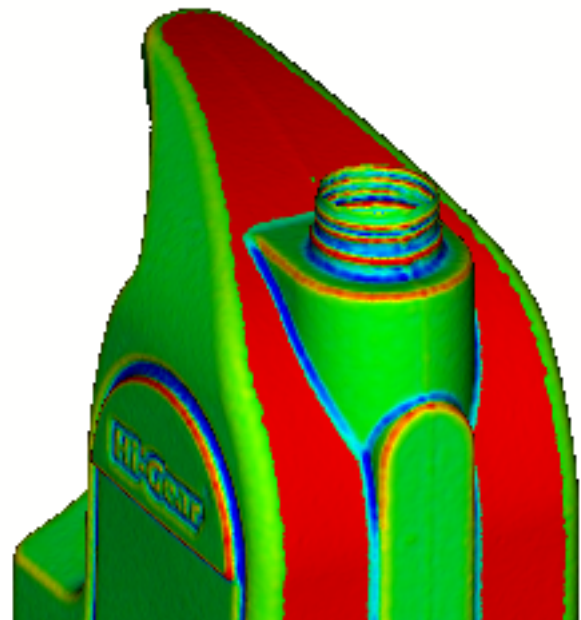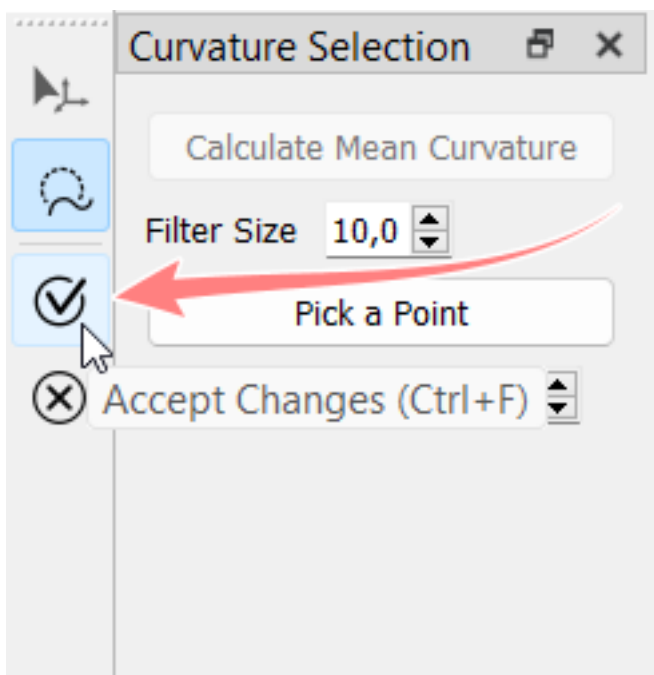
After that, it is possible, for example, to invert selection (Ctrl+I) and delete needless data to save only required part of the model:

Cut

Cut is a tool for deleting parts of point clouds and untextured polygonal models. Select needless parts using any selection tool and then pick the tool on the Side Bar or press Delete. Take note that if there is no selection, the tool will be inactive.
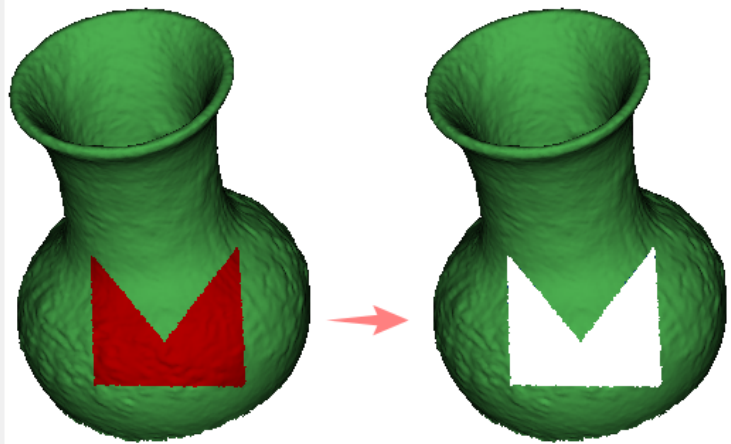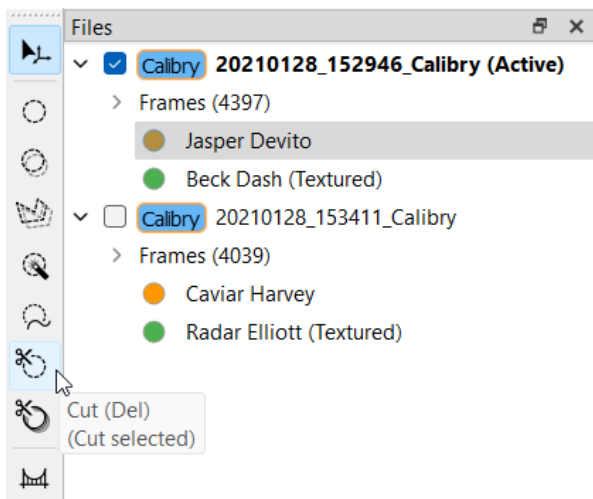
Cut on Frames

Cut on Frames is a tool that not only deletes the parts of a polygonal model (as Cut tool does), but it also deletes corresponding areas of the underlying point cloud. This tool is only active on results with frames and will not be available on point clouds, standalone models and results of multiple scans.

To use the tool, select a part of a scan result and click Cut on Frames on the Side Bar, or press Shift+Delete.
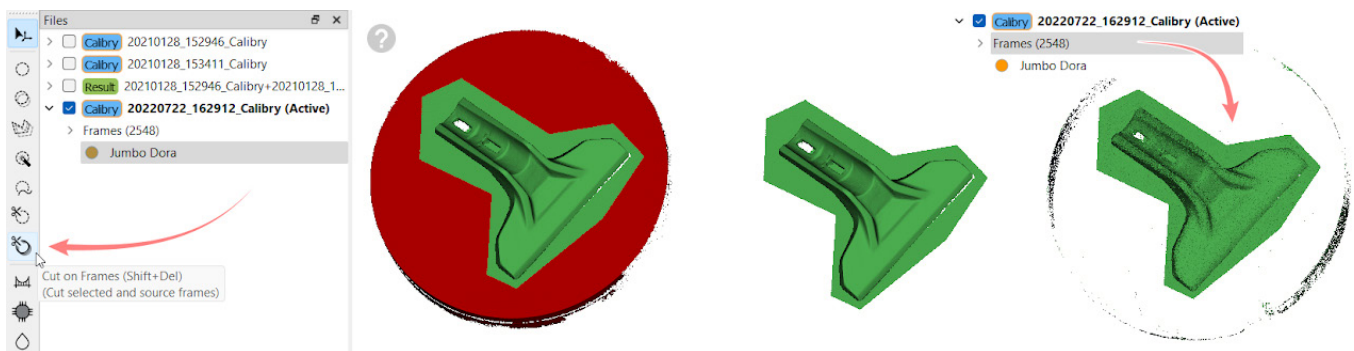
The selected areas are cut not only from the result, but also from the point cloud. Take note that some points can remain on the point cloud, because they might not have been used for building a model (e.g. noise if preliminary cleaning has been disabled during post-processing).

Also, it is important to remember that editing point clouds can negatively affect registration algorithms, especially when assembling the final model out of several scans. Therefore, it is generally recommended to mark these areas as support geometry instead of deleting them. It is achieved with Priority Mode, described in more detail in Chapter 9: Assembling a 3D Model.

Bridge

Bridge tool allows to create a thin polygonal sliver, connecting two sides of a hole. It helps segment big holes, making filling them faster. In many cases it also allows to better preserve topology and geometry of a model. To add a bridge, click Bridge on the Side Toolbar or press B.
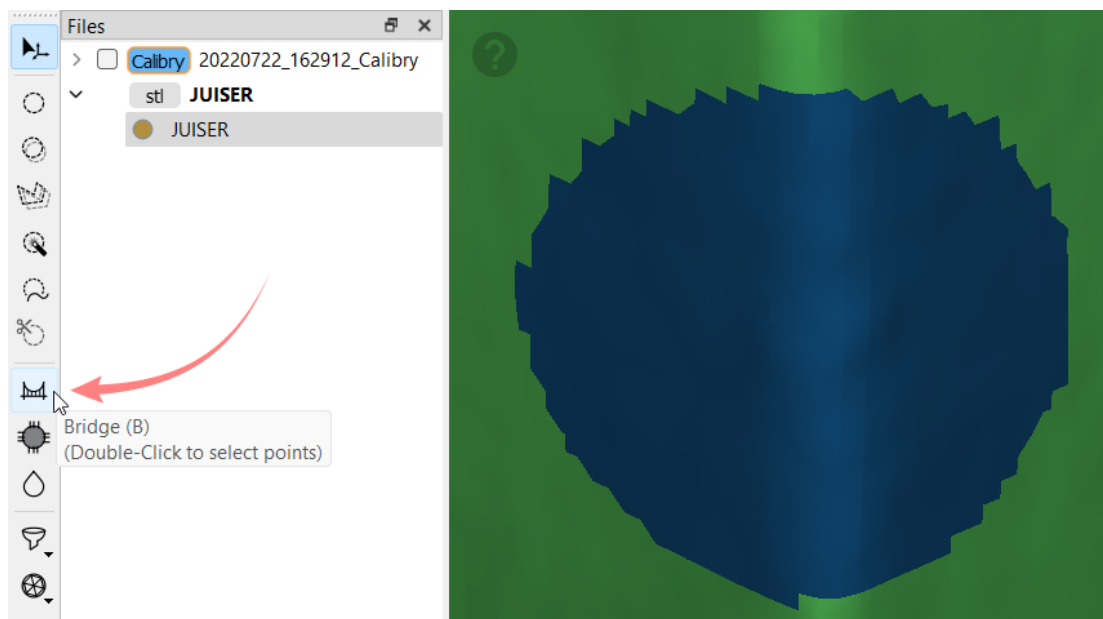
Pick two points on either side of a hole. To pick a point — just double-click on it. When finished, click Accept Changes to create a bridge:
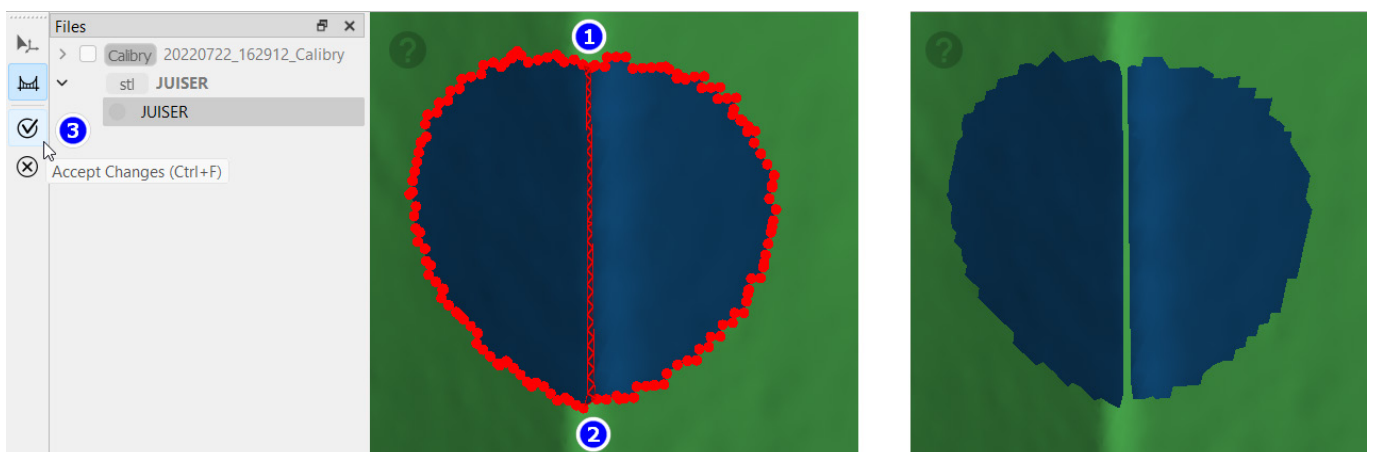
Now the hole has two segments that can be filled separately. In many cases it leads to better results. Plus, oftentimes, some segments may simply be left unfilled. It all depends on the final goal.

If needed, each of these segments can be further segmented into even smaller ones using the same approach.

Fill Selected Holes

Fill Selected Holes shows regions where data is missing and allows to fill those regions with interpolated data. Simply put, it uses the edge of a hole to reconstruct the data in a missing area. This tool is for untextured polygonal meshes only. To use the tool, click on it on the Side Toolbar or press F.
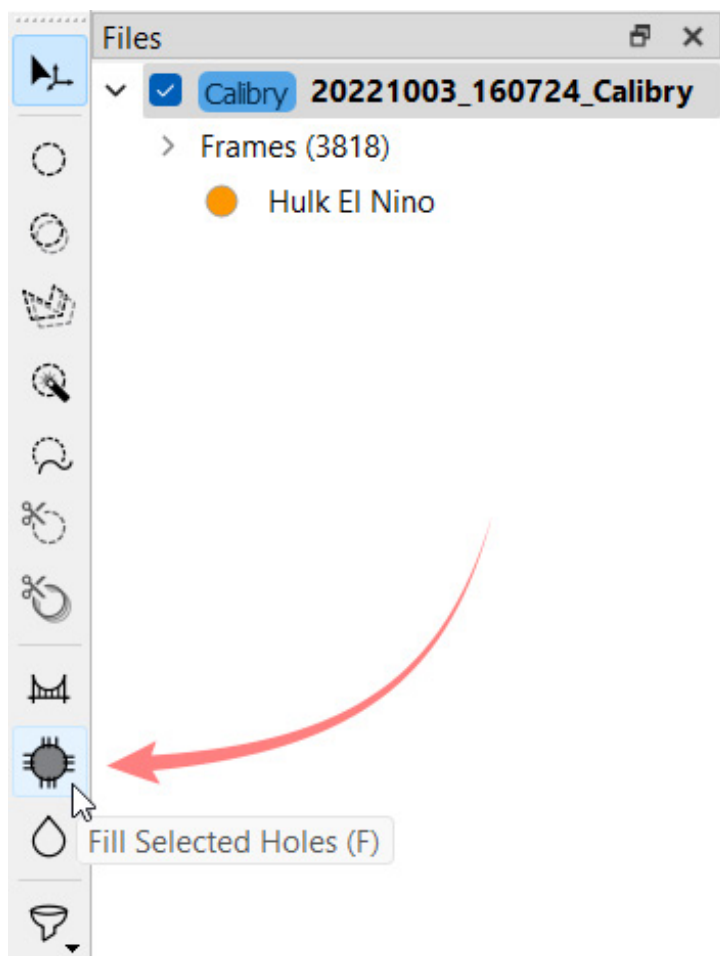
The tool will show a list of holes sorted by size — the biggest on top. In the editing area all holes will be mark with bright green contours. Holes to fill can be picked either from the list or directly on the model. Selected holes are shown both on the list and on the model (with bright blue). When the mouse pointer hoveres over the edge of a hole, its contour changes color to red. Left-click to select the hole. Left-click again to deselect it.
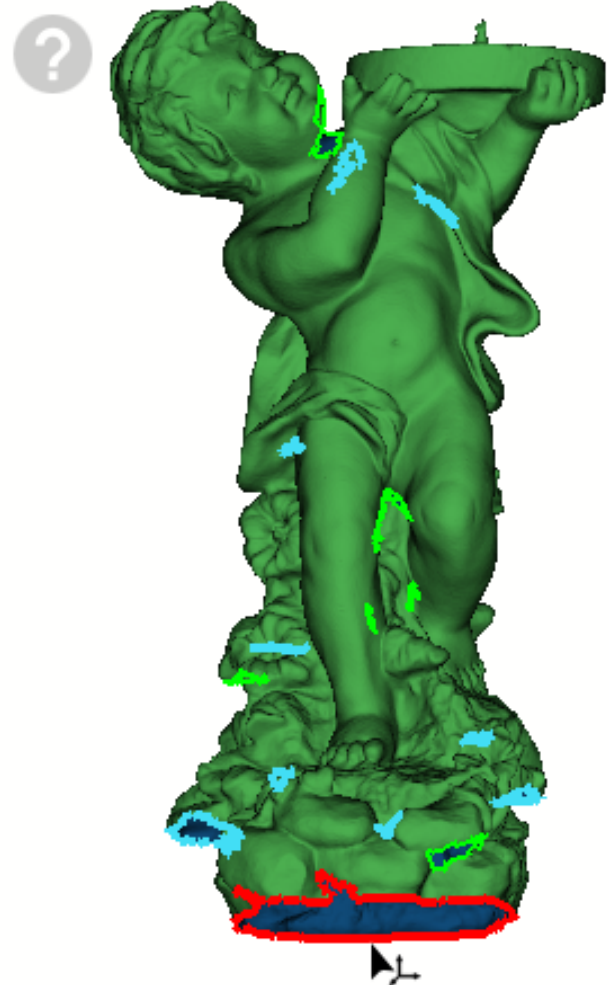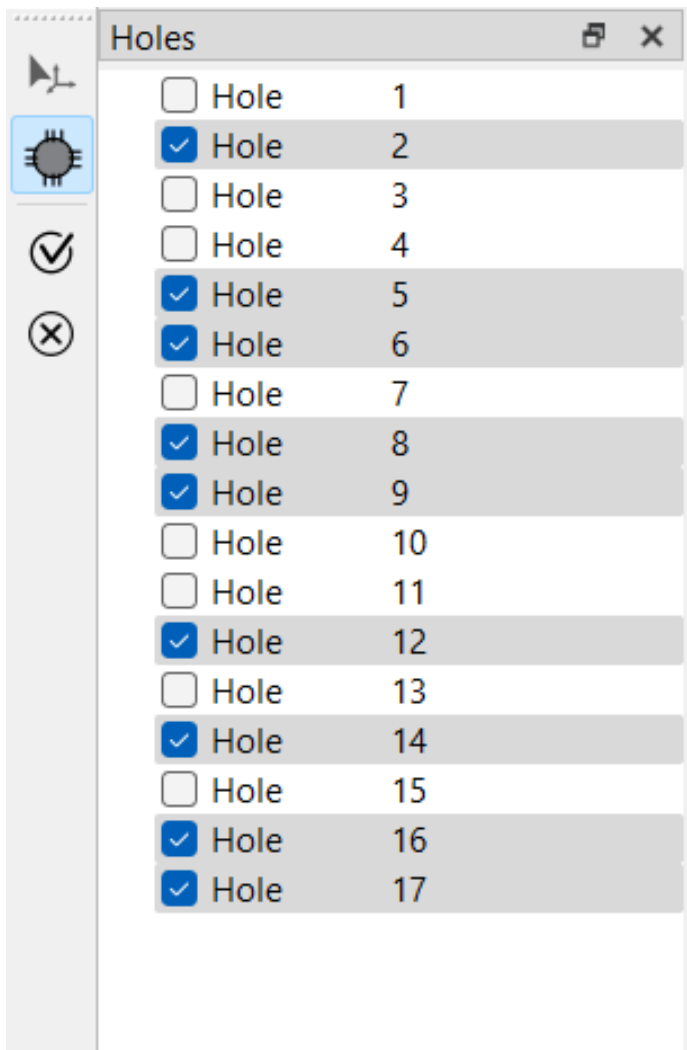
It is also possible to press Ctrl+A to select all holes. After holes to be filled are selected, click Accept Changes or press Ctrl+F to fill them:
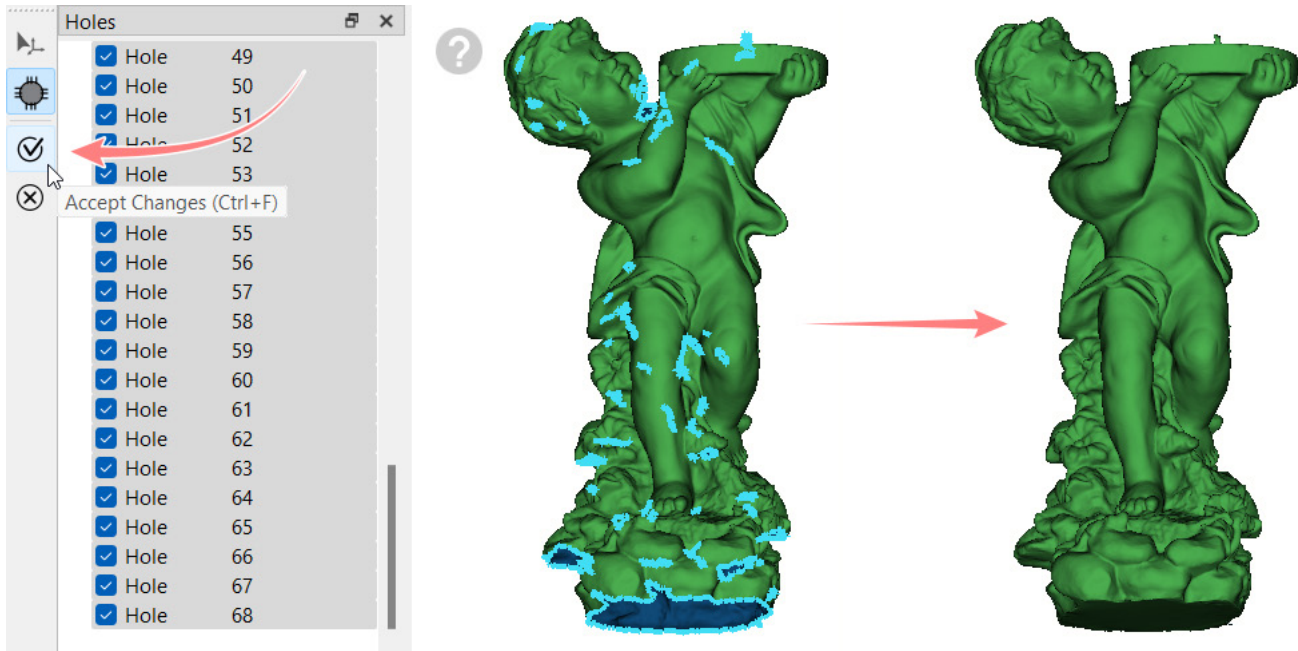
Hole filling algorithms work well on relatively small holes with clean edges. But as the size of holes increases, the possibility of filling errors also goes up. It is especially true if a substantial part of a surface is missing and the geometry of it is complex. In such cases it is preferable to make additional scan of such areas and fuze it with existing data.

If a model has too many small holes (hundreds), most likely hole filling was deactivated in finalization settings or the radius of auto-filled holes is too small. These small holes can be filled both during finalization or with this hole-filling tool after finalization is complete.

It is usually a good idea to first fill the smallest holes (the bottom part of the list) and leave 10-20 biggest holes on top of the list unfilled. Chances are that big holes will be filled with artifacts and it is better either not to fill them at all or segment them first using bridges.

Smooth

Smooth is a tool used to make a rough polygonal surface more even and less grainy. It may prove useful with noisy low-quality scans or if the surface of the object is indeed uneven or dirty.

Often the Smooth tool not only makes the surface more appealing, but also makes it easier to process the model in downstream applications (e.g. during regioning for reverse engineering). But overuse of the tool may cause some details to be lost.

Pick the tool on the Side Toolbar or press S.
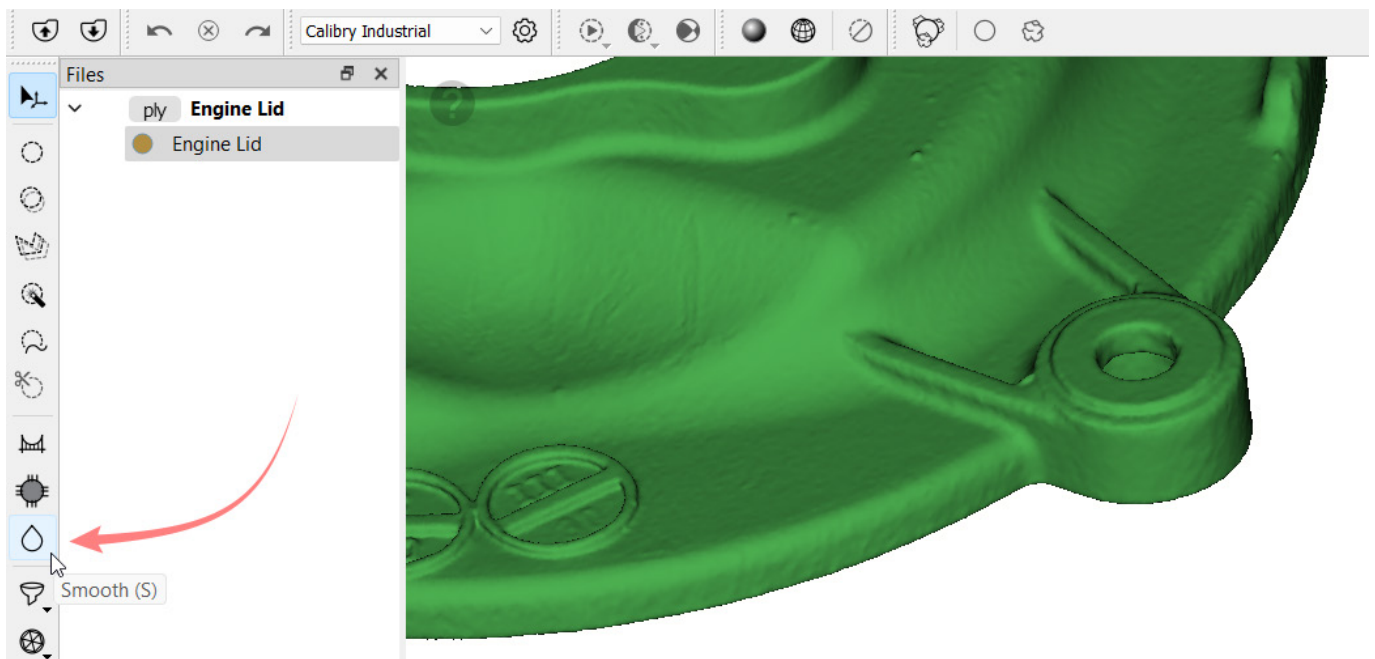
Set the size of the smoothing brush by scrolling the mouse wheel. Left-click the area needed to be smoothed. Moving the brush over the area while holding left mouse button or repeating left clicks makes the area gradually more smooth. After the desired result is achieved, click Accept Changes or press Ctrl+F:
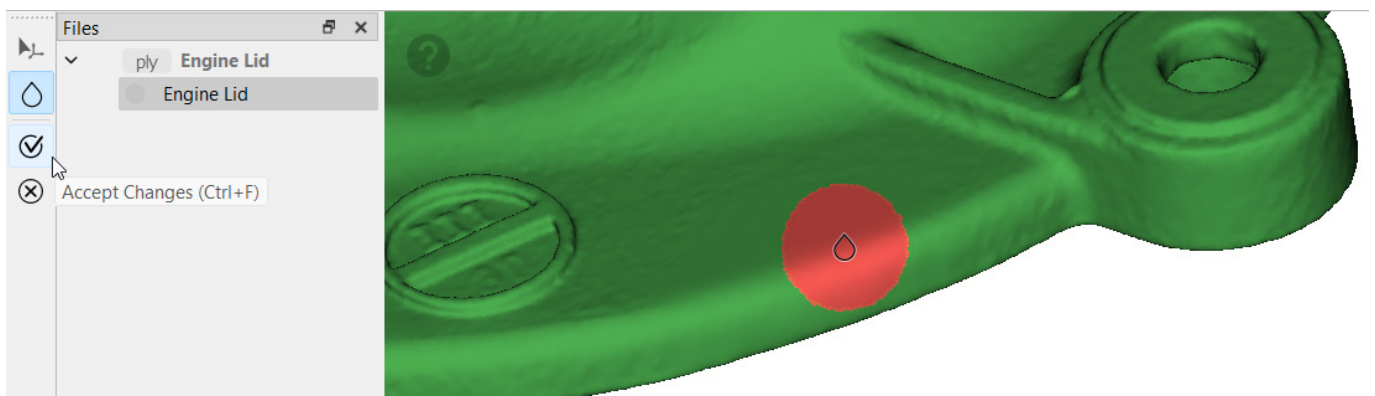
Filtering by Size

Filtering by Size is a tool that helps quickly remove small needless leftovers that may show up on the final model if no filtering was performed during registration, or after assembling the final result out of several separate scans. Chances are that these little pieces have nothing to do with the object itself and can be safely deleted.

To run Filtering by Size pick the tool on the Side Toolbar or press Alt+F. Specify filtering method. Leave the biggest part just removes everything except the biggest segment of the model. Remove parts smaller than removes all the fragments that are smaller than the threshold specified:

Before using Leave the biggest part option it is a good idea to visually check if the main object is indeed the biggest. Often, the surface on which a part was scanned may be bigger than the scanned object itself. In such a case, only the underlying surface will remain and everything else, including the useful object, will be deleted:
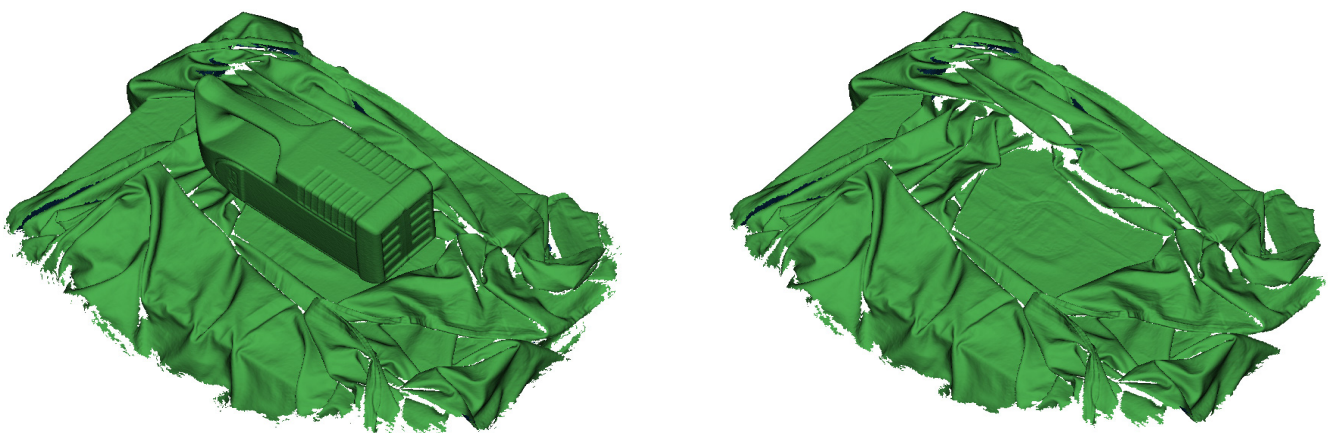
Remeshing

Remeshing is a tool that restructures a polygonal mesh, making it more uniform by replacing original triangles with equilateral triangles of a specified size.

To use the tool, click it on the Side Toolbar and specify the length of a triangle edge. The tool can also be run by pressing Alt+R, but no settings window will be shown and last used settings will be applied.

This function can be used as a way of simplifying the model, if the Edge Length is bigger than the resolution value. It is also a way of making the mesh more uniform, which can speed up texturing or further post-processing of a model, including editing in downstream applications. Plus, it makes the mesh more visually appealing in the wireframe view.

Still, if Edge Length value is too big, small details of a model can be lost. If Edge Length value is too small (smaller than resolution value), the amount of polygons may increase significantly (also increasing the amount of memory needed to store the model), but it will not increase the quality of a model and will not make it more detailed.
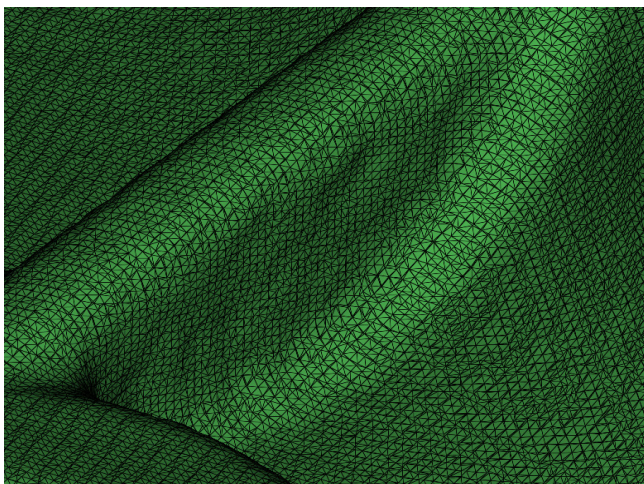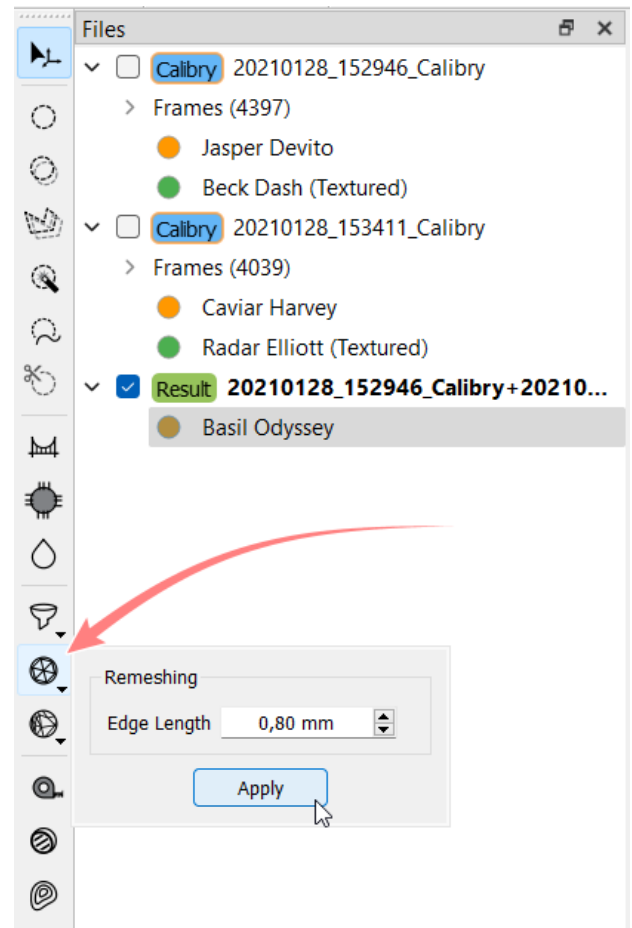
Mesh surface before remeshing
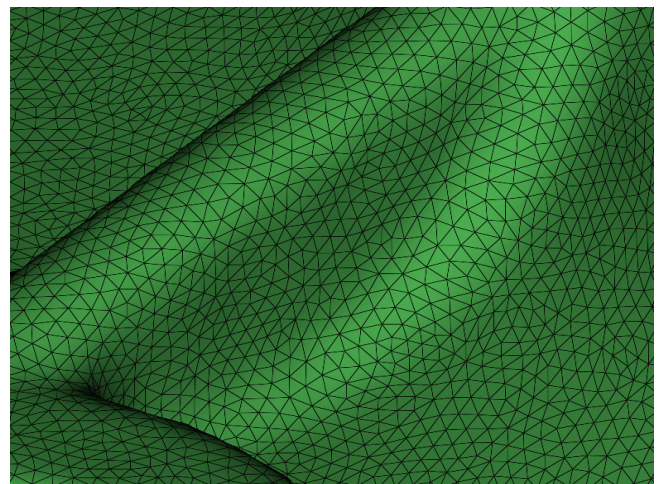
Mesh surface after remeshing

Simplify

Simplify tool reduces amount of triangles a polygonal model consists of. The degree of simplification can be set either as a percentage of the initial amount of triangles or as a specific number of them.

To simplify a model, click the tool on the Side Toolbar and choose the degree of simplification. The percentage value here states what percent of initial number of polygons will be used to build a simplified model. Mark Absolute checkbox to set a specific amount of polygons directly (the real amount of polygons used will be a bit smaller).
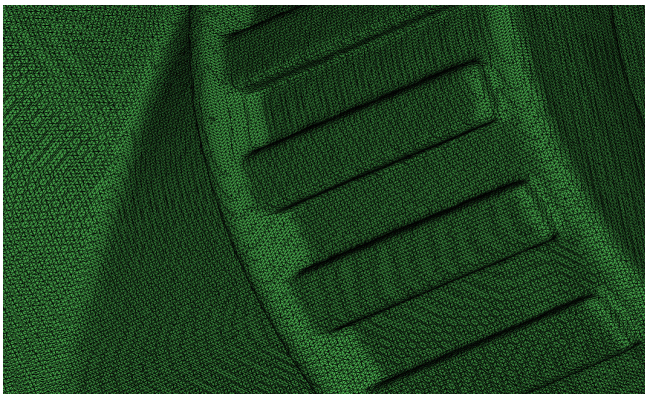
Part of a polygonal surface before simplification
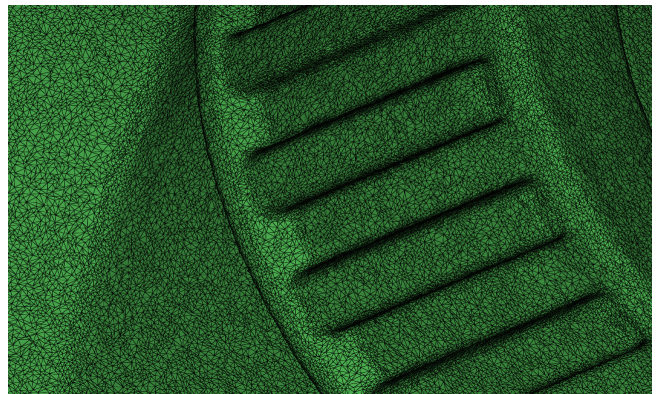
Part of a polygonal surface after simplification

The tool can also be run by pressing Alt+S, but no settings window will be shown and last used settings will be applied.

The main difference of the Simplify tool in comparison with the Remesh tool is the adaptive nature of simplification: during simplification the polygonal grid stays denser on corners, bends and other areas of high curvature to better preserve their details, whereas on more smooth and flat areas the density of the grid is reduced.

Ruler

Ruler tool is used to measure the shortest distance between two points (in millimeters). It is available when working with all project elements.

Activate Ruler tool by selecting it on the Side Toolbar or press R. Double click to set points. Hold Ctrl to move points.
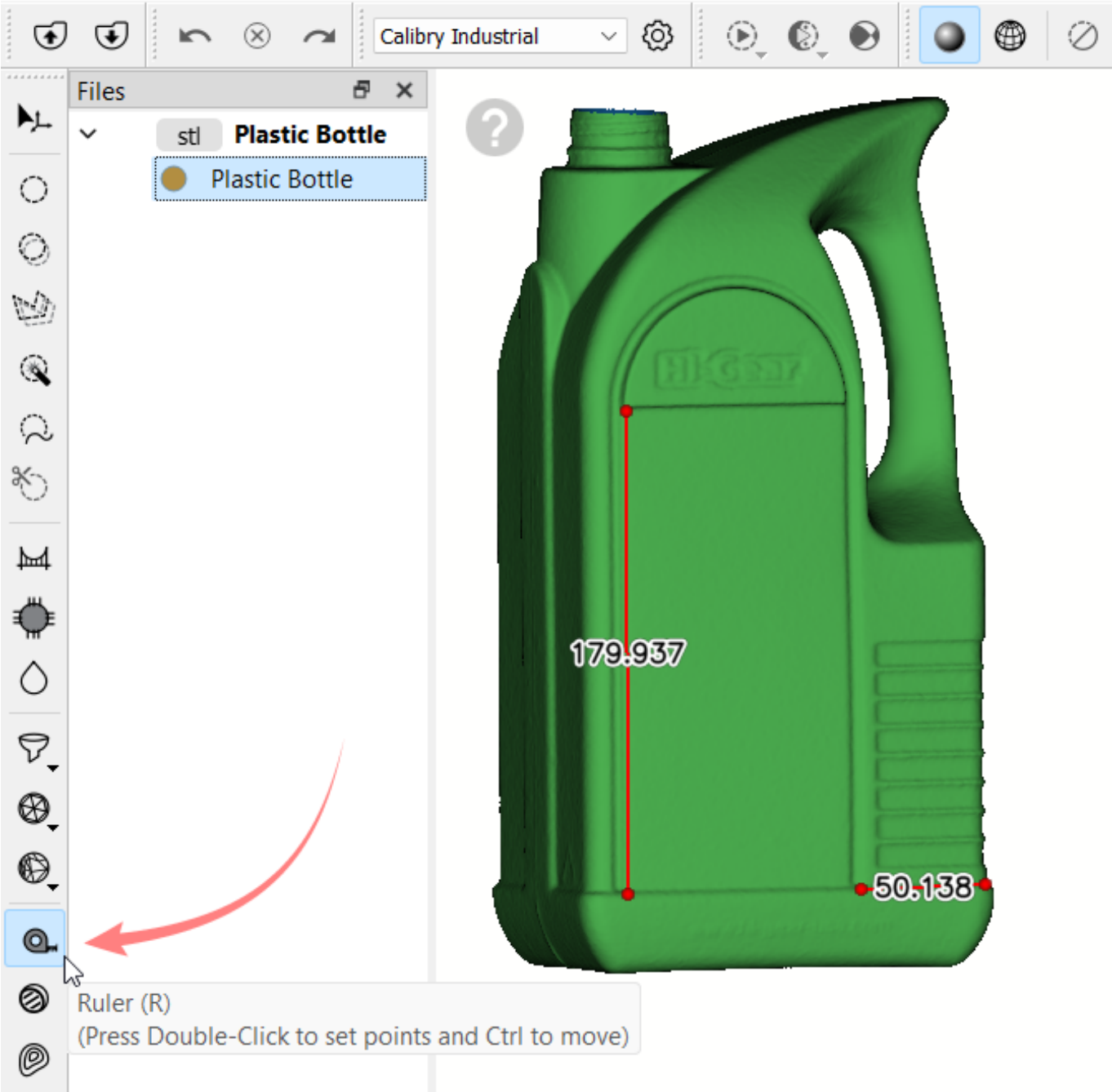
Section

Section tool allows to define a plane and use it to cut the model along this plane. Cutting plane can be defined using a line, three-points method or by fitting it to a selection.

Cutting plane can be used to cut away either side of a model, to measure a perimeter or an area of a cross-section, to save a cross-section profile as a 2D sketch (for further use in CAD applications), or to create a pedestal for a model.
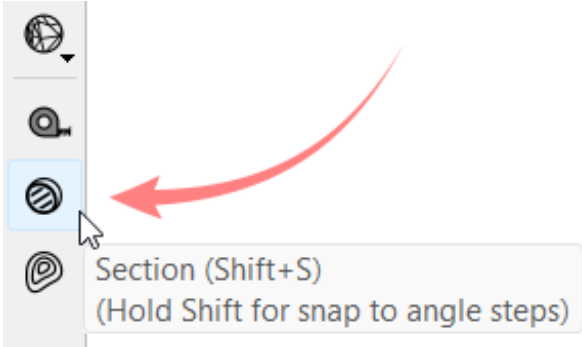
To run the tool, select it on the Side Toolbar or press Shift+S.

To define a cutting plane using a line, press «Define Section» button and draw a line. Hold Shift to keep the line vertical, horizontal or diagonal.
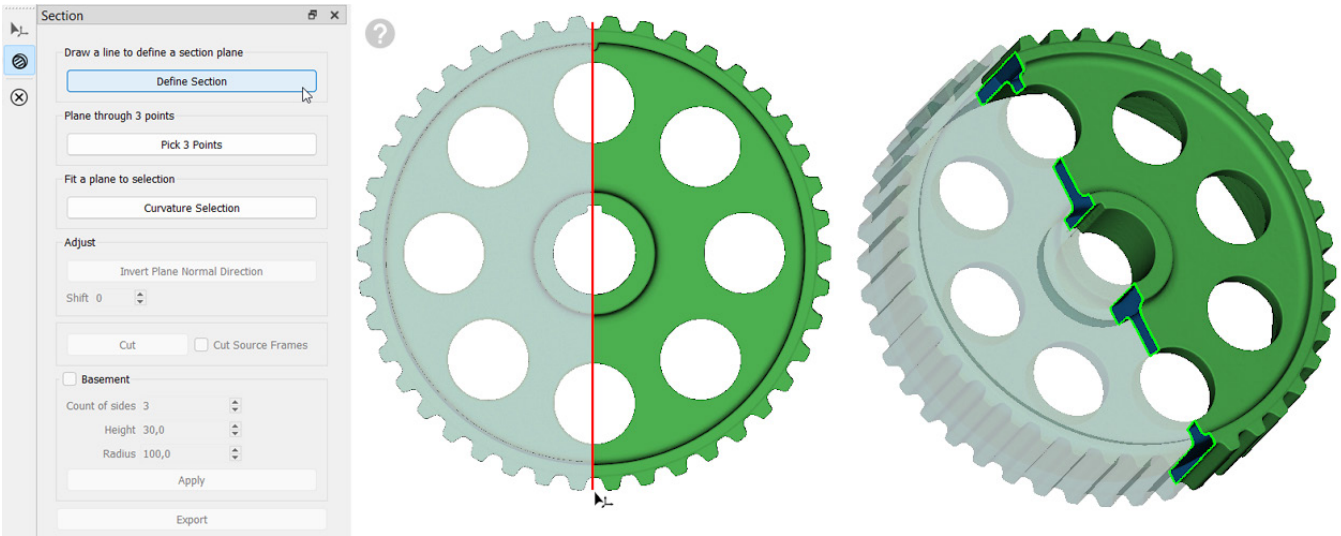
To define a cutting plane using the three-points method, click Pick 3 Points button and select three points on the surface of a model:
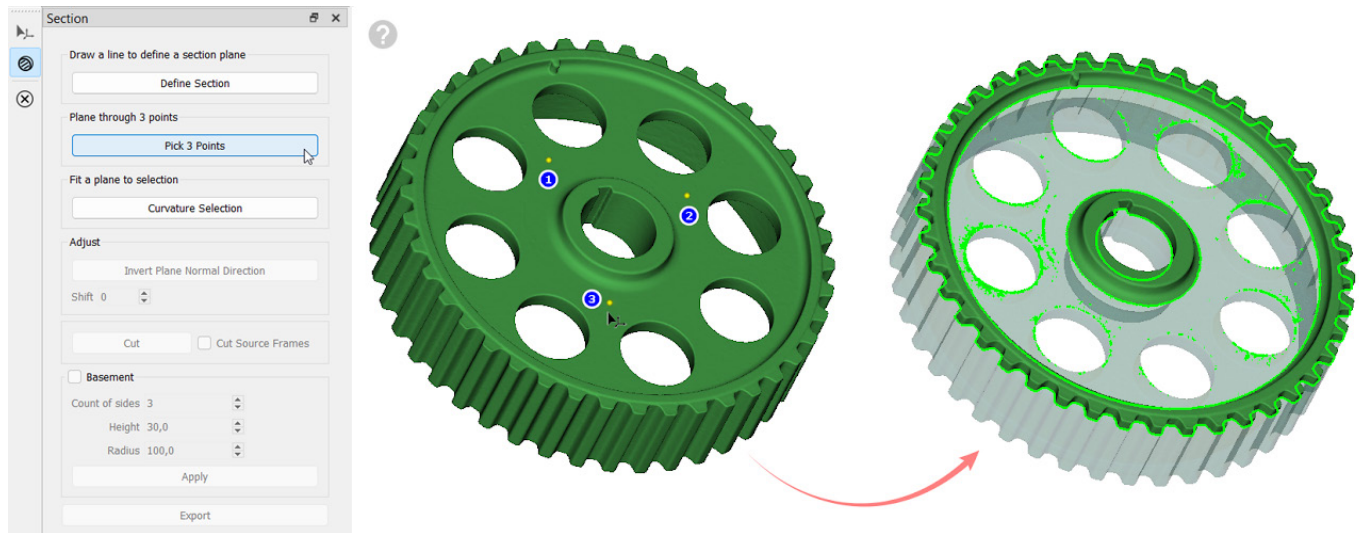
Cutting plane can also be defined using Curvature Selection tool described above: to do so, click Curvature Selection in Section tool, set Filter Size, analyze the model (Calculate Mean Curvature button), pick a point on the model and adjust Selection Tolerance until selection is optimal. Click Fit a Plane to calculate the average plane for selected area.
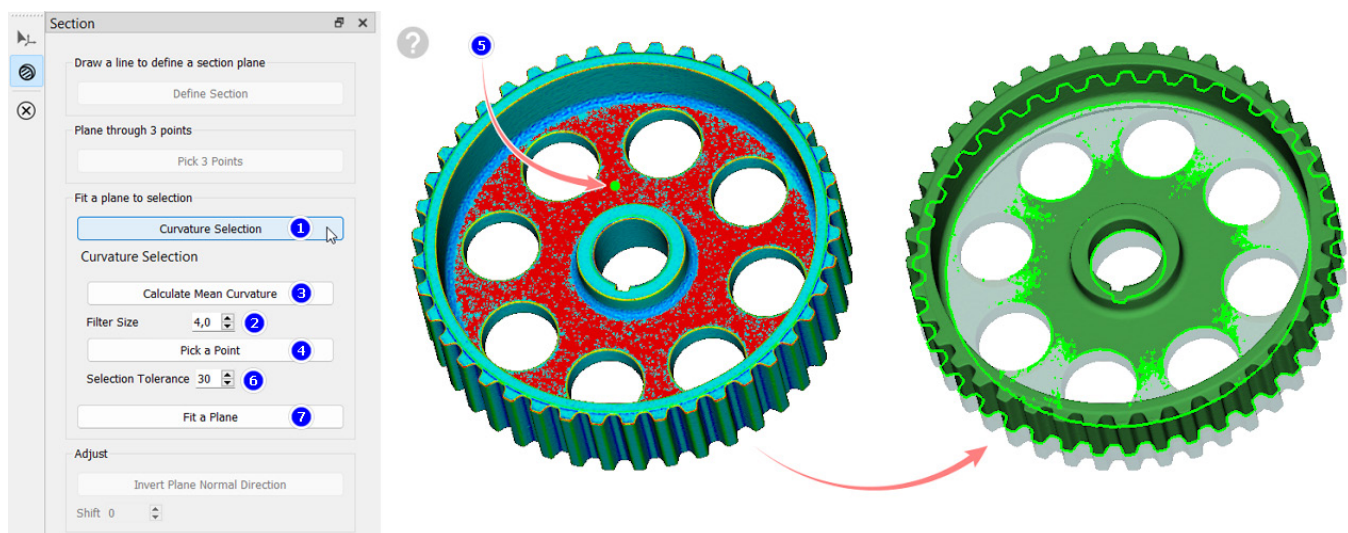
Cutting plane divides a model into active and hidden parts. Click Invert Plane Normal Direction to swap them if needed:
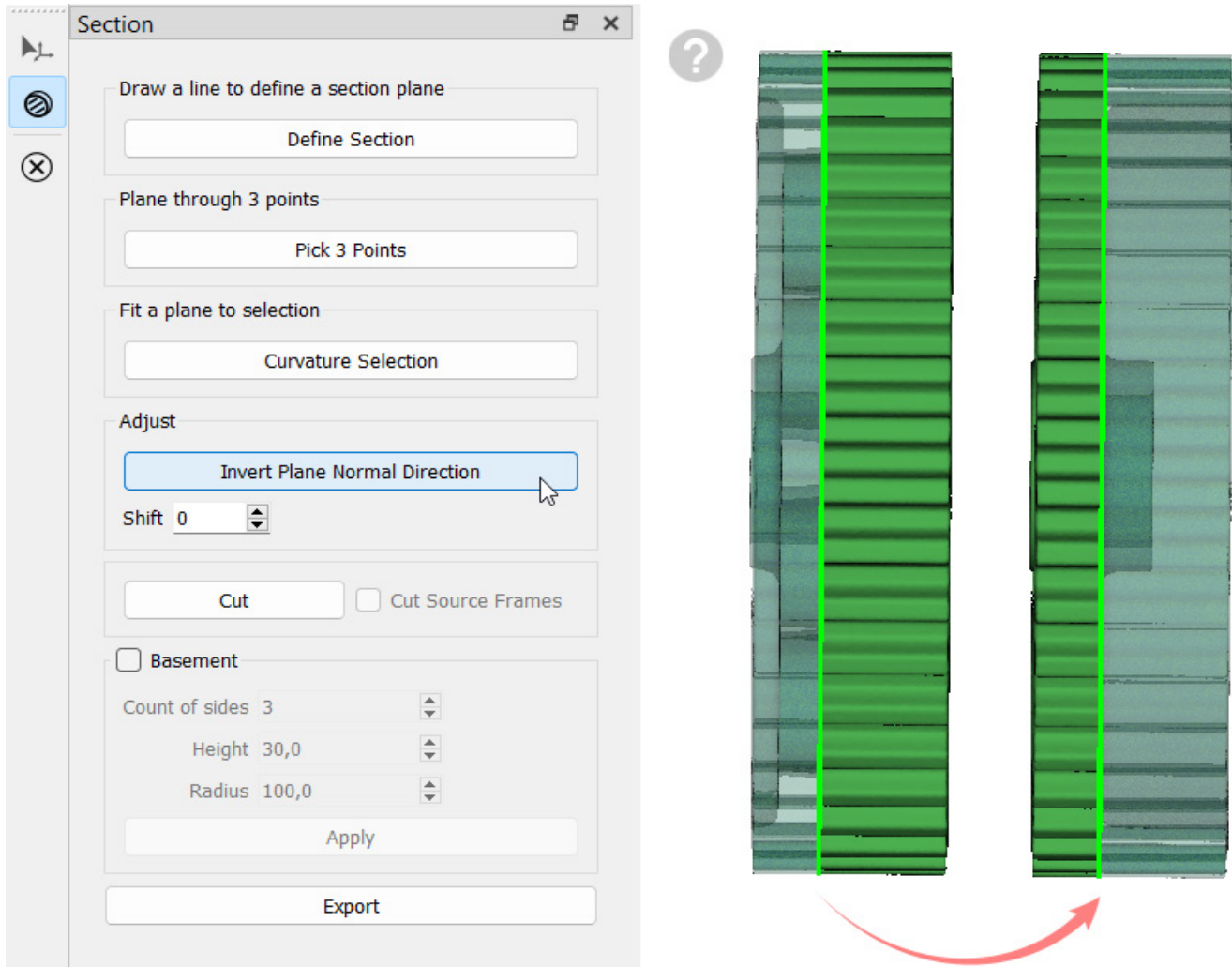
By changing Shift value it is possible to move the cutting plane up and down relative to its initial position. The value is in millimeters and can be either typed in or changed by scrolling the mouse wheel while hovering the mouse over the input field:
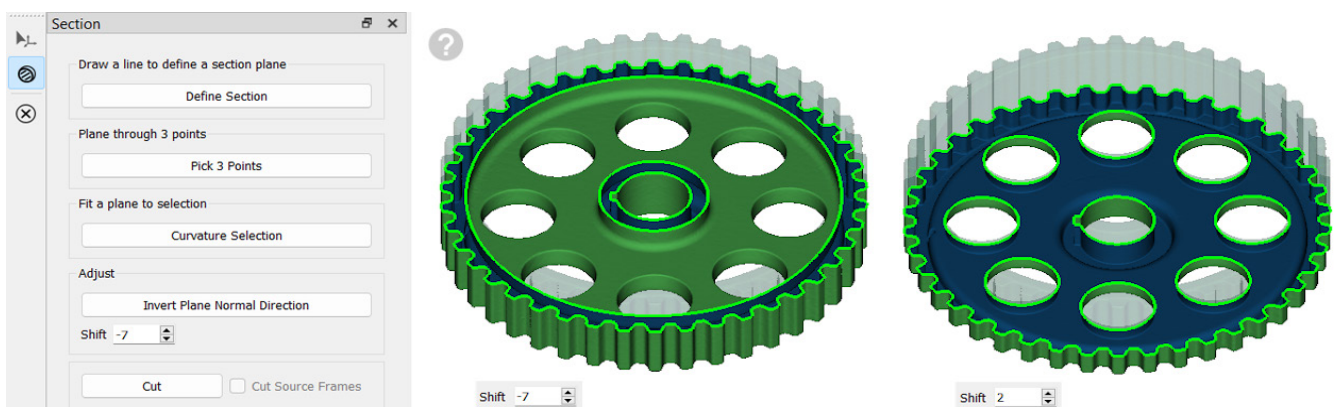
Press Cut button to delete the hidden part of a model. If Cut Source Frames checkbox is selected, the corresponding part of data will also be removed from the point cloud.
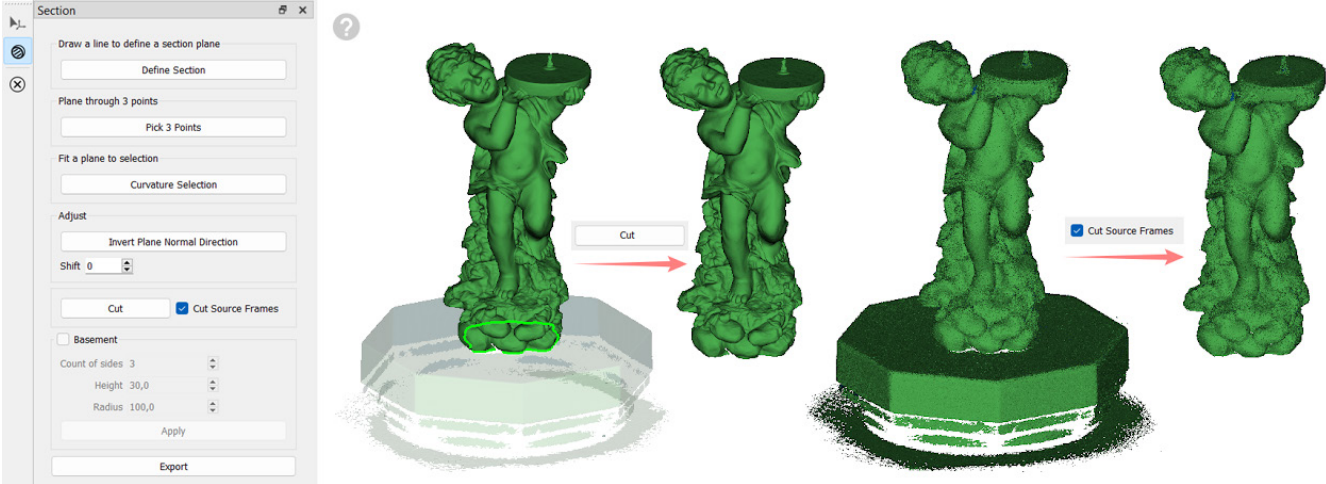
Section tool also allows to add a base to a model. It can be handy when 3D printing human or statue scans. Set a cutting plane and select the Basement checkbox. Set pedestal parameters: how many corners it will have and how thick and big it will be. While setting these parameters, the preview will be shown in red. Click Apply when the result is acceptable.
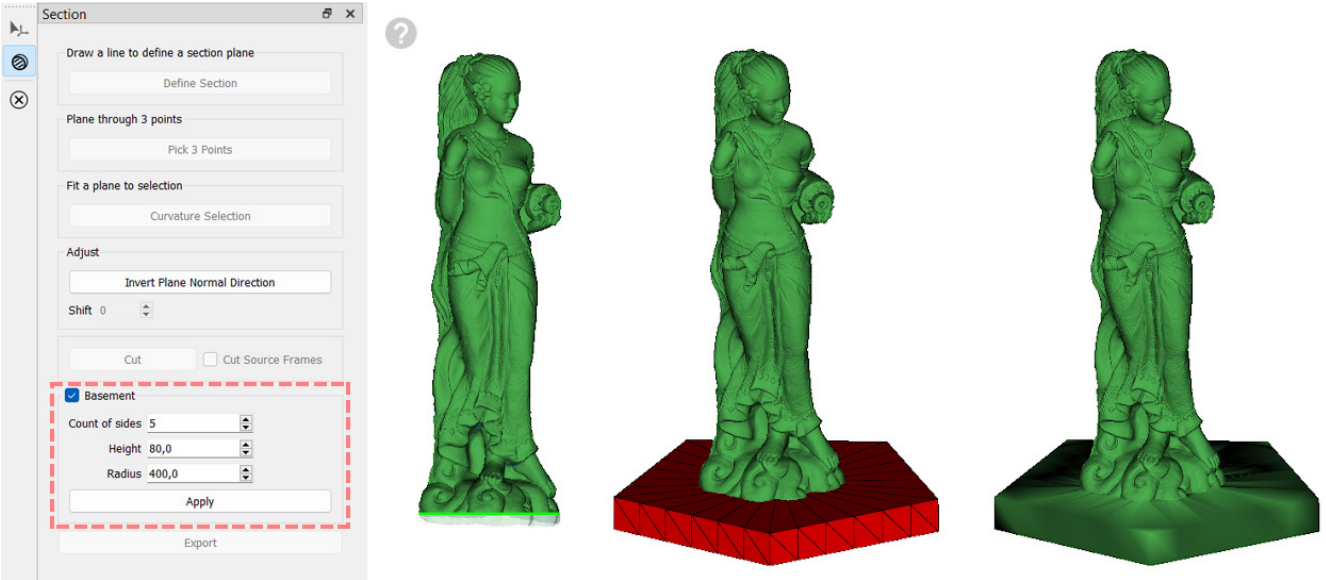
When making a base, it is important for the cutting profile to be watertight. If a profile has gaps, it will not be possible to make a base, and the Basement checkbox will be grayed out. In such a case, define another cutting plane or move current cutting plane by changing Shift value:
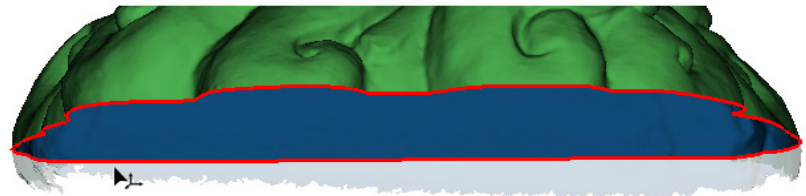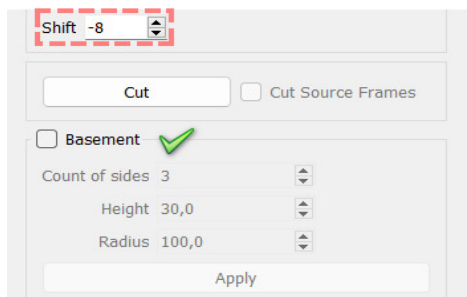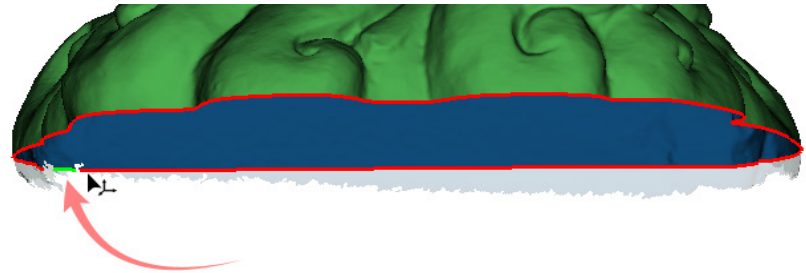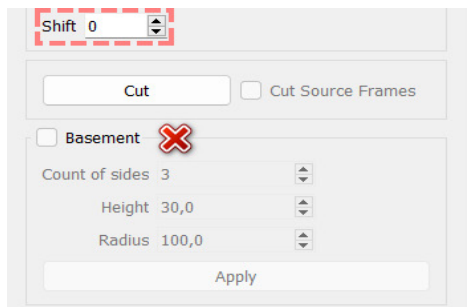
Also, any cutting profile can be selected and saved for further use in downstream applications. When a profile is selected, the Section panel shows info on whether the profile is watertight or not, and shows information on its length and area:
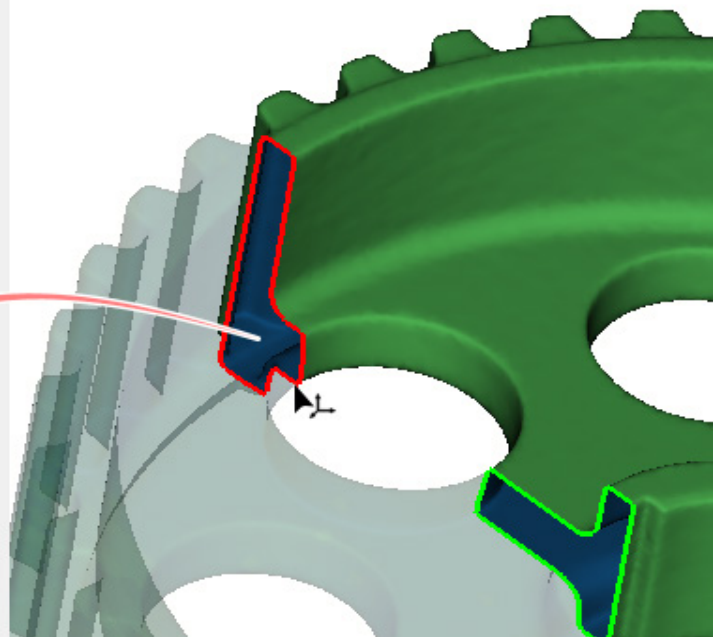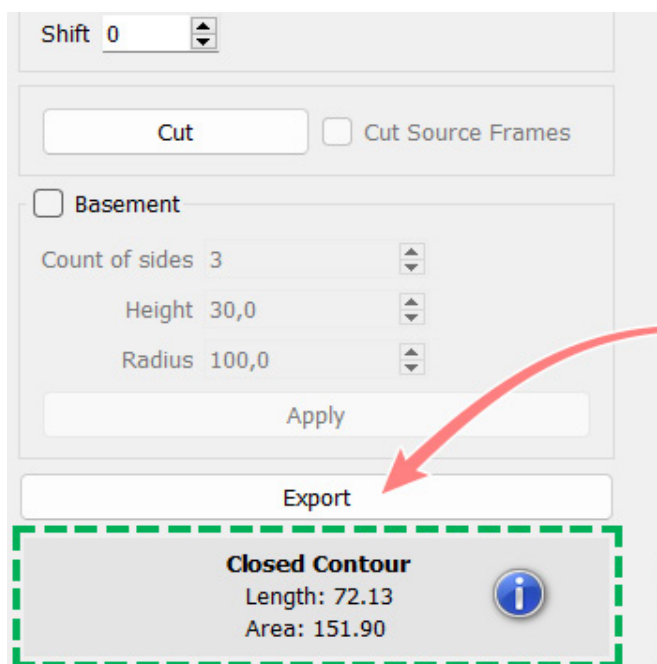
To save a cutting profile, left-click it and click the Export button. Specify a file name and choose file format: .svg or .dxf.

Geodesic Distance

Geodesic Distance is a tool for finding the shortest path between two points on a polygonal model. It also generates a gradient color map, showing regions equally distanced from the source point. If a destination point is picked, shortest surface path is shown as a black curve.

Before using the tool, it is highly recommended to simplify the model, otherwise calculations may take a long time. To run the tool, click Geodesic Distance button on the Side Toolbar or press Shift+G.

Geodesic Distance (Shift+G)
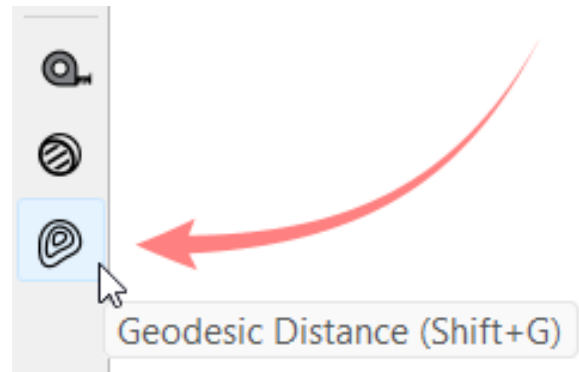
Choose the initial point by clicking Pick Source Point button. The analysis of a model will begin and after it is complete, the model will be shown as a color map of distances from the point specified. Areas closest to the source point are shown in blue. The most distant areas are shown in red. Hover the mouse over the model to see the distance (in millimeters).
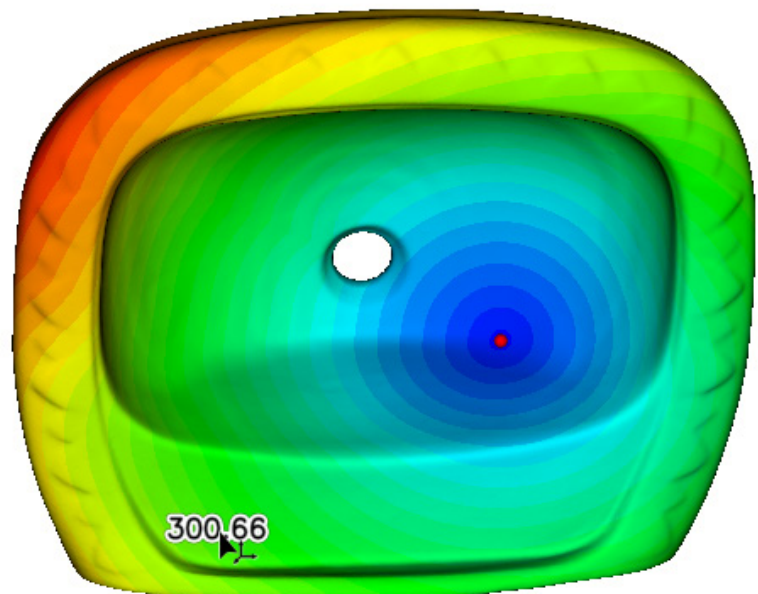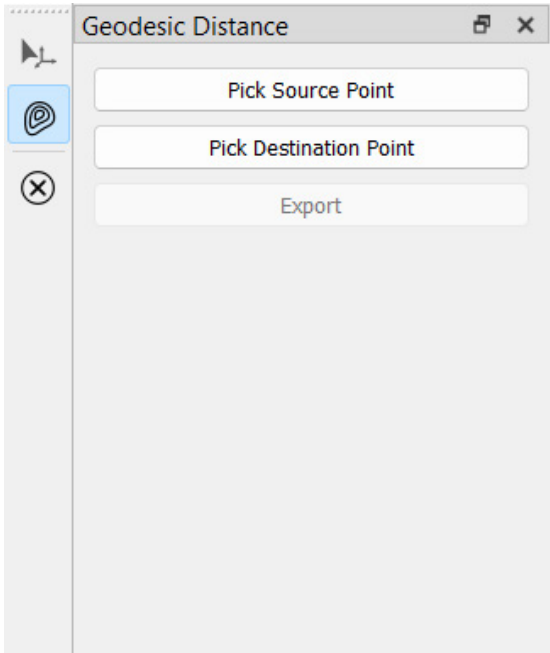
To draw a trajectory from Source Point to Destination Point, click Pick Destination Point button and choose a second point. Shortest path will be shown as a black curve with numeric distance value in millimeters.
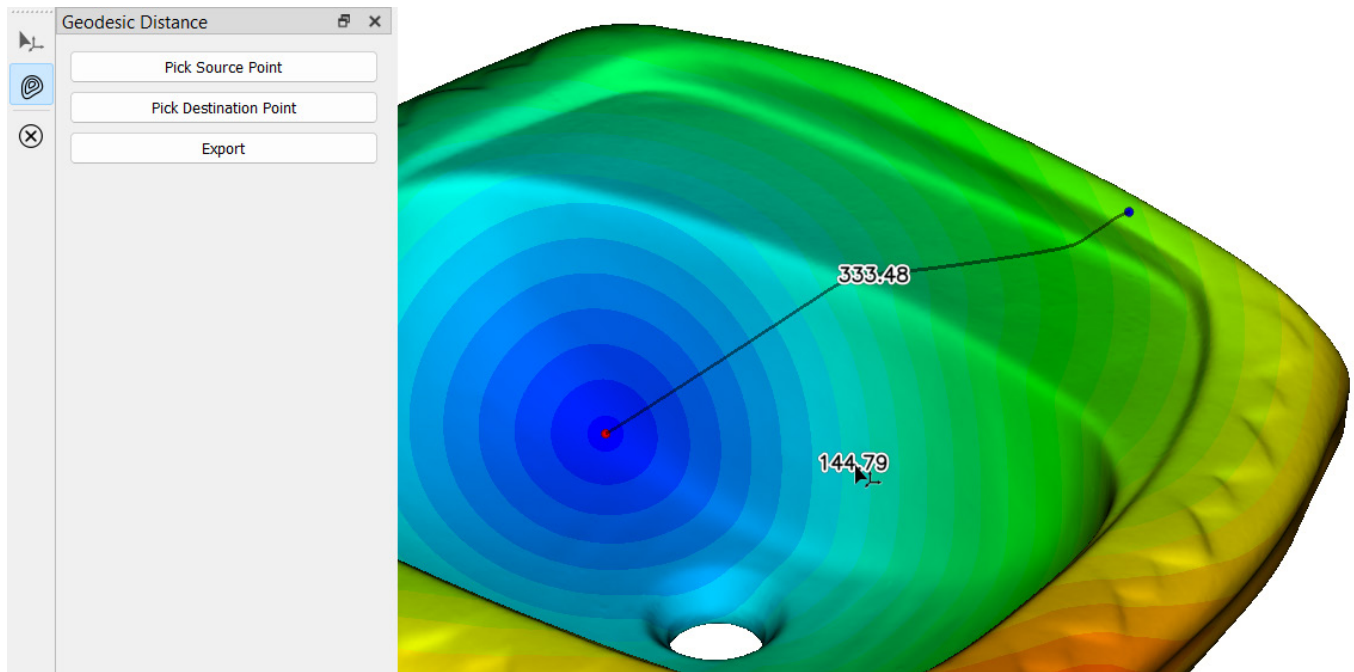
To export the curve, click Export button and specify path and name for a file. The file will be saved in .dxf format.

Texture Editing Tools

Calibry Nest has several tools for editing texture. These tools are available on the Side Toolbar when a texturized result is selected:
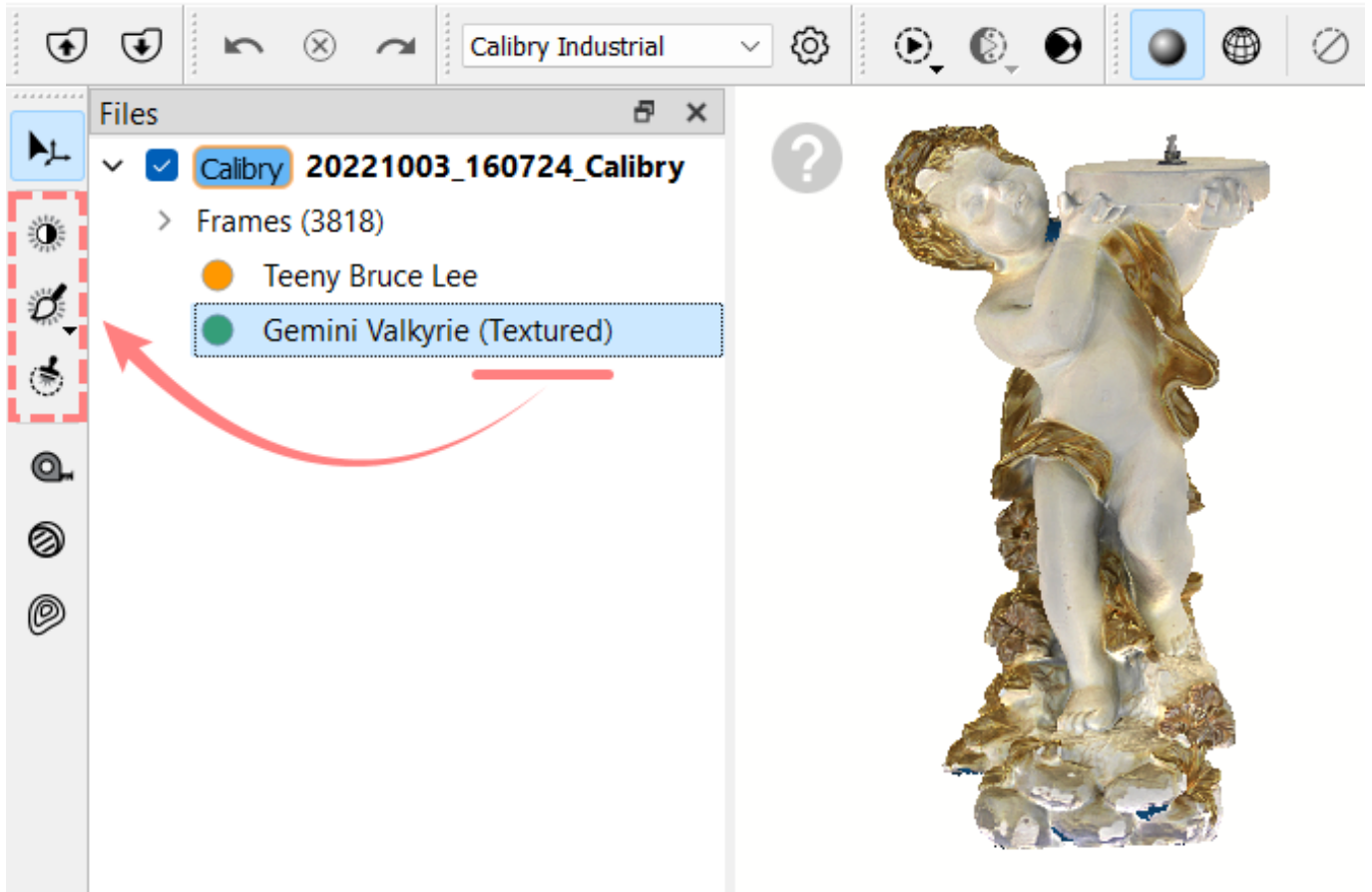
Adjust Texture

Adjust Texture helps change brightness and contrast of a texture atlas, plus edit the color balance for each of three base colors. To use the tool, select texturized result and click «Adjust Texture» on the Side Toolbar. Change the values until the optimal result is achieved and click OK to accept or Cancel to reset the changes.
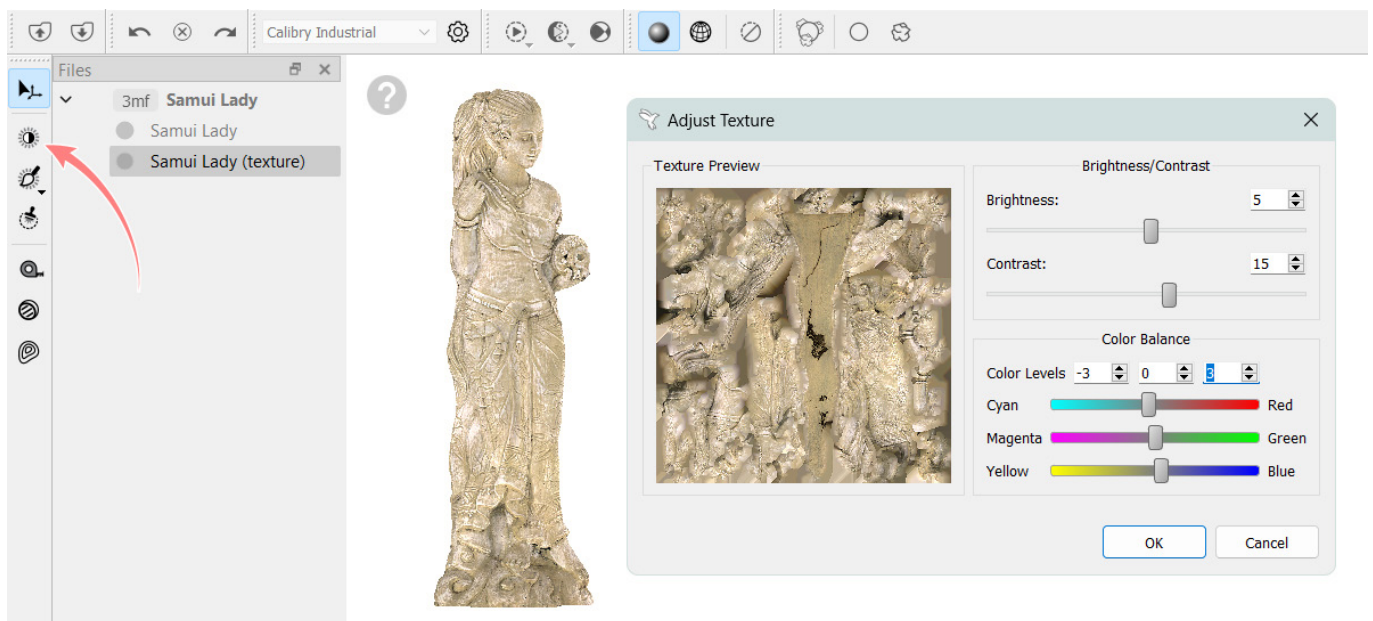
Luminosity Brush

Luminosity Brush help change brightness locally in certain areas (either increase or decrease).

Select a textured model and click Luminosity Brush on the Side Toolbar or press L.

A right-click on the tool opens a submenu where Hardness and Strength of the tool can be set. Hardness defines how smoothly the effect of the tool fades out from the center to the borders of the brush. Strength defines how significant the changes will be in the middle of the brush.
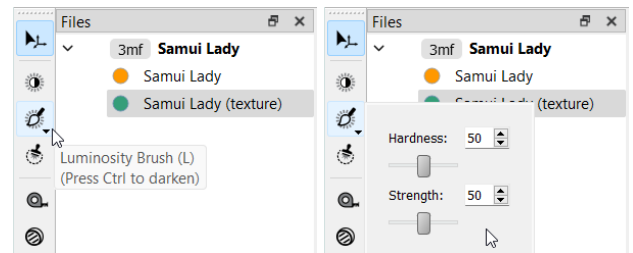
Define the size of the brush by scrolling the mouse wheel. Left-click and move to increase the brightness locally. To darken the area, use the tool with Ctrl pressed.

Magic Clone Stamp

Magic Clone Stamp helps edit texturing defects by replacing the area under the brush with nearby texture. To use the tool, select a textured result, and click the tool on the Side Toolbar.

Set the size of the brush by scrolling the mouse wheel while holding Ctrl. Select a texturized region with a defect or blemish to replace it with the adjacent texture. To select a region, hold Ctrl.

In the same way the markers can be removed from the texture:
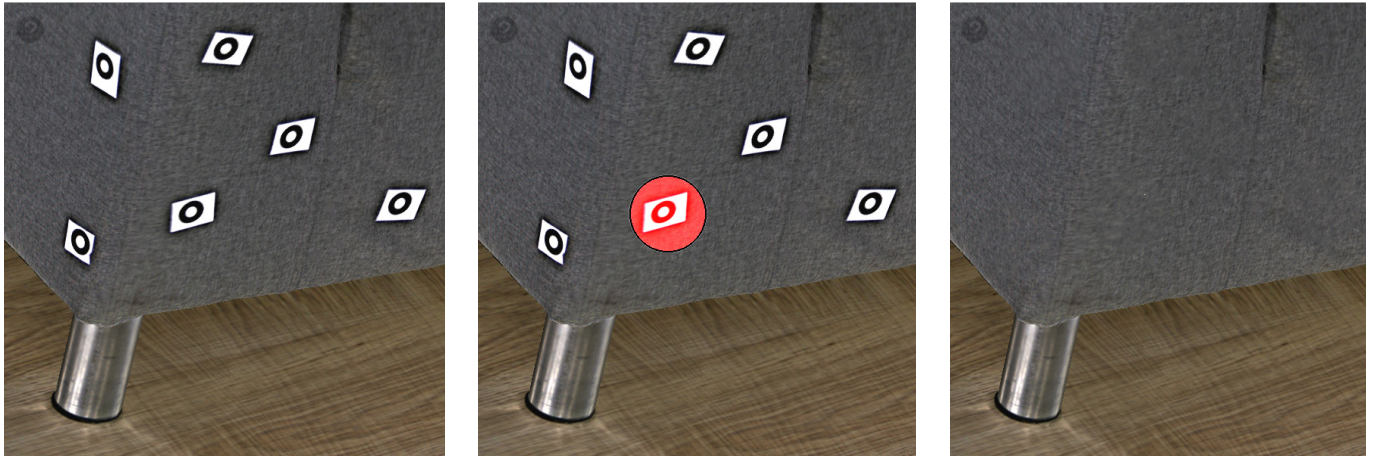
Keep in mind that this tool uses nearby texture to replace the texture under the brush, therefore artifacts may appear when this tool is used on vibrant texture or on texture with lots of colored lines.

11. Additional capabilities

Select Marked Frames

A typical scan consists of hundreds of frames, each containing some of the points of the resulting point cloud. In Calibry Nest it is possible to select a part of a point cloud and then highlight only those frames in the list, which contain at least one point from the selection. To do so, select some points using Marquee Brush or Polygonal Tool, then right-click Frames in a scan and choose Select Marked Frames from the menu:
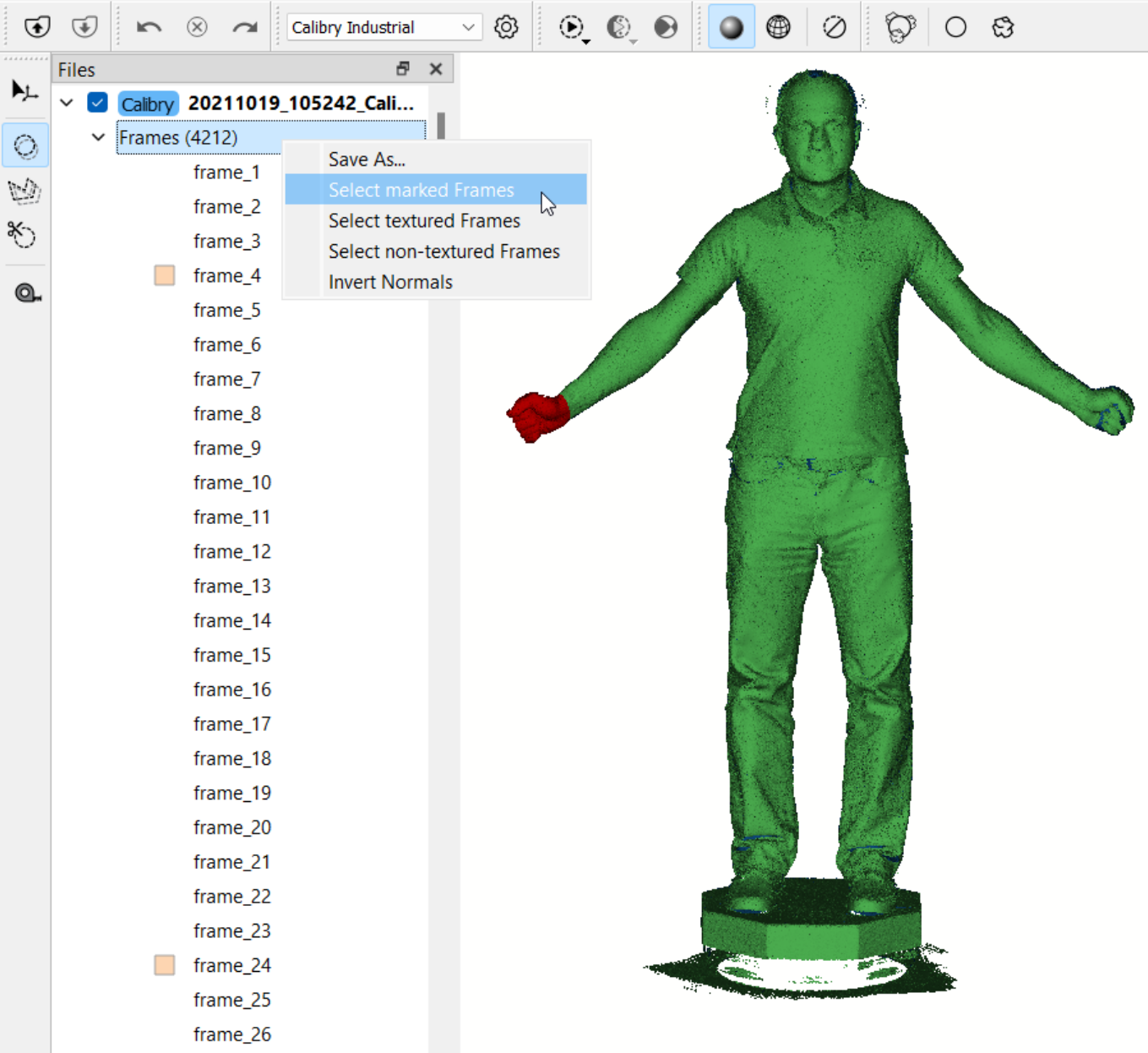
As a result, from all the frames only those containing at least one point from the selection will be highlighted, and only data from these highlighted frames will be shown in the editing area:
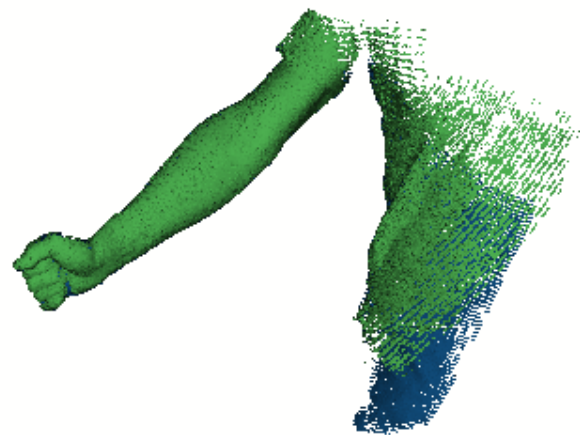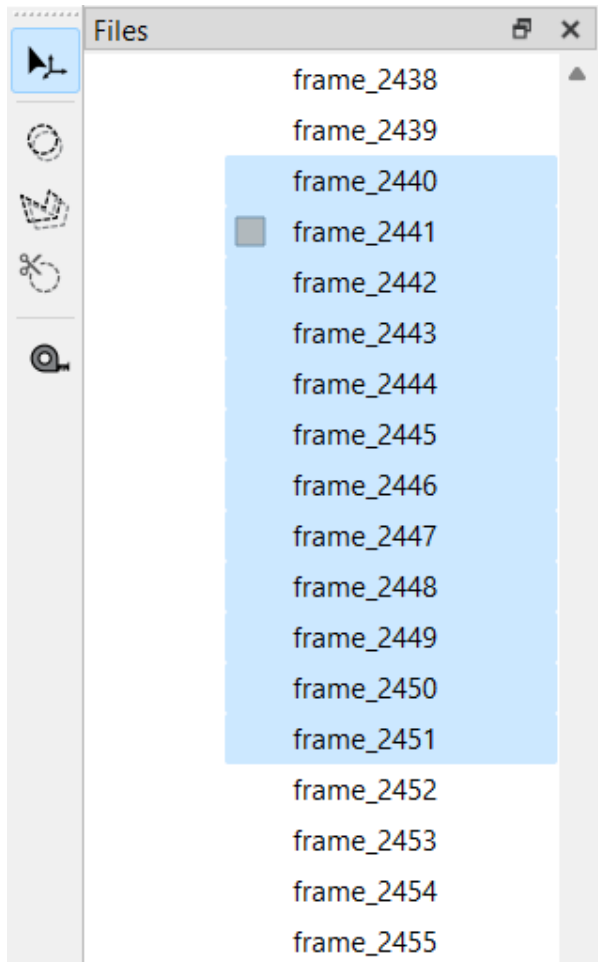
Keep in mind, that these frames will not necessarily be adjacent. In most cases, there will be multiple isolated groups of frames. It all depends on the shape of the selection, size of the object and the scanning trajectory.

Selecting All Textured or All Non-textured Frames

In the Frames context menu the option is available to select all textured frames in a scan.
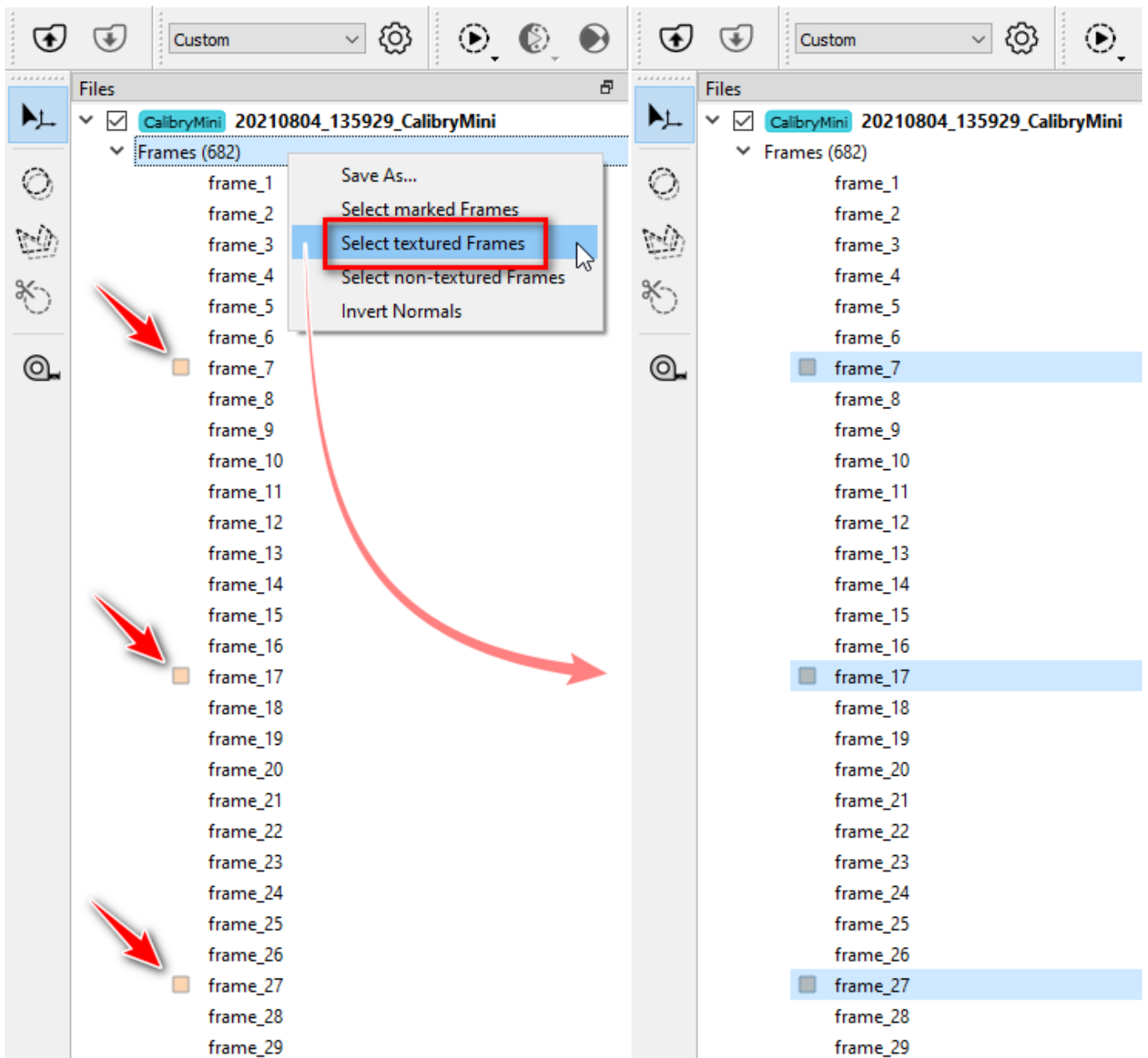
In the same way it is possible to select all frames except textured:

Saving a Texture Frame

Any texture frame from a scan can be saved as .jpg if needed. To do so, open any scan in Calibry Nest, expand the Frames section, select any frame with texture (such frames are marked with pink square). The texture frame will appear below. Right-click it and pick Save As. Choose the destination path and the name for a file, and click Save.
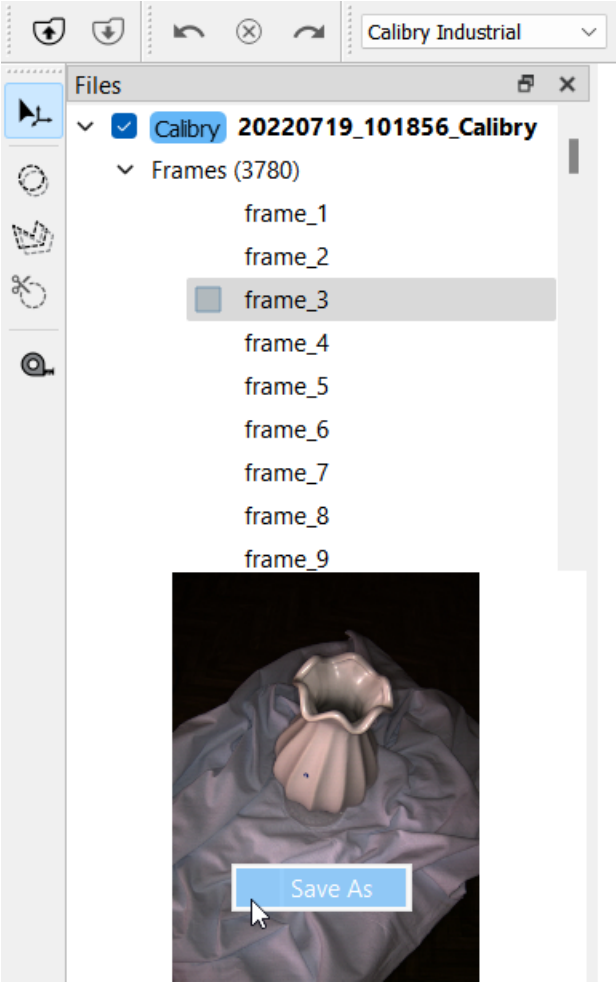
Invert Normals

In point clouds obtained with Calibry scanners, each point has a normal. Normals are used to define which side of the surface is facing outwards, and which is facing inwards. In Calibry Nest the outer side of a surface is shown in green, and the inner side of a surface is shown in blue. In some cases it may be useful to swap them, which is basically equal to turning a model inside out. Classic example is scanning a cast to digitally create an object, or scanning an object to create a mold for making copies of itself.

For such tasks Calibry Nest has an option of inverting normals. Right-click Frames in a scan, and click Invert Normals — direction of normals will be flipped to the opposite for each point in a point cloud. Thus, external (green) surface becomes internal (blue) and vice versa.
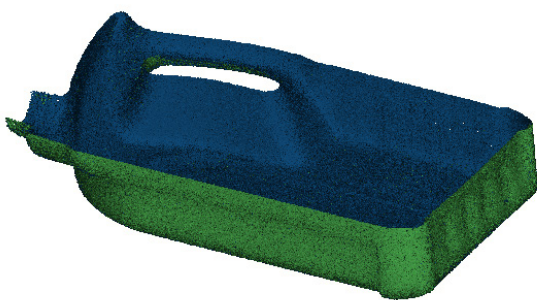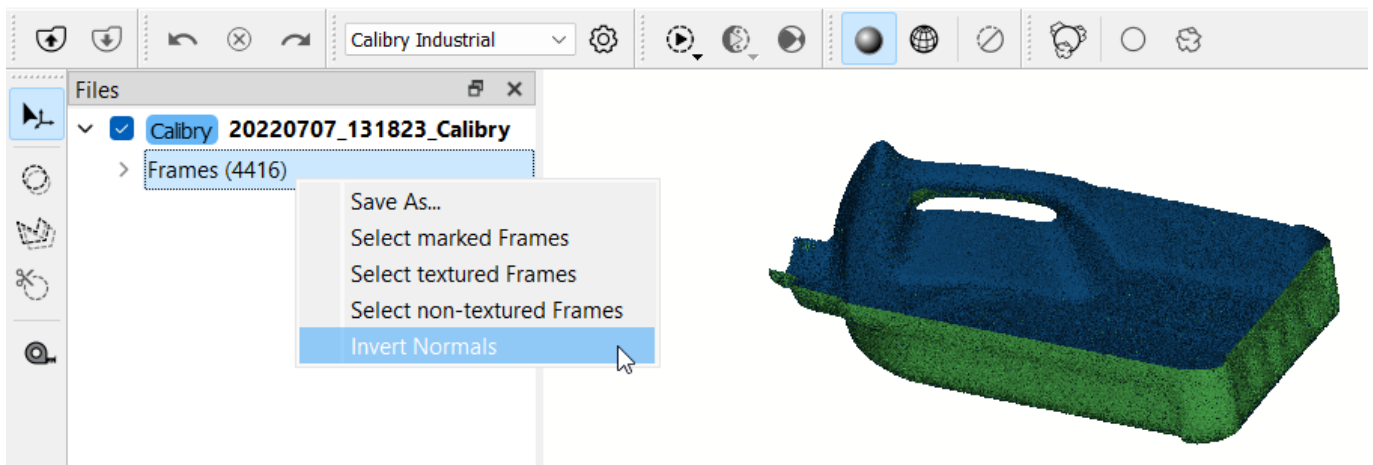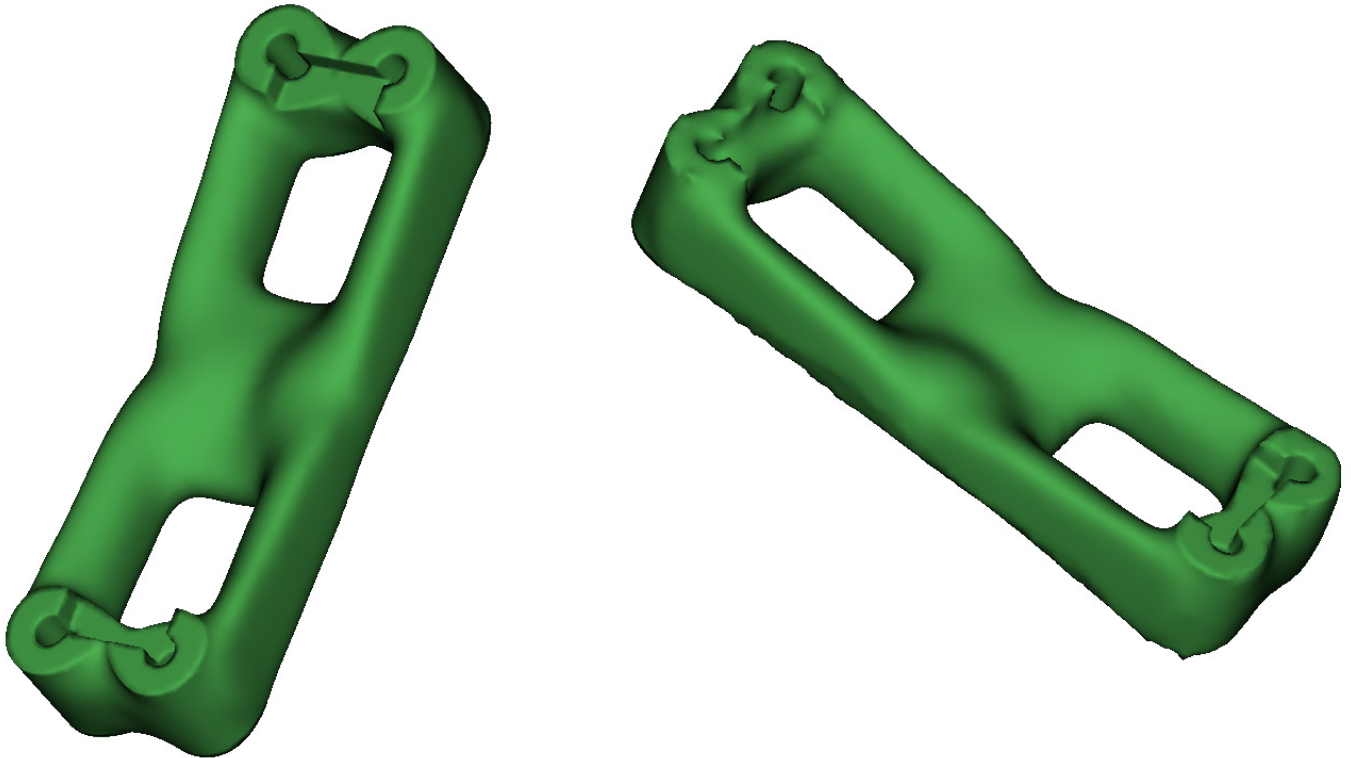

Fragment of a point cloud of a scan
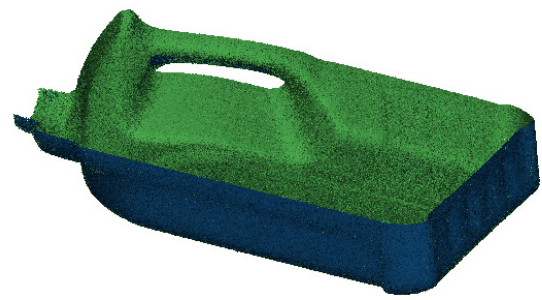

The same fragment with inverted normals

Distance Map

The tool of calculating the distance when comparing two models. It is available when working with two polygonal meshes simultaneously.

Prior to using this tool, make sure to Align the models (this is explained in detail in Section 9. Assembling Multiple Scans).

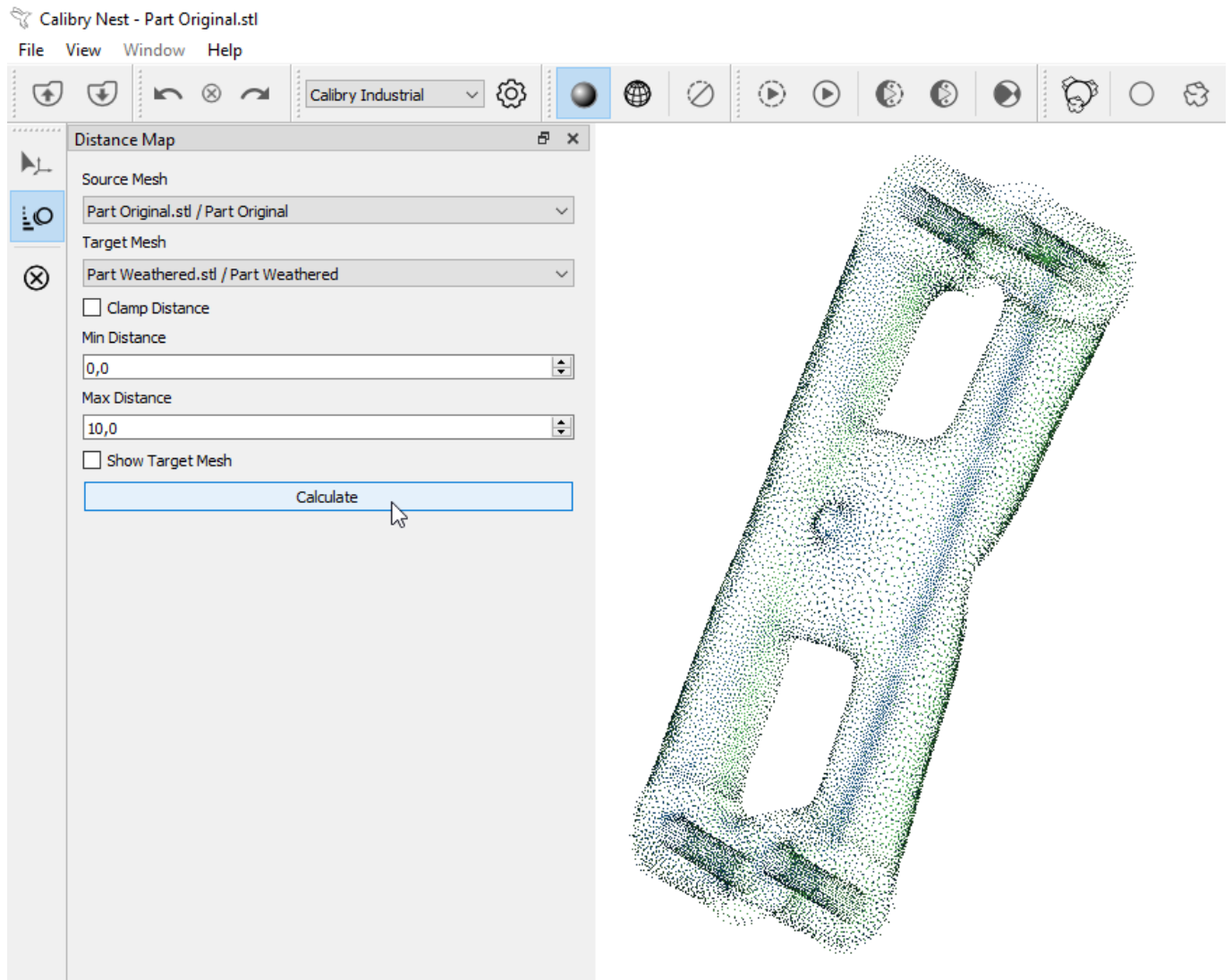After alignment has been performed, select both projects and click Distance Map on the Side Toolbar or press Shift+D.
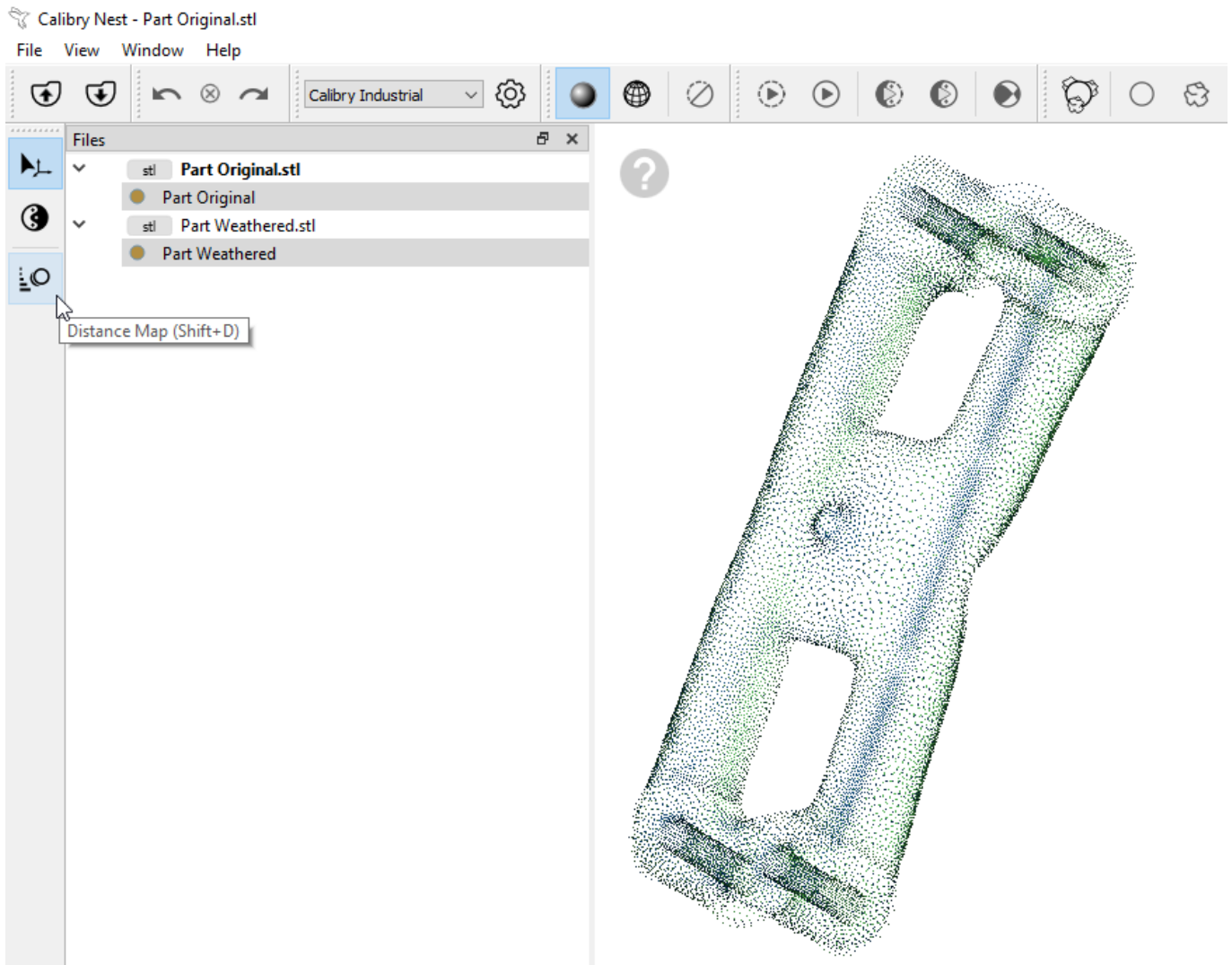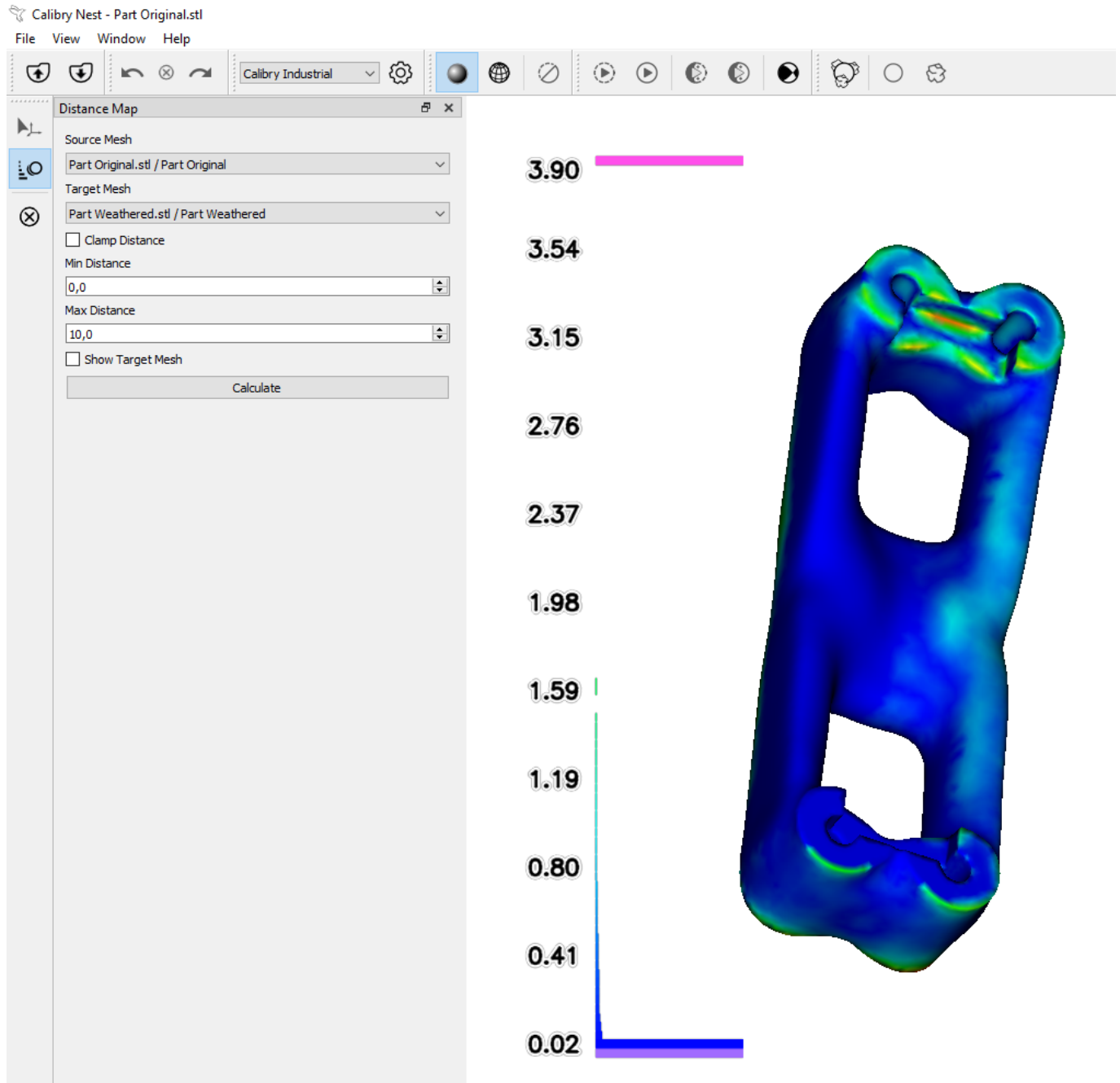
Once Distance Map has been opened, press «Calculate» to determine the distance between the two models.

After calculations are complete, a distance color map will be visible which shows the deviation of one model from the other. The higher the deviation, the higher the number on the deviation scale. This deviation is also indicated by red/pink.

Select Clamp Distance and the distance range for constructing the color gradient. Use the Min and Max fields to define the distance range. This is useful for determining with more precision where the deviation between the two models is the highest. The closer to the red/orange range, the more there is deviation. By setting these limiting values we can see the difference in a specified range much clearer.
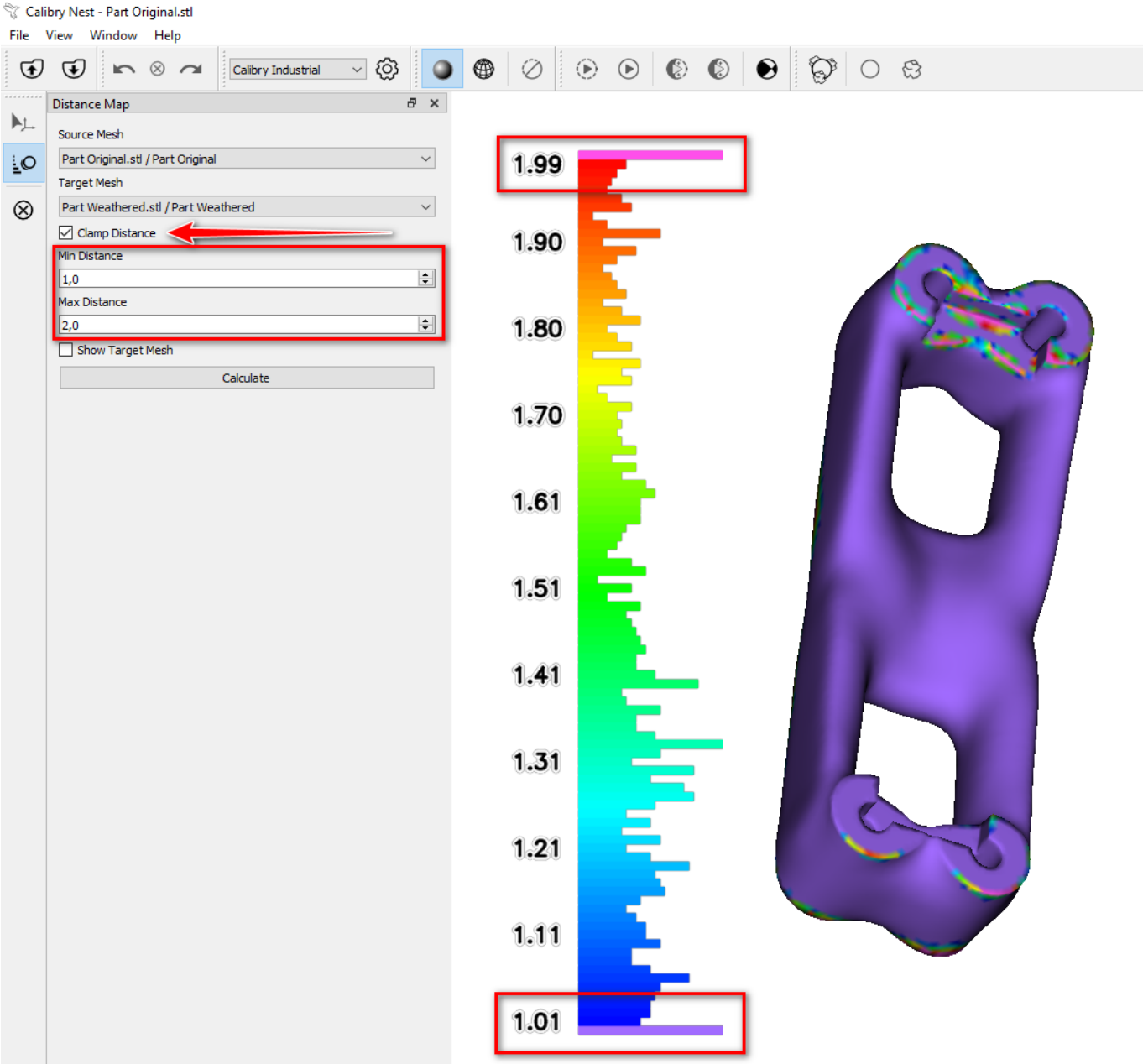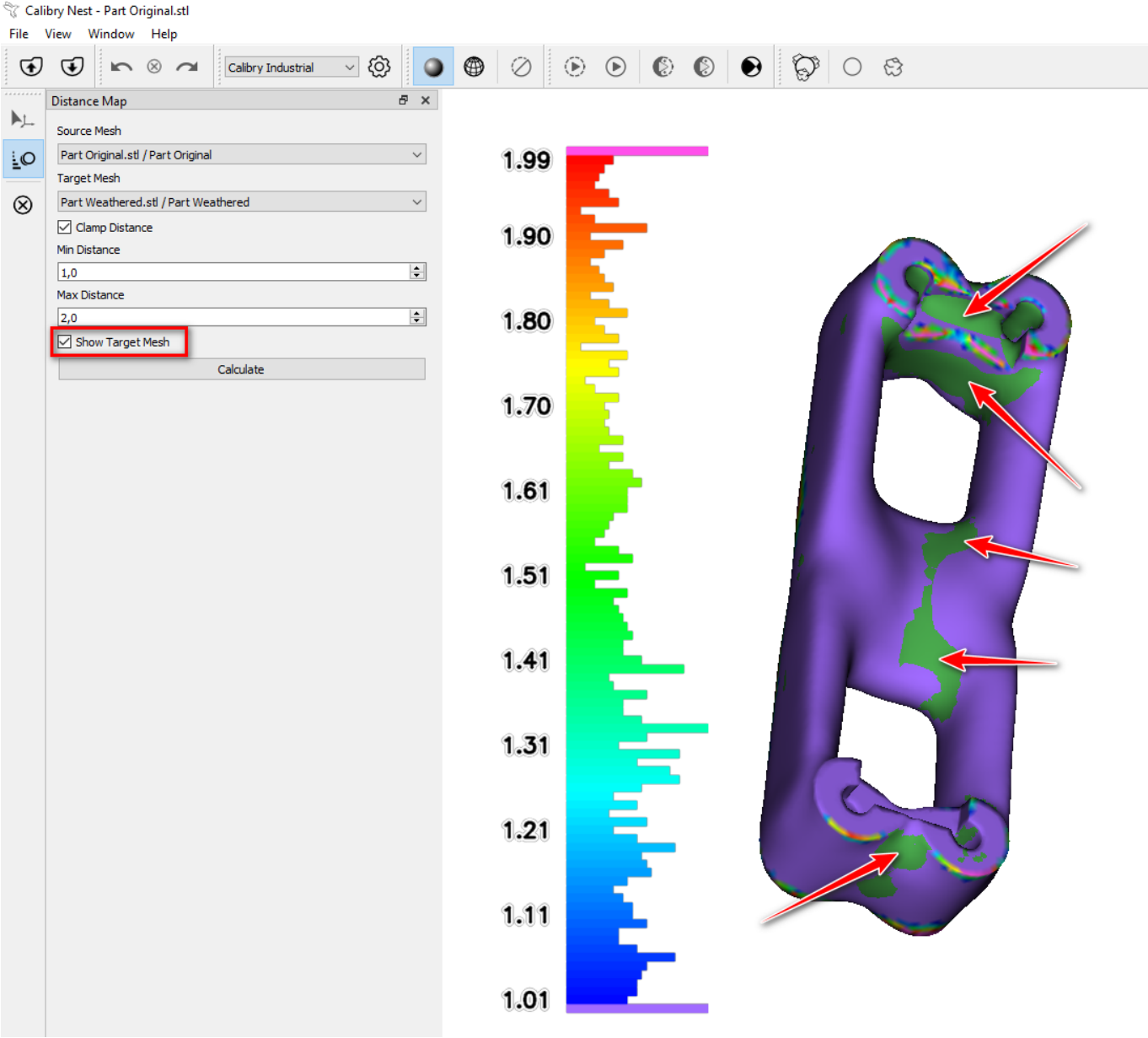
By right clicking on a specific point on the model the exact deviation is shown for that exact spot.
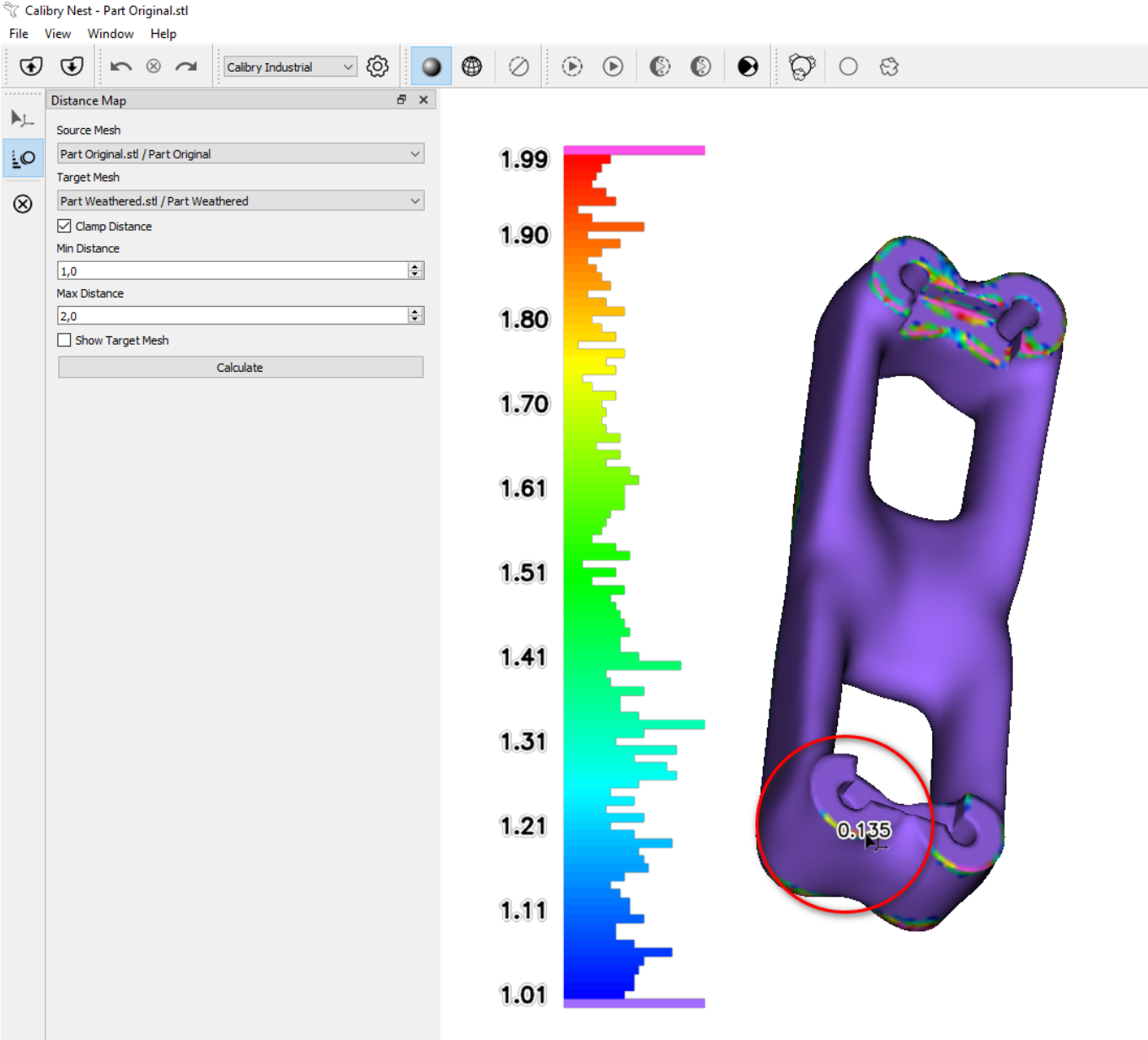
Clicking «Show Target Mesh» will show the deviating mesh.
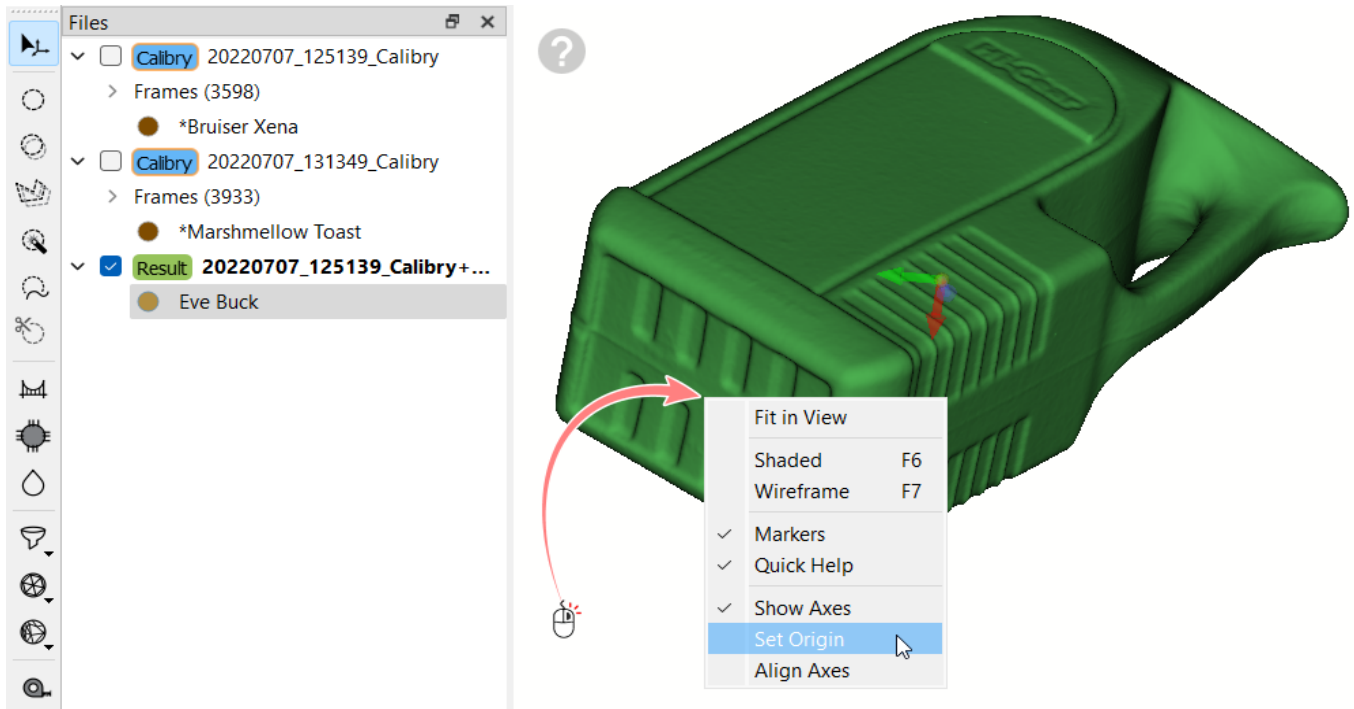
Align Axes

During scanning and post-processing, the spatial orientation of a model is mostly ignored. Still, for easier further processing of a model in downstream applications or for use in online galleries or for 3D printing it may be a good idea to perform a preliminary alignment of a model with a coordinate system.

To do so, right-click the editing area and choose the Show Axes command. It can also be found in View menu.
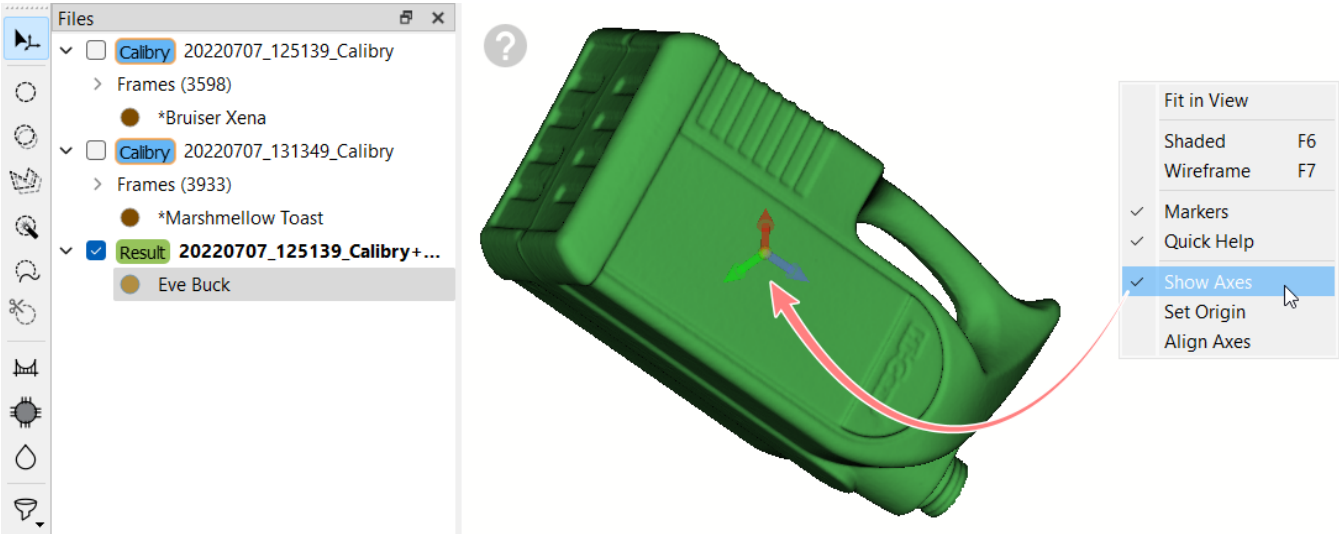
The axes will be shown, but the orientation of a model and the position of the origin will be random. Before aligning the axes, right-click a point on the surface of the model that will be used as a new origin, and choose Set Origin command in the dropdown menu.

After the axes are moved to the desired new origin, it is time to orient the object to the required position. When it is done, right-click the editing area and pick Align Axes command. The axes will be aligned with the current view.
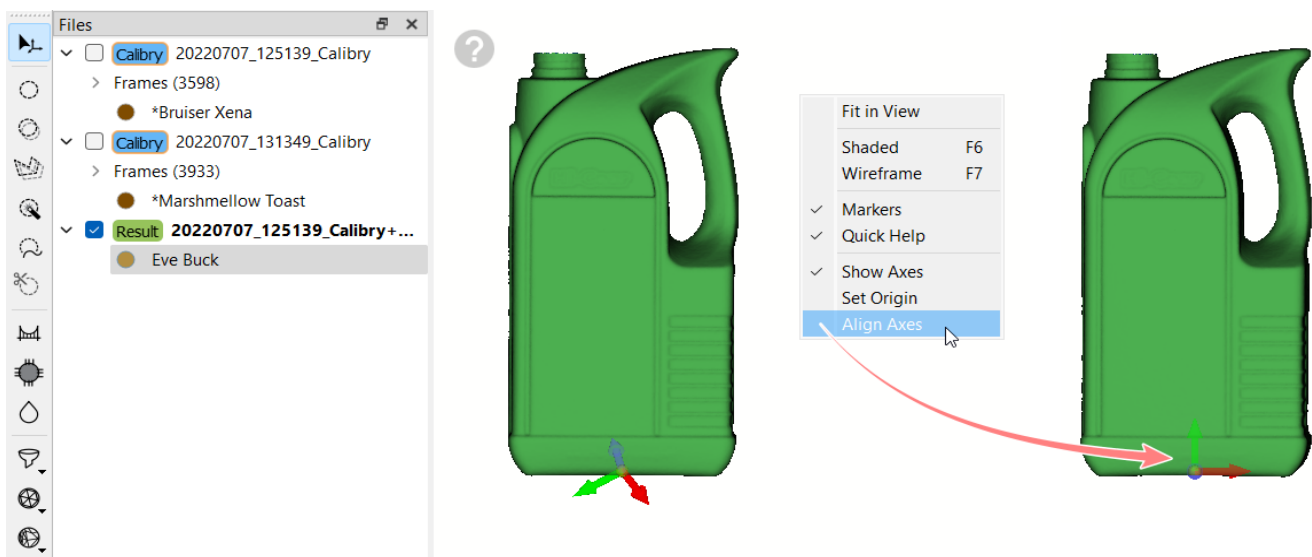

Now the model can be saved. Its new position in the coordinate system will be saved as well.

Temporary Loading and Unloading Scans

When working with several scans, it may be useful to unload some of them from RAM. Especially when total amount of available RAM is low or when there are lots of scans being open in Nest.

To unload some of the scans temporarily, select the scans, right-click the name of one of them, and pick Unload from the context menu. Selected scans will be written to a temporary folder on a hard drive, and the memory they occupied in RAM will be freed for other tasks:
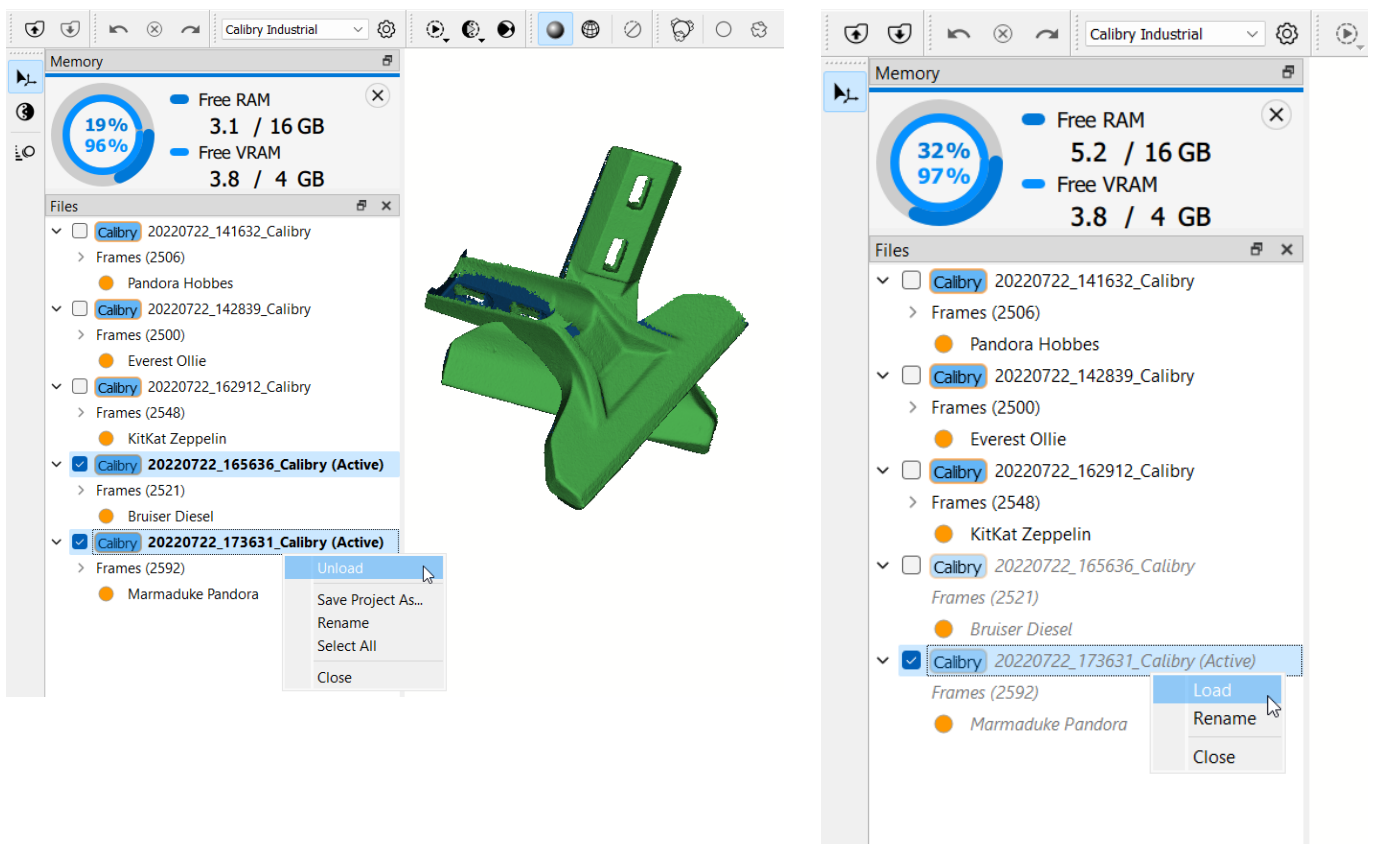

Unloaded scans are shown in gray italic in the list of projects. These scans cannot be edited. To load an unloaded scan back into RAM, click its name and pick Load — the scan will be loaded back for further editing.

Scan Split

If a scan has layering of data and registration does not fix it, in many cases it is possible to find the frame at which the layering had begun and then split the scan into two parts to process them separately. In this example the chair scan has layering which registration cannot fix:
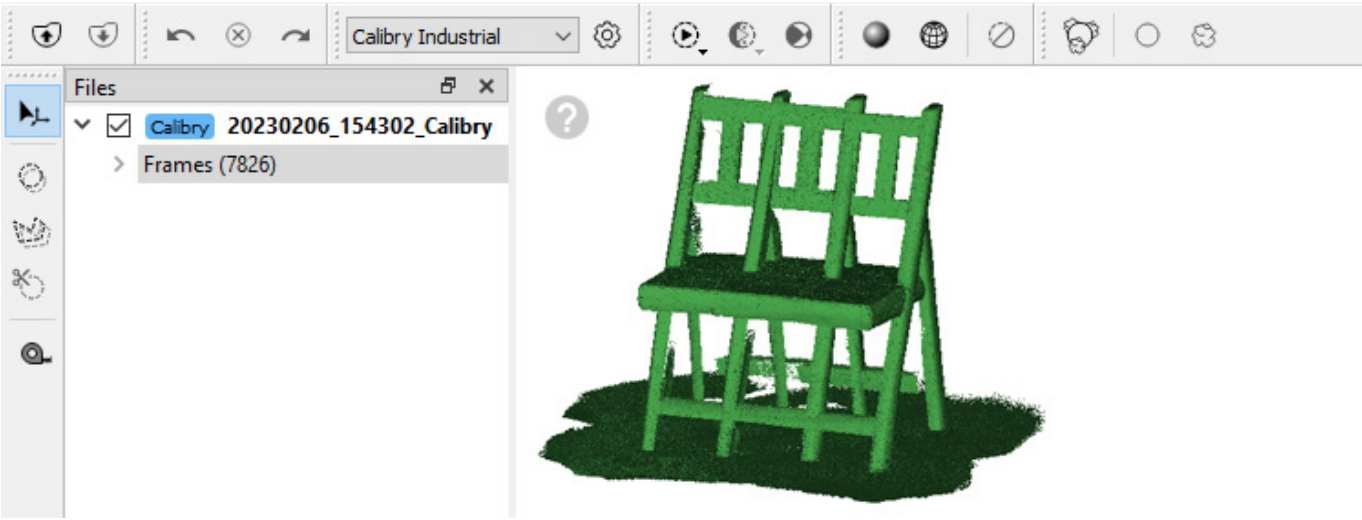

To find the place where this layering began, open «Frames» and start selecting the frames from the first one down. While doing that, control the data in the editing area: continue selecting the frames, until you reach the place, where data starts to look inconsistent. In this example, the frame 3385 is the first frame inconsistent with the selection (the misplaced data begins to show up in the editing area):
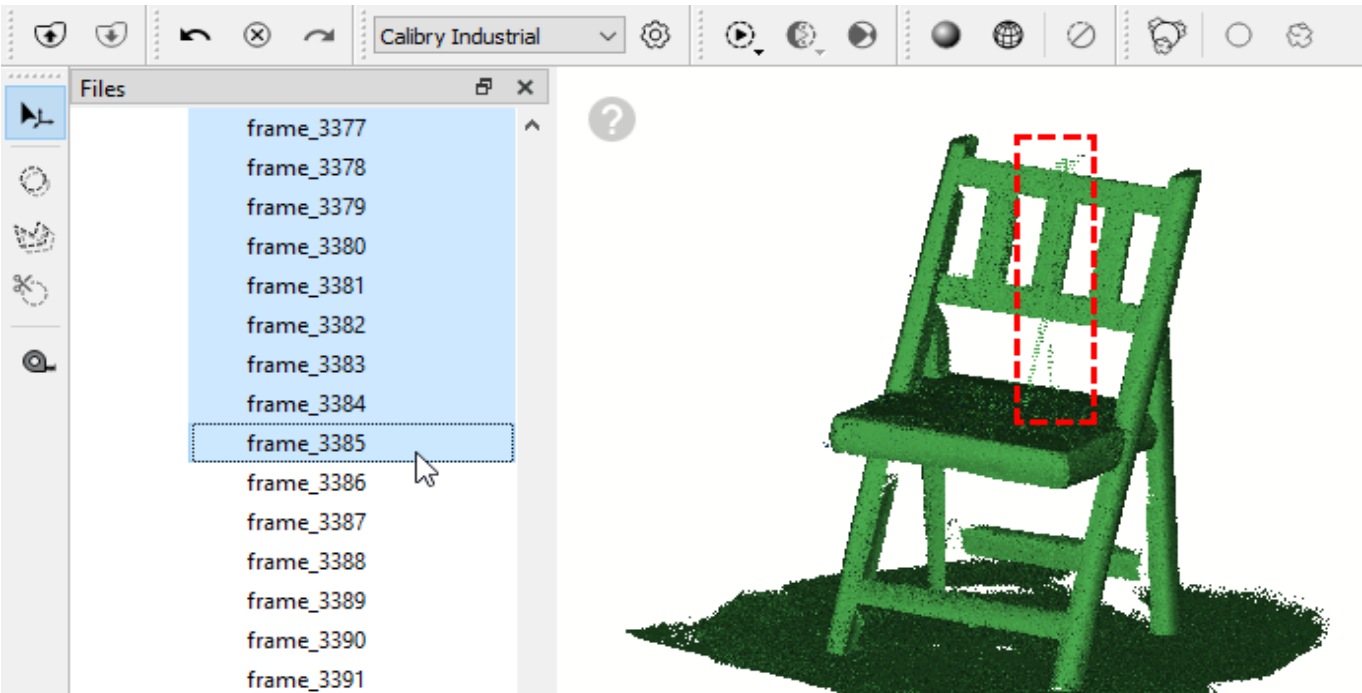
To split the project, right-click the frame and choose «Split project»:
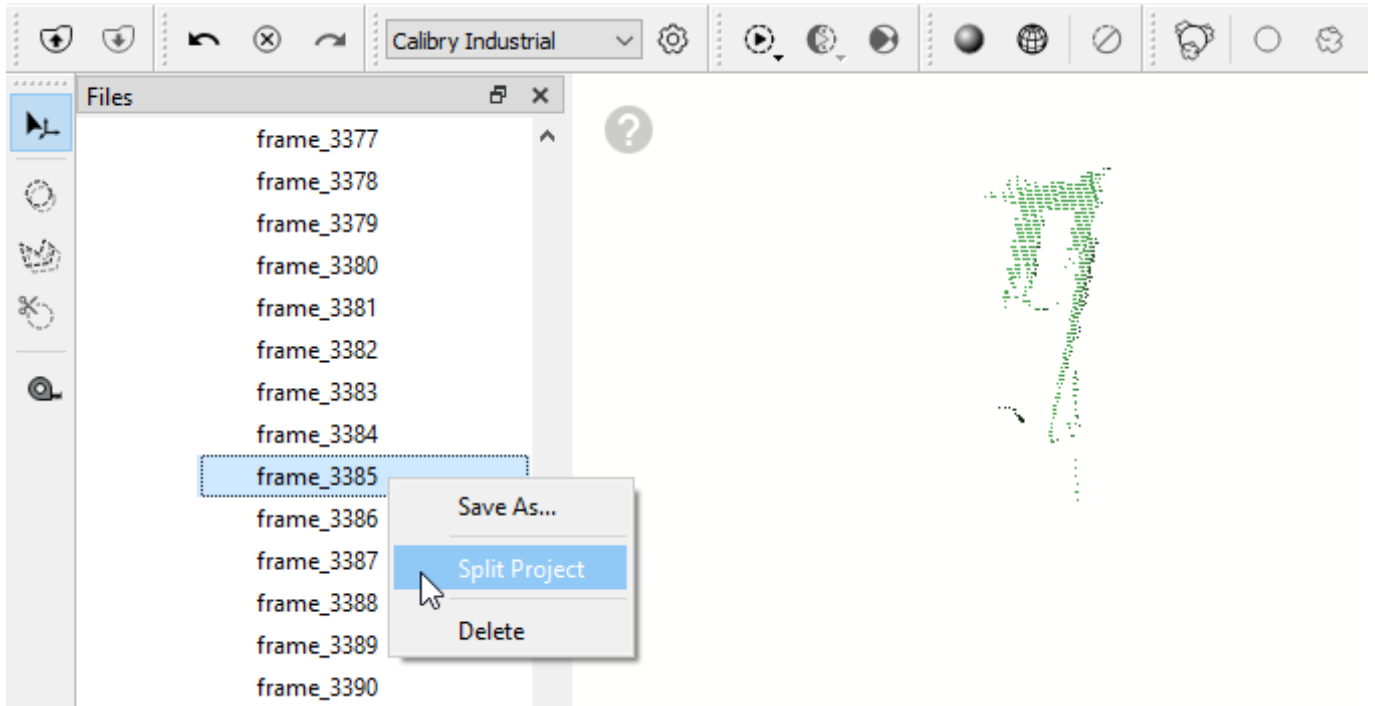
The scan will be cut into two parts, that can be processed separately. The first part will contain only the frames before the split (consistent data):
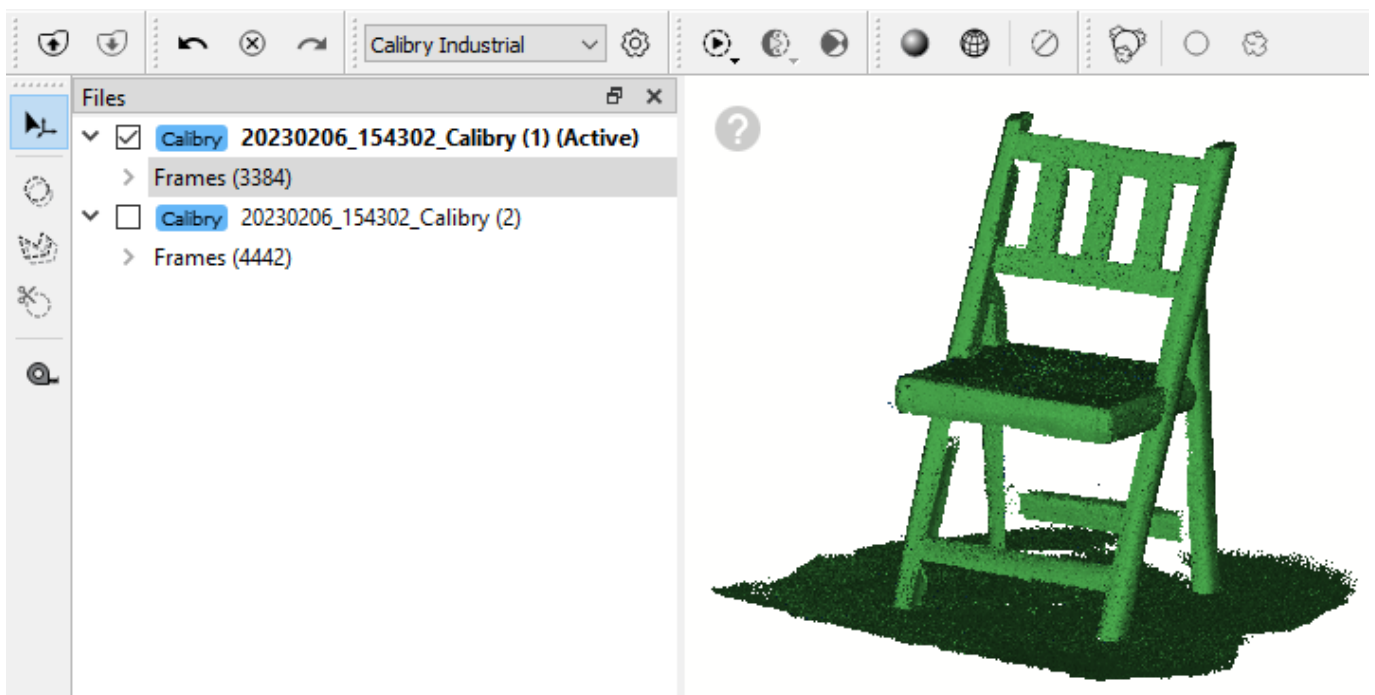
If the second part still have layering, it can be either split again in the same way, or just be discarded.