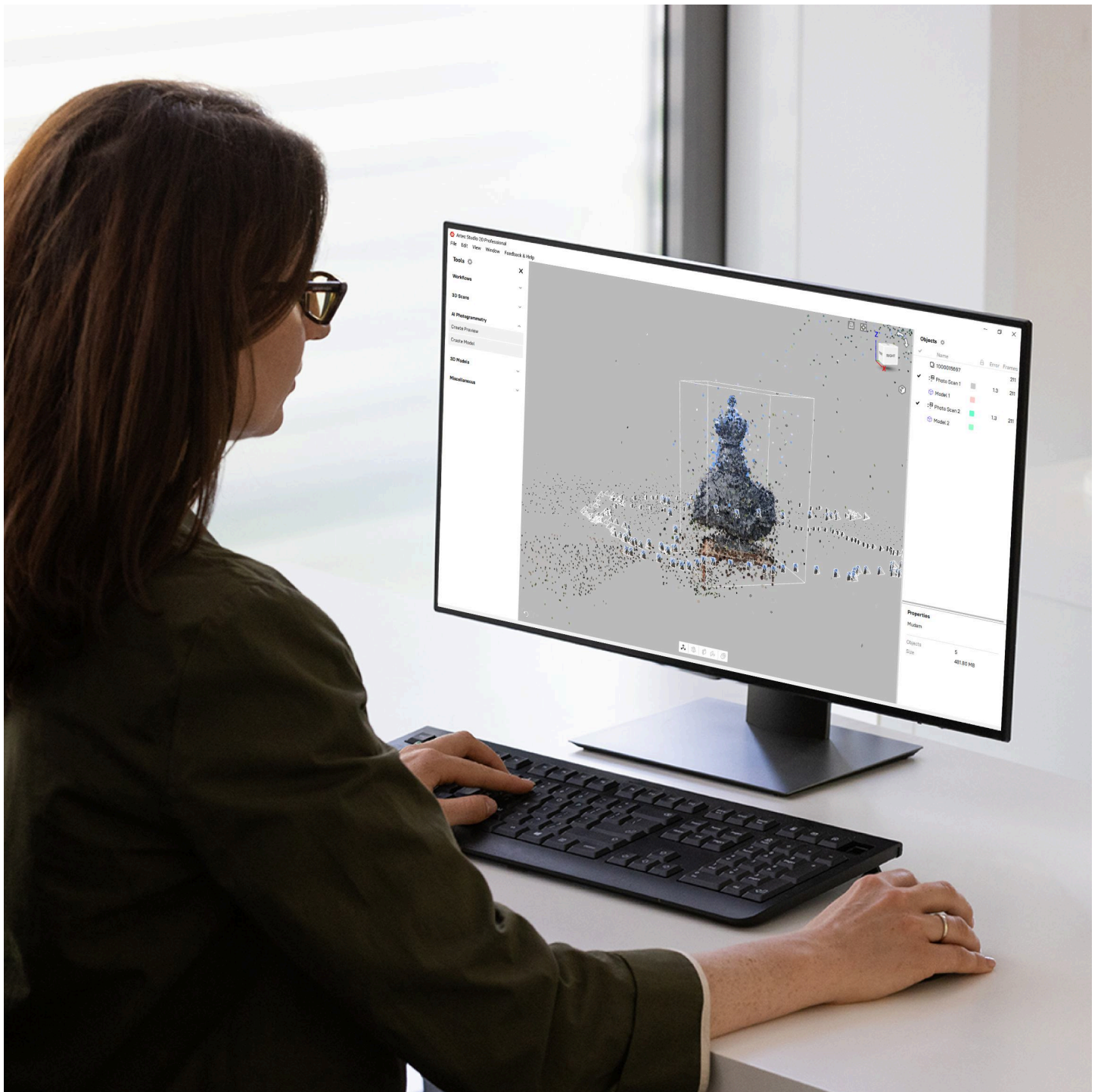


Artec Studio 20



Advanced User Manual



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Popular Topics

- [How to scan](#)
- ☒ [How to scan in HD mode](#)
- [Autopilot](#)
- [Create model manually](#)
- [Align scans](#)
- [Apply texture](#)
- [Orient model](#)
- [Fusion](#) and [Real-time fusion](#)
- [Bridges or Smart Hole Filling](#)
- [Export model](#)
- [Measure model](#)
- [Construct CAD-primitives](#)
- [About your scanner](#)
- [Ask for help](#)

Artec Studio is an industry-acclaimed software package for advanced 3D scanning and data processing. It enables you to scan countless objects using [Artec scanners](#).

This manual will show you how to use the application as well as your 3D scanner to quickly and easily create great-looking 3D models. Use the left panel to get an overview of the entire manual, or refer to the [Quick Start Guide](#). To get the most out of the documentation, review the various [terms](#) we use throughout. Consult the Index to find references for specific parameters that appear in processing algorithms. Also, take a look at the [Conventions and Acronyms](#) section for a key that describes how we highlight semantic elements.

The incomplete list of chapters below is intended to clarify the document structure.

- [3D Scanning at a Glance](#) (Quick Start Guide) is a brief overview of scanning and processing basics. It also covers [Autopilot](#) mode.
- [Using the Hardware](#) covers hardware-related matters: scanners, third-party 3D sensors and 3D mice
- [Scanning](#) explains the basic principles of object scanning and offers advice on how to conduct the scanning process to obtain the best results.
- [AI Photogrammetry](#) covers AI Photogrammetry, including how to capture and process photos for creating a 3D model.
- [Viewing Scans and Models](#) describes ways in which to control an object's appearance in the 3D View window and obtain the best view of the 3D model.

- [Projects, Scans, and Models](#) contains information on data management, working with projects, exporting and importing data, undoing recent operations, and saving the history of project changes.
- [Data Processing](#) focuses on data-processing techniques: working with separate scans, alignment, fusion, filters, defect-elimination methods and texturing.
- [Additional Modes](#) demonstrates how to publish models on the Web; how to use additional features, such as employing several scanners to capture an object; and how to use measuring tools.

In addition to this manual, you can find practical tips and other information at the [Support Center](#). If you encounter an issue when using our 3D scanners or applications, please [submit a request](#).

Documentation for earlier versions of the software is available [here](#).

3D SCANNING AT A GLANCE

Before you start using the guide, we want to show you how easy 3D scanning can be. This brief summary will help you understand the 3D scanning process with the Artec 3D tools and get started quickly. If you prefer to begin with comprehensive and detailed information, you can skip this chapter.

The figure below schematically shows a typical common sequence of the 3D scanning and processing in the Artec 3D environment.



Scanning Working with a scanner, transferring data from the scanner to a PC (mobile device) for further processing.

Cleaning Rough cleaning of scans with the *Eraser* tool. Removal of the base surface and side objects.

Alignment Aligning multiple scans of the same object.

Registration Optimizing the position of frames within one or more scans.

Fusion Creating a mesh model on the base of scans.

Postprocessing Mesh simplification, Mesh smoothing and other optional steps.

Note: The need for a particular step depends on the individual case.

1.1 Preparation

1.1.1 PC Requirements

Besides a scanner itself, you need a PC to create and process models in Artec Studio. Your PC must run on the 64-bit version of Microsoft Windows 8, 10 or 11. The more powerful the PC, the better. The main memory (RAM) and graphics card are the most critical components (visit our [FAQ page](#) for more information).

1.1.2 Activation

Warning: Don't connect the scanner just yet! Continue reading for more information.

1. Register for an account at [my.artec3d](https://my.artec3d.com).
2. Sign in and download Artec Installation Center from the welcome page.
3. Install Artec Installation Center. When prompted, enter your email and password.
4. Plug the scanner into a power outlet, then connect it to your PC using the USB cable.
5. Wait for Windows to detect the scanner. Click *Activate*.
6. Click *Install* in the *Software* section to get Artec Studio running on your machine.

(For more details, see [User Account](#), [Scanner Activation](#) and [Offline Activation](#).)

1.1.3 Prepare Object and Scene (Common Recommendations)

Most objects are easily scanned, but observe the following recommendations for best results:

- Before scanning transparent, reflective or black objects, we suggest applying a powder coating or a special anti-glare spray.
- To scan monochrome objects with simple geometric shapes, do the following:
 - Add auxiliary objects (e.g., crumpled paper) to the scene
 - Paint markers (e.g., “X” shapes) on the surrounding surfaces
- Be sure to provide good ambient light.

See also:

[Selecting and Preparing Objects for Scanning](#).

1.2 Scanning

1.2.1 Scanning with Point

After the Artec Point Addon plugin has been installed, the scanner has been set up and connected to the PC correctly, you can start using the device.

1. Launch Artec Studio, connect the scanner to your PC and turn it on. Calibrate the scanner. To achieve the best results, it is recommended to calibrate Artec Point before each scanning session.
2. Attach reflective targets to or near the work piece.

3. Adjust target size by expanding the Advanced section in the Scan panel.
4. Click the *Play* button to the right of the Scan targets in the Scan panel, and then press the *Play* button on the scanner to turn on its laser.
5. Scan targets.
6. Adjust the [Artec Point scan settings](#) by expanding the Advanced section in the Scan panel.
7. Select the scanned target cloud that scanning will be based on by clicking the *Scan geometry* button.
8. Scan the object itself.
9. If necessary, use the *Refine scan* feature to select the desired area and rescan it at a higher resolution.

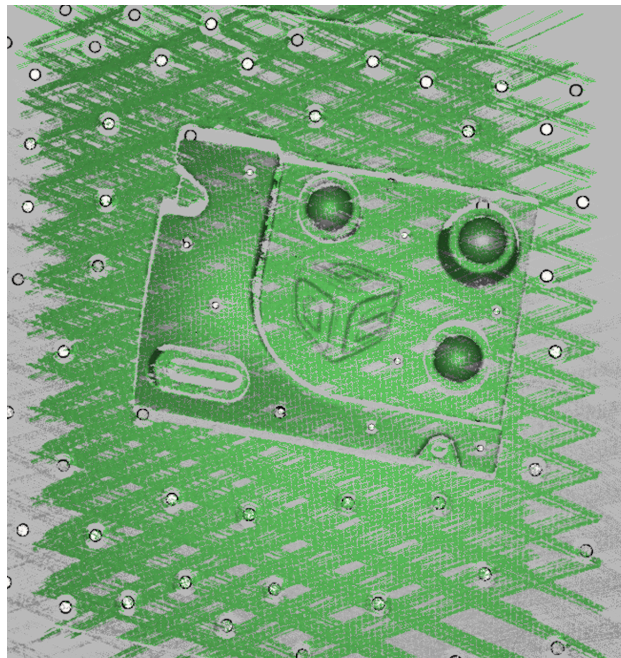


Figure 1: Scanning object with Artec Point.

See also:

[Scanning with Artec Point](#) in details.

1.2.2 Scanning with Spider/Spider II, Eva

1. Launch Artec Studio, then aim the scanner at the object.
2. Press ► on the scanner to start *Preview* mode. For Artec Spider II, click the *Preview* button in the *Scan* panel.
 - *Geometry + Texture* is the default scanning mode and is suitable for most cases
 - For older PCs, *Geometry* mode is a good alternative

- The *Real-time fusion* renders a model in real time, allowing you to view preliminary results as you scan. Click *Stop*, then select the *Real-time fusion* checkbox and click *Preview*.
3. Make sure the object is visible, then press ► once again to initiate recording. If possible, scan all sides of the object in one go, slowly moving the scanner around it as pictured below.

Note: While scanning, pay closer attention to the object on the screen than to the actual object.

4. If you hear an alert sound and the screen displays an error against a red background, smoothly aim the scanner at the area you just captured. Possible reasons for the “Tracking lost” error include the following:
 - You are scanning simple geometric shapes
 - The part of the object you are scanning is too small
 - Scanner movement is too fast
5. Press ■ to finish scanning. For Spider II, use the *Stop* button in the *Scan* panel.

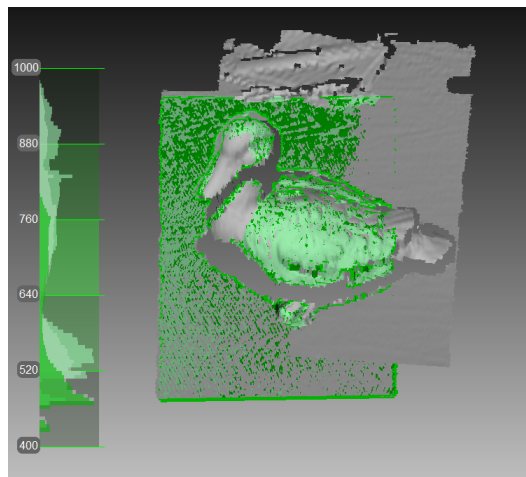


Figure 2: Scanning with Eva.

Turn and Scan (Optional)

Turn the object and capture any remaining unscanned regions (press ►). Also, to facilitate alignment, record at least one previously scanned region.

See also:

- [LED Indicators for Eva, Spider and Spider II](#)

1.2.3 Scanning with Micro II

1. Launch Artec Studio, connect the scanner to your PC and turn it on. [Calibrate](#) it if necessary.
2. Fit an object in the camera view. The object must be entirely visible. For large objects, consider removing extra spacers from the scanner.
3. Adjust *Brightness* and [other quality settings](#) as necessary. Tune it to minimize areas highlighted in red (potentially noisy areas).
4. Adjust [bounding and cutoff settings](#) as necessary.
5. Select *Scanning path*. For simple cases, use the *Preview* mode.
6. Click *Scan with Artec Micro II*. Micro II will start capturing frame while swinging the fixture platform and rotating the turntable.

If necessary, flip the object and affix it. Then repeat the steps above to scan the remaining areas. You'll need to later [align](#) the scans obtained this way.

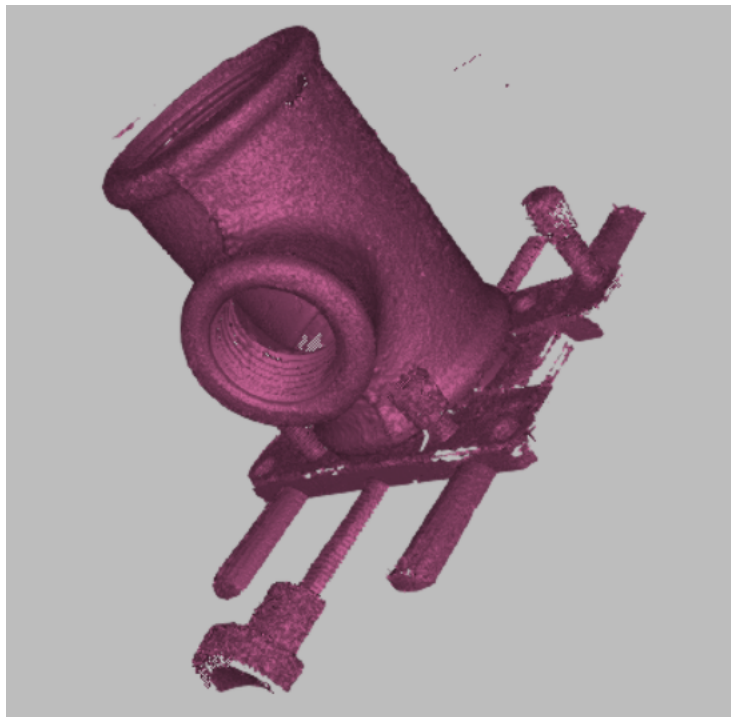


Figure 3: Aligned scans from Micro II.

See also:

[Scanning with Micro II](#) in details.

1.2.4 Scanning with Micro

1. Launch Artec Studio, connect the scanner to your PC and turn it on. [Calibrate](#) it if necessary.
2. Fit an object in the camera view. The object must be entirely visible. For large objects, consider removing extra spacers from the scanner.
3. Adjust *Brightness* and [other settings](#) as necessary. Tune it to minimize areas highlighted in red (potentially noisy areas).
4. Select *Scanning path*. For simple cases, use the *Preview* mode.
5. Click *Scan*. Micro will start capturing frame while swinging the L-shaped arm and rotating the turntable.

If necessary, flip the object and affix it. Then repeat the steps above to scan the remaining areas. You'll need to later [align](#) the scans obtained this way.





Figure 4: Aligned scans from Micro.

See also:

[Scanning with Micro](#) in details.

1.2.5 Scanning with Leo

Since Artec Leo is a self-inclusive device featuring computing and graphics processing units, you don't need to connect it to a PC running Artec Studio while scanning.

1. Tap *New project* or press the red button on the handle of the scanner. Leo will start preview, i.e. building surfaces without recording them.
2. Configure the [Leo settings](#) as you need.
3. Direct the scanner at the object. Practice your movements and assess the quality of the surface being reconstructed on the screen.
4. Once you're ready, tap  or press the red button on the handle of the scanner.
5. Scan the object from all possible sides.
6. Tap  or press the red button on the handle of the scanner.
7. Rotate or turn the object upside down to scan the missing regions.
8. Tap *Close* if you are done with the scan.

Once you have recorded a scan, it is added to the [project](#).

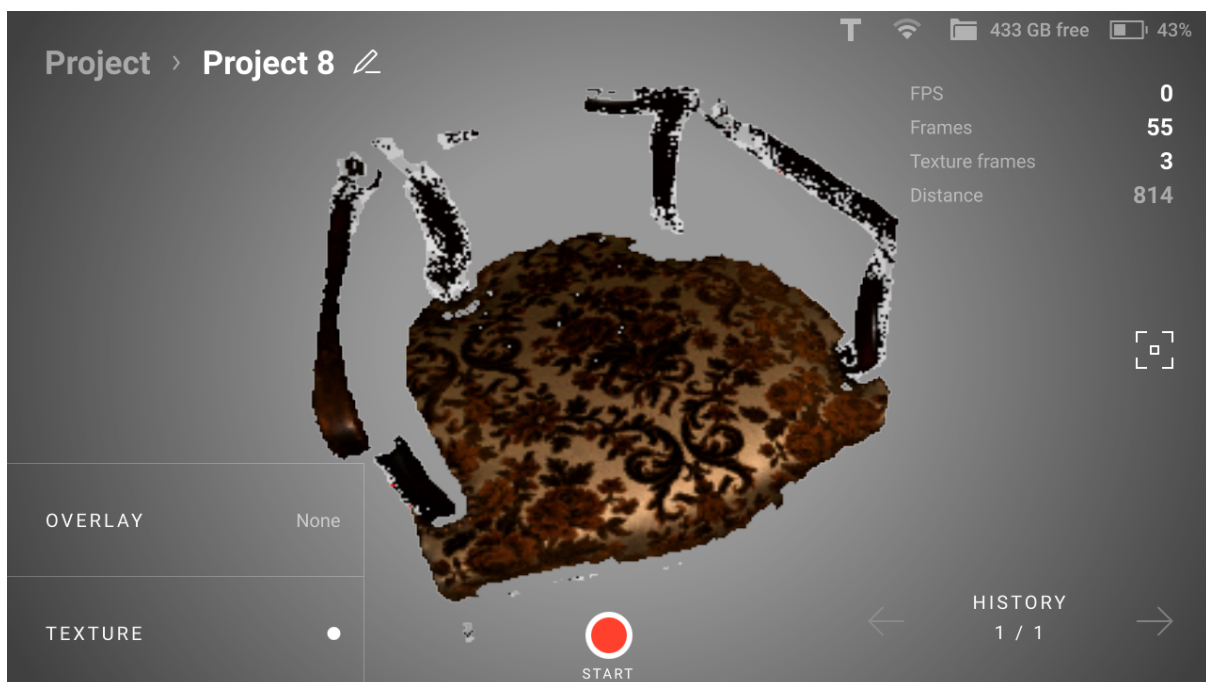


Figure 5: Scanned object.

It is possible to import projects from Artec Leo either over a network from Artec Studio. See [here](#) for details.

See also:

[Scanning with Leo](#) in details.

1.2.6 Scanning with Ray II

Note: Scanning with Ray II can be controlled only from the mobile application [Artec Remote](#). However, you can import Ray II scans to Artec Studio 18. This short introductory document will cover the work with Artec Studio.

1. First, you should scan your object using the Artec Remote app. For further scanning details, please refer to the [Artec Remote scanning information](#).
2. Use the USB stick to transfer data to the external computer.
3. Launch Artec Studio.
4. Select *File* → *Import* → *Ray II scans* menu option
5. Select scans for import
6. Adjust import settings.



Figure 6: Scanned object.

For details, please refer to the [Importing Ray II scans](#).

1.2.7 Scanning with Ray

Note: Ray can work both through Artec Studio and the mobile application [Artec Remote](#). This short introductory document will cover the work with Artec Studio.

1. First, you should [make a preview scan](#) for the following reasons: to get a low-resolution image of the area you are scanning so you can see the desired object; to [estimate the required point density](#) for scanning.
 1. Ensure Ray is connected to your computer.
 2. Launch Artec Studio.
 3. Open the *Scan* panel. Click *Scan with Ray*. The application will open the Ray scan panel.
 4. Click *Preview*. Ray will capture a preview.

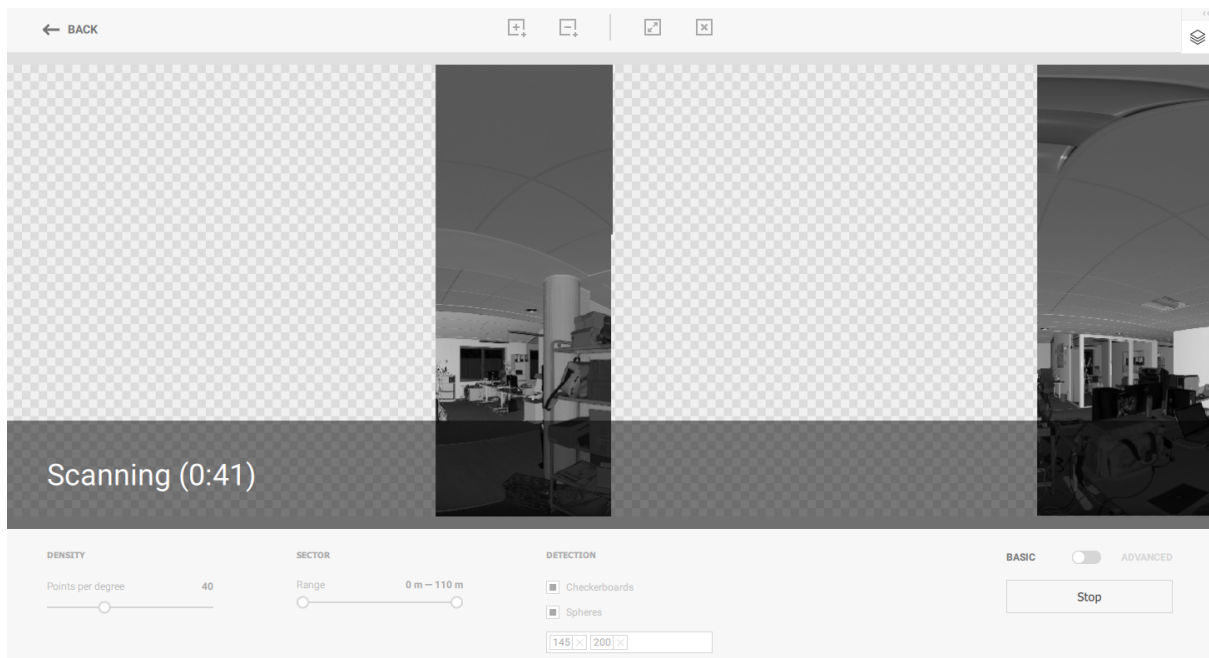




Figure 7: Ray preview scanning.

2. Once you have a preview, you can
 - Select the entire preview image to scan the whole space.
 - Locate and mark sections to scan particular objects in the scene using interface buttons like  and .
3. [Adjust point density](#) and other necessary [settings](#).
4. Scan selected sections using the *Scan* button in Artec Studio.

See also:

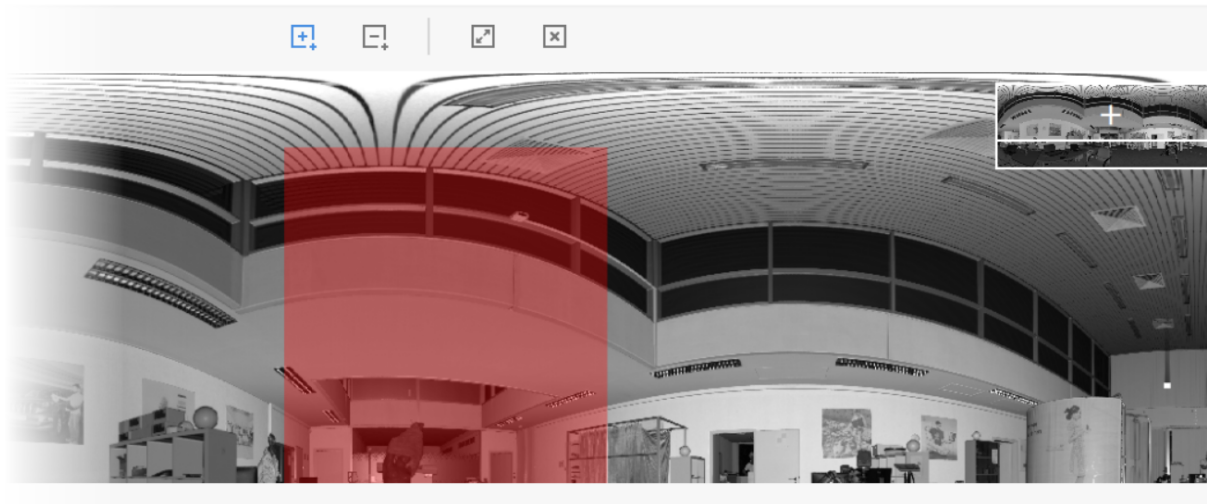


Figure 8: Marking section.

- [Tweaking Scanning Options](#),
- [Scanning Procedure](#),
- [Tracking Modes](#), and
- [Scanning With Real-Time Fusion](#).

1.3 Use Autopilot

For beginners, the easiest way to obtain a 3D model is by using [Autopilot](#). It's also a great time saver for advanced users. If you prefer performing all the steps manually, refer to the [Process Manually](#) section.

Autopilot is a special mode that helps users obtain a complete 3D model without learning all the ins and outs of postprocessing. It consists of two major parts: semiautomatic (editing and alignment) and [automatic](#).


Tweaking Autopilot Settings


- *Hole-filling method* (available options are *Don't fill*, *Watertight* and *By radius*) instructs the algorithm to fill or not fill holes in the model.
- *Model resolution*—the lower the resolution value, the sharper the shape and the more details you will see. If you're unsure, leave the value as Auto. Effectively, it's the same as [Creating Models \(Fusion\)](#) resolution. Note that the resolution should be no less than 0.5 for scans captured using Eva and no less than 0.1 for Spider.
- *Polygon count* determines how many polygons the resulting model will have. The greater the value, the better the quality and the larger the file size. If you're




unsure, leave the value as Auto. For more information, consult the [Mesh Simplification \(Tools, Mesh Optimization\)](#) section.

- *Texture*—clear this checkbox if you don't want to apply texture to the model.
- *Texture resolution* takes specific values in the range of 512x512 to 8192x8192 or 16384x16384 pixels depending on the available GPU memory.
- *Export final model* saved the resulting model in the defined *Format* with the given *Name* to the location specified in the *Save to* option.

To produce a model,

1. Click *Autopilot* in the left panel or hit **F9**.
2. Become familiar with the steps that you will perform in this guided mode (listed in the welcome screen).
3. In the *Workspace* panel, use the  flag to mark all scans that you intend to use, then click *Next*.
4. Then specify the input parameters for the model-creation step and click *Next*. Primary settings may include the following:

Note: We suggest consulting the tool tips, which you can reveal by clicking the  button next to the option name.

- a. *Scan quality (geometry)*. Click  to determine whether your scan of the object has the correct geometry by examining the tool-tip images.
 - b. *Scan quality (texture)*. Click , look at the images and decide whether your scan has sufficient texture.
 - c. *Hard-to-scan surfaces*. Select this option if your object has surfaces that are difficult to capture. Consult the image samples by clicking the  button.
 - d. *There are parts to erase*. Select this option to erase some parts of the scans prior to processing.
 - e. *Scans are well aligned*. Select this option if the alignment step should be skipped.
 - f. Decide on the *Object size* by referring to the image samples.
 - g. Leave the default values for the remaining options in this window (sufficient for most cases). For advanced scenarios, you can tweak these settings (more details appear in the [sidebar](#)).
5. If necessary, erase any extraneous objects that can hinder processing and postprocessing. Learn how to use *Eraser* by consulting the [Erasing Portions of Scans \(Eraser\)](#) section.

6. Once you're done, click *Next*. If the object was captured over several scans, Autopilot will align them and show you the result. You can approve it or align the scans manually (consult [Best Fit Alignment without Points](#)).
7. Click *Next*.
8. Autopilot will begin processing and then [postprocessing](#). Once it's finished, a message will appear informing you that the model is ready. Click *OK*.

The automatic steps can be grouped as follows:

- **Processing**
 1. Global registration
 2. Outlier removal
 3. Fusion
- **Postprocessing**
 1. Small-object filter
 2. Mesh simplification
 3. Texturing

Note that, the *Autopilot* mode does not implement advanced techniques such as *HD Reconstruction* and *Photo Registration*.

1.4 Process Manually

1.4.1 Crop Surroundings

Once you finish, click *File* and select *Save project*. Close the *Scan* panel. You can now crop the surroundings.

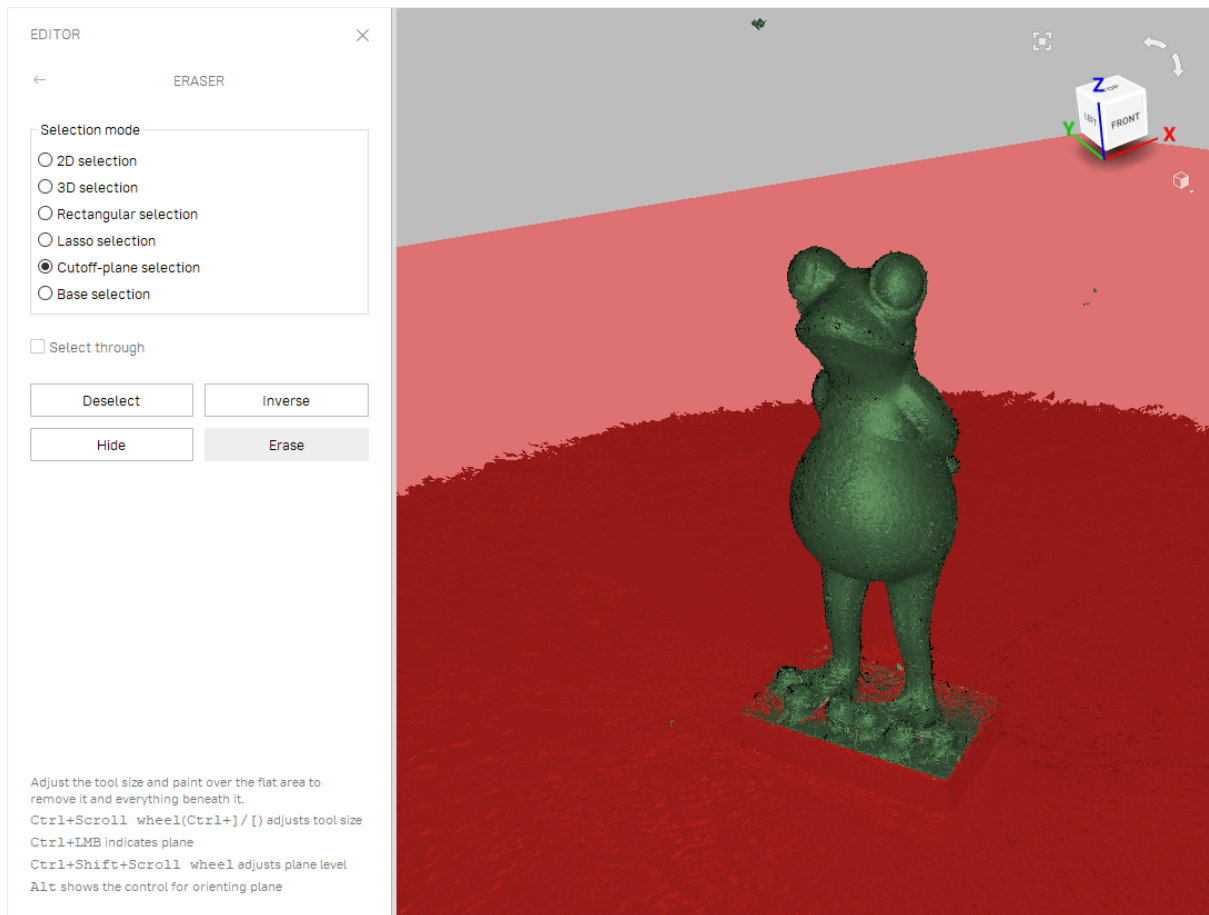
Purpose: To erase auxiliary surfaces (e.g., a table or floor).

Steps: Open *Editor* → *Eraser* → *Cutoff-plane selection*. Follow the panel instructions.

Tip: Use freely other types of the *Eraser* (not only *Cutoff-plane selection*) to remove other unwanted elements from the scan.

See also:

[Editing Scans](#).




1.4.2 Align

Tip: If you have only one scan (see the *Workspace* panel), or if you used [Auto-alignment](#) during scanning, you can skip this step.

Purpose: To align several scans.

Steps:

1. Mark two or more scans using , click *Align* and select those scans in the *Best fit* tab while holding the `Ctrl` key.
2. Click *Auto-alignment*.
3. If alignment fails owing to a lack of texture or lack of overlapping areas, manually match the features among the scans and click the *Align* button.

See also:

[Alignment](#) in details.

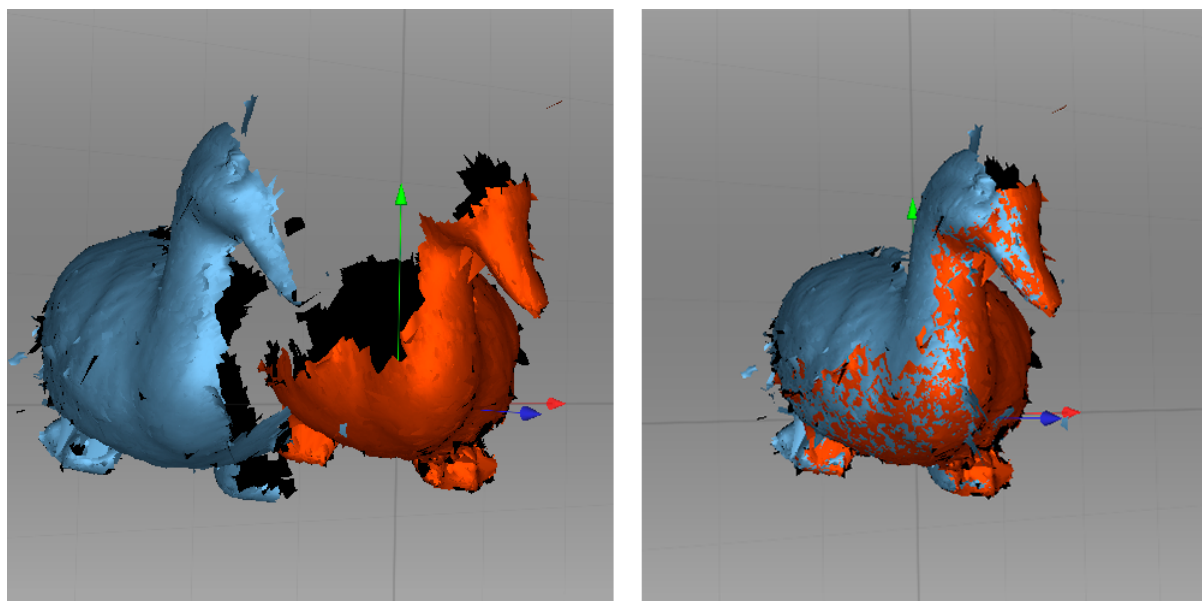


Figure 9: Two scans before and after alignment.

1.4.3 Global Registration

Purpose: To simultaneously optimize the frame position across all scans, thus preparing them for further processing.

Steps: Mark scans using ✓, then click *Tools* → *Registration* → *(Global) Run*.

Tip: If you see some obvious problems with preliminary (*Rough*) registration after scanning, try to resolve them by *Global registration* of each scan separately. See [Global-Registration Parameters](#).

See also:

[Global Registration](#) in details.

1.4.4 Eliminate Noise

Purpose: To erase large outliers and some noise.

Steps: Open *Tools* → *Outlier removal* → *Run*.

See also:

[Editing Scans](#) and [Eliminating 3D Noise \(Outlier Removal\)](#) for more details.

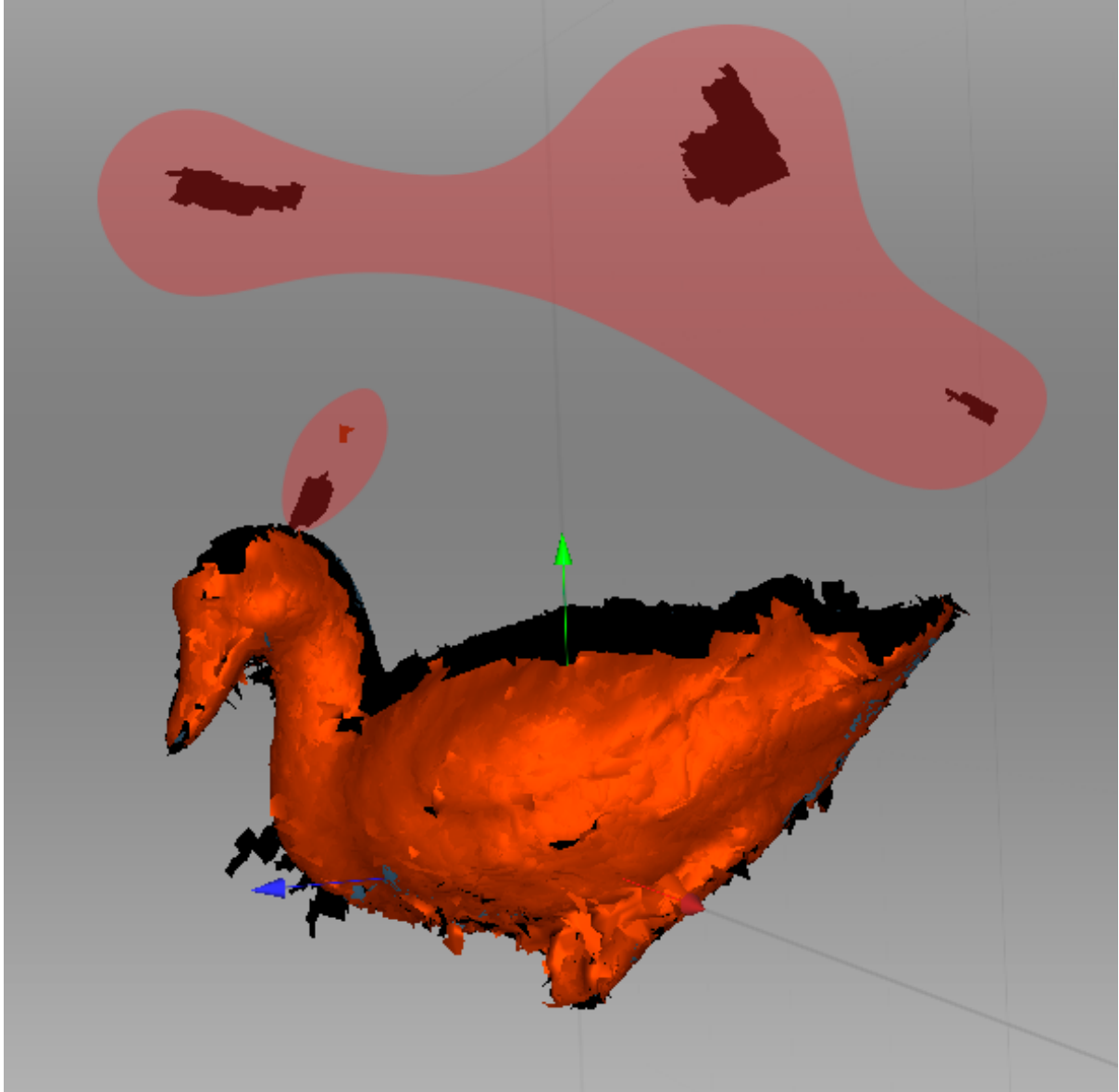
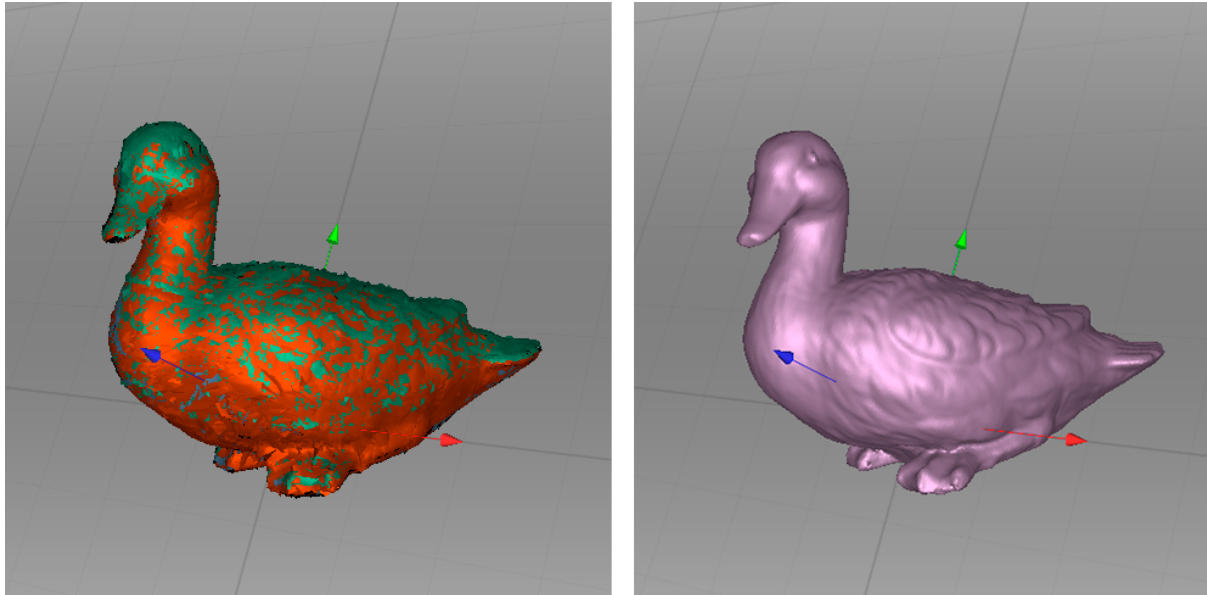


Figure 10: Outlier removal.

1.4.5 Fusion

Purpose: To create a model (a single surface, as opposed to the multiple surfaces that constitute the source scan).

Steps: Select *Tools* → *Fusion* → *Fill holes* → *All (watertight)* → *Run*.



Tip: To obtain sharper surfaces, set the *Sharpness* value of the *Fusion* algorithm to 1.

In any case, *3D resolution* can be adjusted: the smaller the value, the more precise the resulting surface.

See also:

[Creating Models \(Fusion\)](#) in details.

1.4.5.1 Erase Flaws (Optional)

Purpose: To erase any outliers and poorly scanned regions.

Steps: Click *Editor* → *Defeature brush*. Follow the instructions.

See also:

[Editing Scans](#)

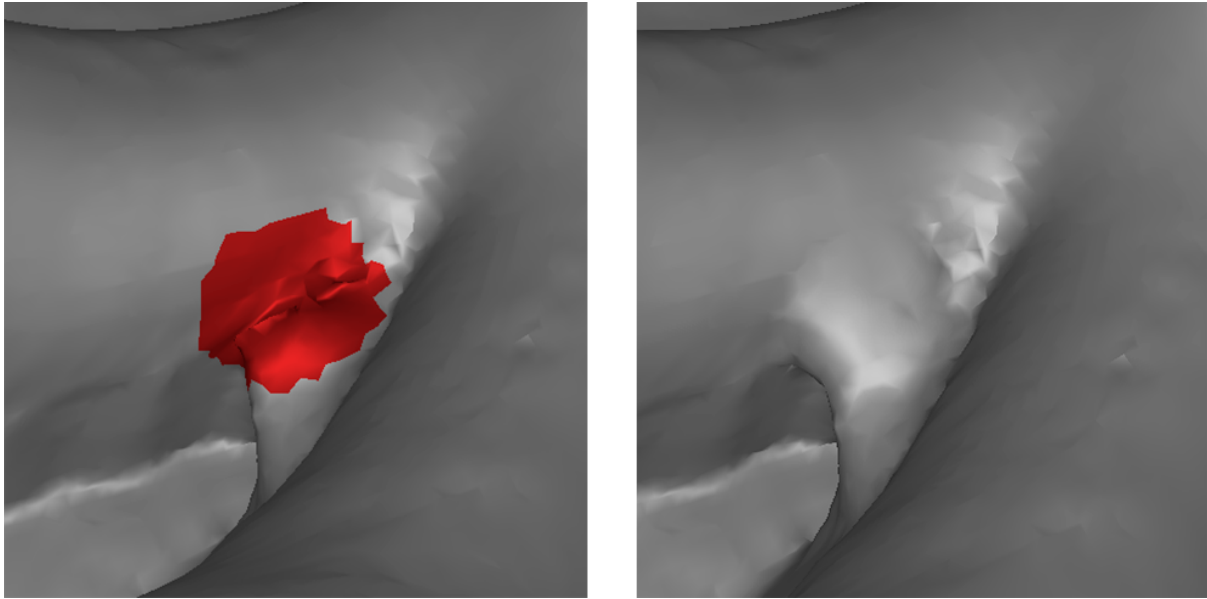


Figure 11: Using Defeature brush.

1.4.6 Simplify Mesh

Purpose: To reduce the file size by decreasing the number of polygons without significantly distorting the actual 3D geometry.

Steps: Click *Tools* → *Mesh Optimization* → *Mesh simplification* → *Run*.

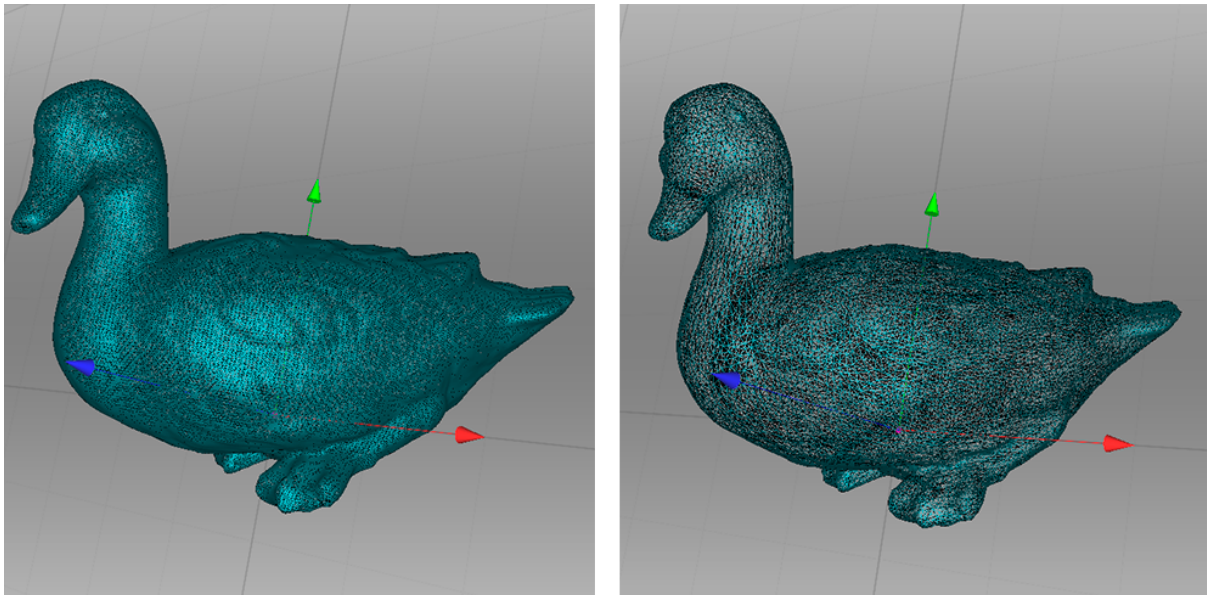


Figure 12: Mesh simplification.

See also:

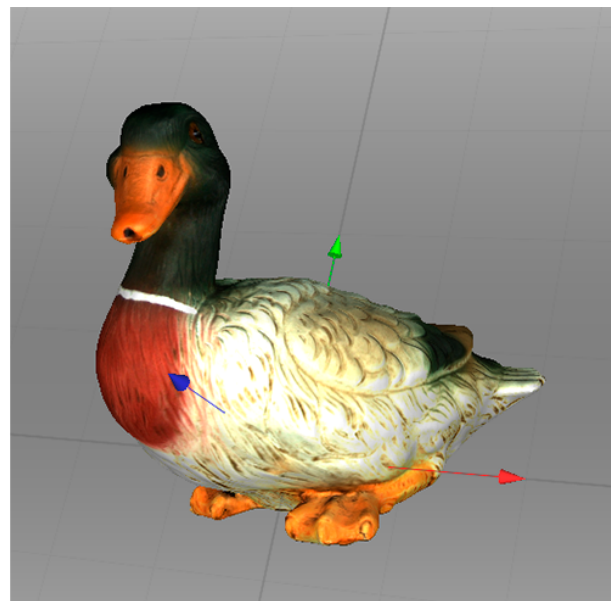
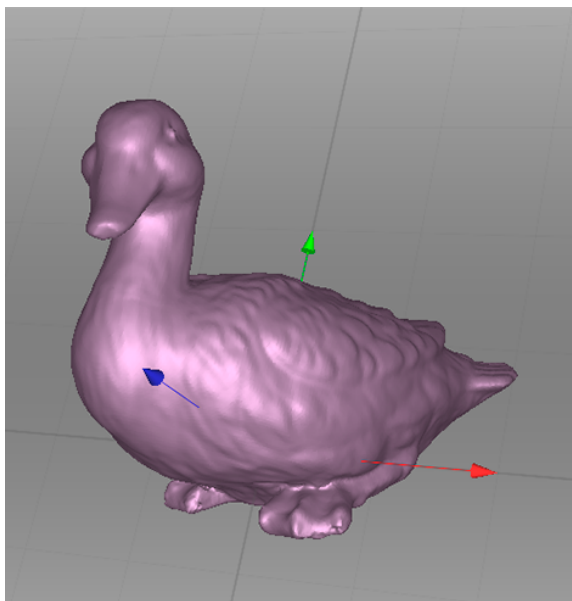
[Mesh Simplification \(Tools, Mesh Optimization\)](#) in details.

1.4.7 Texturing

Purpose: To create a textured model.

Steps:

1. Click *Texture*.
2. Select a model (the output of the *Fusion* algorithm).
3. Make sure its source scan(s) is selected in the *Source data* section. Also see [Photo Registration](#)
4. Select the *Output texture size* and click *Apply*.



See also:

[Texturing](#) and [Photo Registration](#) in detail.

1.5 Export, Measure, Share

To export a model(mesh):

1. Select the object, right-click and select the *Export* → *Meshes* option from the context menu, or alternatively, open *File* → *Export* → *Meshes*.
2. Select a required format, specify the folder and file name, then click *OK*.

To measure the model:



1. Open *Measures*.
2. Select one of the following:
 - *Distance* for distance calculation: points are connected by lines (linear) or curves that pass over the model surface (geodesic)

- *Sections* for area and volume calculation

See also:

[Exporting Models, Scans, and Point Clouds](#), and [Measurement Tools](#).

1.6 Tips and Tricks

- You can reset all settings to their defaults using `F10` → *Scan* tab → *Reset to defaults*.
- To return any altered parameters in the *Tools* panel to their default values, click the adjacent  button. A parameter lacking this button is set to the default value.
- Save screenshots by hitting `Ctrl+Shift+S`.
- Apply annotations using *Measures*: click `Ctrl+LMB` to tag a label and type text, then click  or anywhere outside the label's pop-up window.

GLOSSARY

The following terms related to Artec Studio and 3D scanning appear regularly in this manual.

accuracy How closely a measurement matches the actual value of the quantity being measured.

Autopilot An advanced smart mode that guides the user through postprocessing in a few steps, automatically selecting the most effective settings and producing a 3D model.

bundle Capture of an object through simultaneous use of multiple scanners, whose numbers and relative positions are specified in the application.

CAD object A feature-based, parametric solid model used in design engineering and manufacturing. It can be created in a CAD system, reverse-engineering software package or Artec Studio since version 15.

CAD primitive A simple CAD model created in Artec Studio and either fitted to a polygon *model* or positioned independently.

collection A set of scans (or models) for alignment. An alignment session may only have one collection of registered scans and several collections of unregistered ones.

fine registration A thorough frame alignment using an algorithm for relative positioning of sequential frame pairs.

frames 3D surfaces captured during a scanning session, collectively constituting a *scan*. The scan rate varies with scanner type and can reach a maximum of 15 frames per second using Eva.

fusion Process that creates a polygonal 3D model. It effectively melts and solidifies the captured and processed frames or point cloud surfaces. Fusion can be run as a separate *algorithm* or throughout the scanning (*Real-time fusion*).

global registration Algorithm that optimizes the relative positions of all frames using a single coordinate system.

group A method of organizing *objects* in the *Workspace* panel hierarchy.

HD scan A scan that contains some frames of the high-definition (HD) resolution.

key frames Frames used by the global registration algorithm. The algorithm selects them

automatically to fully cover the surface of the captured object using as few as possible.

mesh The surface geometry of a 3D model; it comprises a series of linked polygons.

model The 3D object that results from the fusion operation (in Artec Studio) or another modeling process in a different software package.

near and far cutting planes Planes that limit the space in which the scanner is capturing 3D frames. The device will ignore everything that is closer than the near cutting plane or more distant than the far cutting plane.

object A distinct entity in the scanned scene, or a generic term for all 3D data in Artec Studio: scans, point clouds, polygon and CAD models, and primitives.

origin The center of the coordinate system.

photo scan A point cloud generated by the Create Preview algorithm of AI Photogrammetry from photos positioned in 3D space.

project A method of managing the scanned material, processed data and user operation history, either in memory or on disk. Artec Studio project files use the *A3D* extension.

resolution The ability of a scanning system to capture detail in an object. See also 3D resolution.

rough registration Preliminary frame alignment performed during capture.

scan A sequence of frames captured in a single continuous movement of the scanner around an object or scene.

SD scan A scan that contains only frames of the standard-definition (SD) resolution.

section; in a point cloud scan Corresponds to the region selected in the Ray preview area. The application may save these sections in the export files differently ([Export Settings for Point Clouds](#)).

section; in measurements Short for cross-section. Section is the plane that splits model or scan into two parts ([Sections and Volume](#)).

supporting surface A surface on which the object is resting (e.g., a table or the floor).

target cloud An OBC file with a set of reference targets created in a photogrammetry solution, which can be imported to Artec Studio. It is possible to import multiple targets clouds and switch between them in a particular scanning session. During scanning, each target from the original set of reference targets is captured multiple times on different frames, resulting into a number of instances. The instances representing one particular target are grouped into clusters. Information about captured targets and their deviation from the reference ones is available in the *Features* panel. See also [Inspecting Quality Of Targets Clouds Registration](#). Alternatively, a target cloud can be created by scanning targets on the object with Artec Point.

targets Stickers placed on the object being scanned to ease identification of the various regions. There are two types of targets: non-coded and coded. Unless the type is explicitly specified, the target is considered non-coded. Typically, a non-coded target is a round sticker that has a black ring with a white circle in the center; a coded

target has a unique code ring that photogrammetry software can automatically recognize.

tracking Calculation of the scanner's position in a coordinate system relative to the scene.

transformation Any change in the position of a scan and/or its frames, for example, translation and rotation.

You can also find these terms along with some algorithm parameters in Index.

USING THE HARDWARE

3.1 3D Scanners

Artec Studio can work with one or more Artec 3D scanners. It offers tools to quickly create 3D models of physical objects. Besides managing the process of capturing objects, it lets you perform full data postprocessing, optimize mesh tessellations and apply other operations to obtain a quality 3D model. You can then send the complete model to a CNC machine or import it to another 3D-modeling application.

Most Artec 3D scanners are specifically designed for handheld use, offering light weight and compact size. Using them is easy—no special knowledge or skills are necessary. To obtain a complete 3D model, simply scan the object from different angles and fuse the resulting scans into a single model using Artec Studio.

In the images below, you can see the front and side views of Artec Spider II and its components.

3.1.1 Spider II

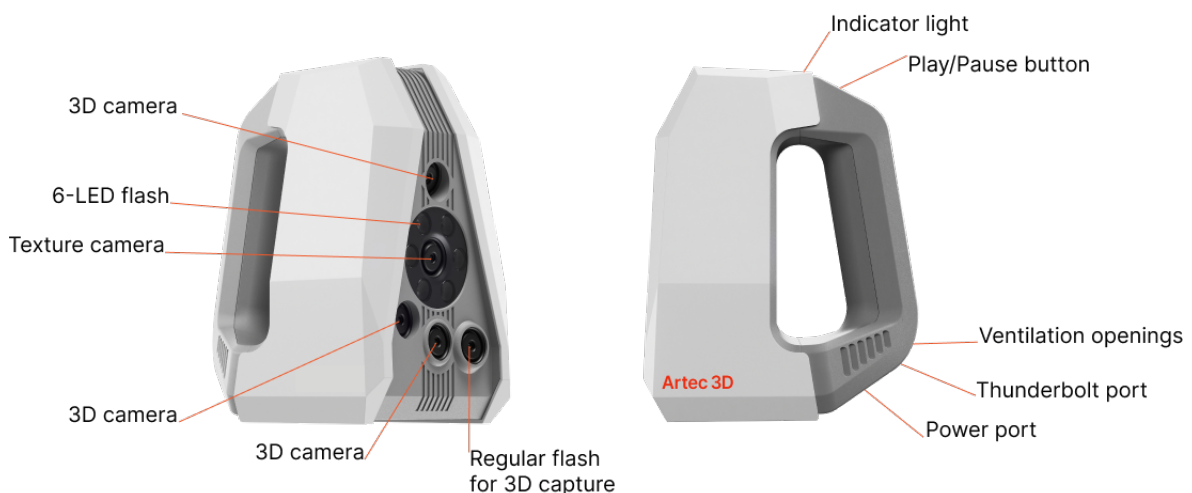


Figure 13: Spider II. Front view

For detailed information on the technical specifications of Artec Spider II, scanning settings, and the full scanning workflow, refer to the [Artec Spider II Advanced User Manual](#) . For a quick start guide and safety instructions, see the [Artec Spider II Quick Start Guide](#) .

3.1.2 Point



Figure 14: Point components.

For detailed information on the technical specifications of Artec Point, scanning settings, and the full scanning workflow, refer to the [Artec Point Advanced User Manual](#) . For a quick start guide and safety instructions, see the [Artec Point Quick Start Guide](#) .

3.1.3 Micro II

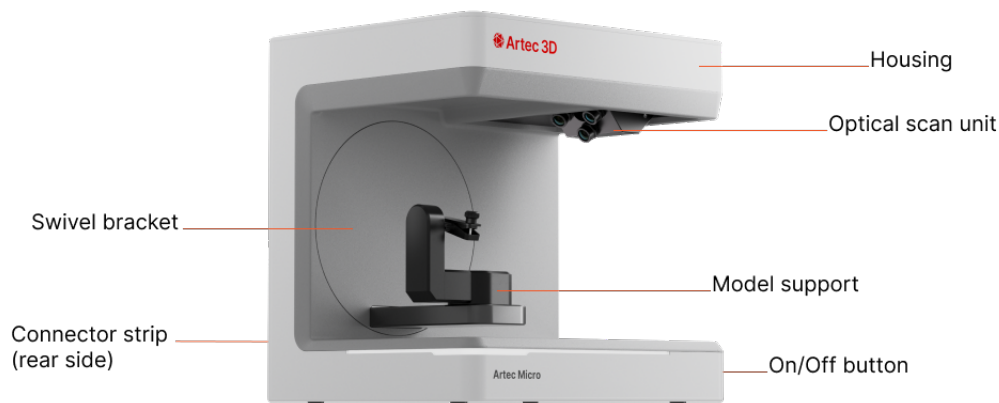


Figure 15: Micro II components.

For detailed information on the technical specifications of Artec Micro II, scanning settings, and the full scanning workflow, refer to the [Artec Micro II Advanced User Manual](#) . For a quick start guide and safety instructions, see the [Artec Micro II Quick Start Guide](#) .

3.1.4 Leo

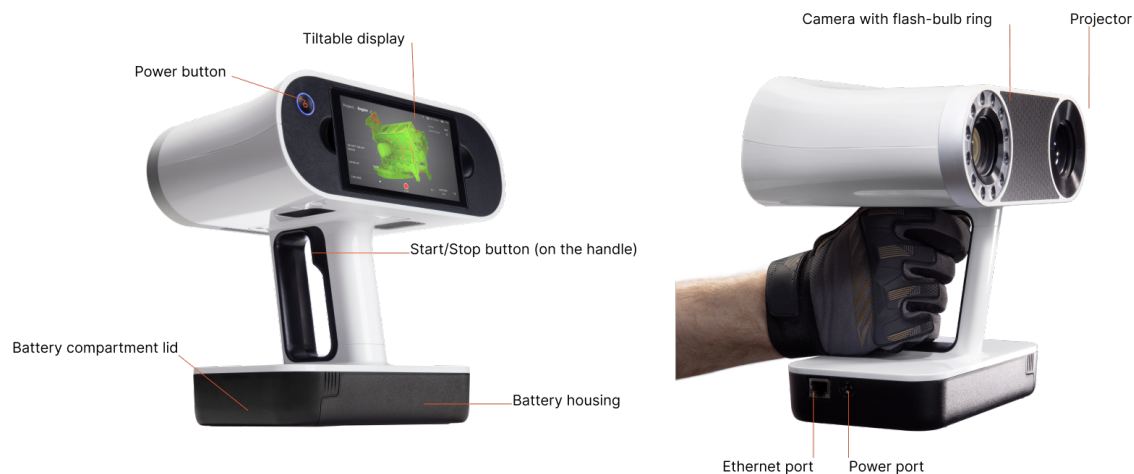


Figure 16: Leo components.

For detailed information on the technical specifications of Artec Leo, scanning settings, and the full scanning workflow, refer to the [Artec Leo web manual](#) . For a quick start guide and safety instructions, see the [Artec Leo Quick Start Guide](#) .

3.1.5 Ray II

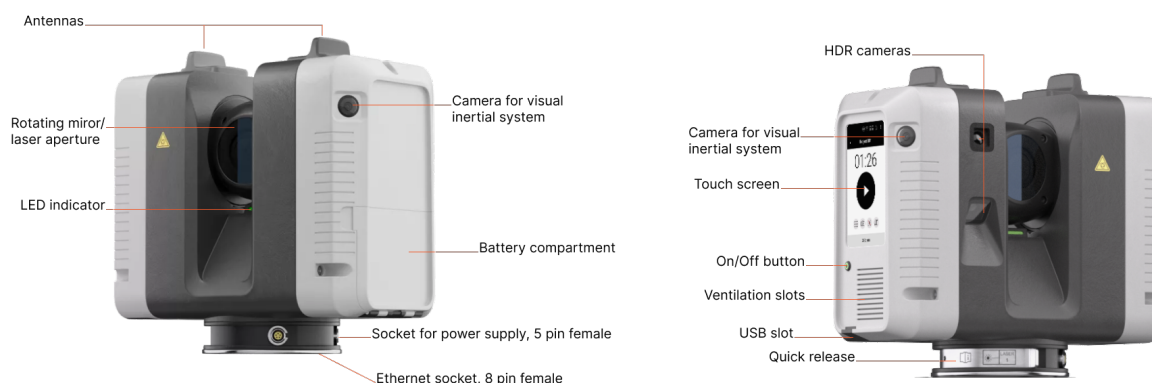


Figure 17: Ray II components.

For detailed information on the technical specifications of Artec Ray II, scanning settings, and the full scanning workflow, refer to the [Artec Ray II Advanced User Manual](#). This user manual is available in multiple languages on [Documentation Portal](#). For a quick start guide and safety instructions, see the [Artec Ray II Quick Start Guide](#).

3.1.6 Micro

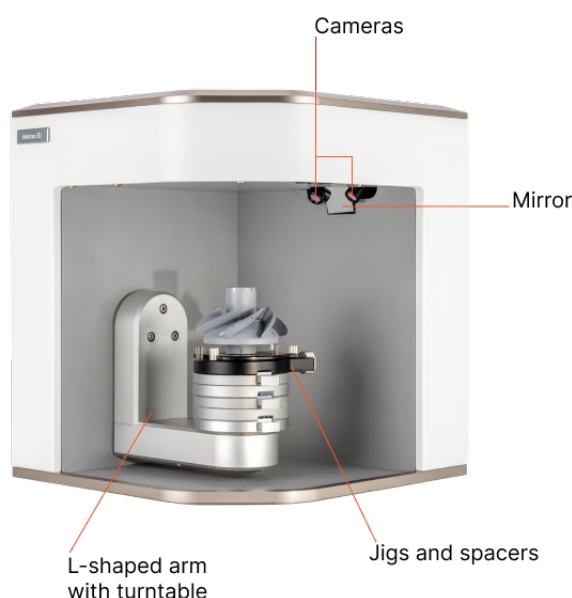


Figure 18: Micro components.

For detailed information on the technical specifications of Artec Micro, scanning settings, and the full scanning workflow, refer to the [Artec Micro web manual](#). For a quick start guide and safety instructions, see the [Artec Micro Quick Start Guide](#).

3.1.7 Ray

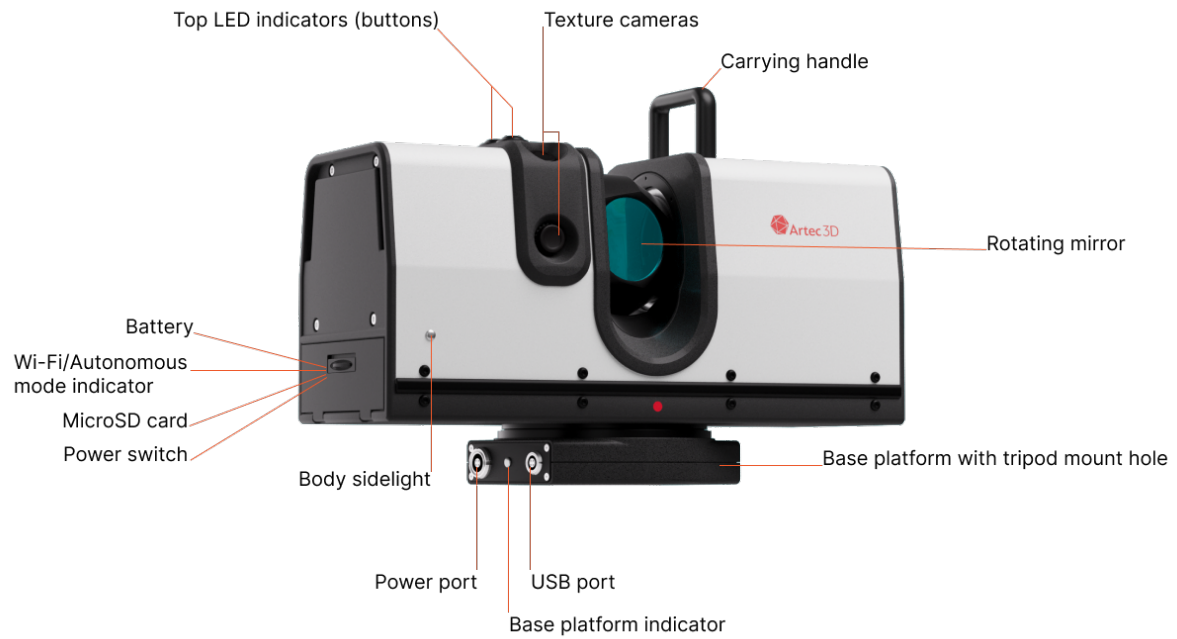


Figure 19: Ray components.

For detailed information on the technical specifications of Artec Ray, scanning settings, and the full scanning workflow, refer to the [Artec Ray web manual](#).

3.1.8 Eva



Figure 20: Eva components.

For detailed information on scanning with multiple Eva scanners, refer to [Hardware Synchronization for Eva](#), for HD scanning with Eva, see [Notes on HD Scanning With Eva](#), and for further processing of scanned data, visit the [Data Processing page](#).

3.1.9 Spider



Figure 21: Spider components.

For detailed information on scanning workflow, refer to [Notes on Scanning With Spider](#) and for further processing of scanned data, visit the [Data Processing page](#).

3.1.10 Field of View Comparison: Artec Eva vs. Artec Spider

Depending on the size of the object you're scanning, use either the Artec Point, Artec Ray/Ray II, Leo, Eva, Spider/Spider II, or Micro/Micro II. The primary difference between these models is the depth and field of view. They also differ in 3D resolution as well as point accuracy; consult the [Artec website](#) and relevant manuals for details.

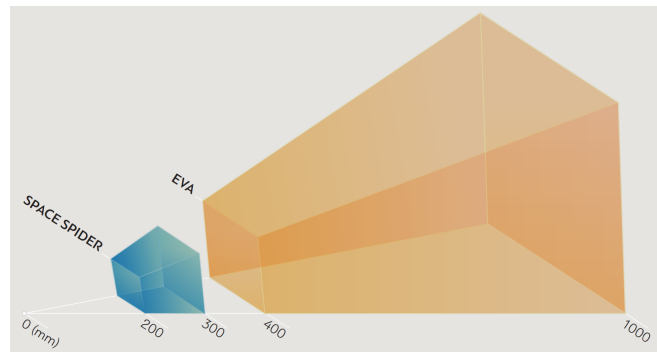


Figure 22: Fields of view for Eva and Spider 3D scanners.

You can combine several different scanner types while capturing a scene. In some cases when capturing complex shapes, this capability increases the scanning rate and enables you to achieve your desired precision.

3.1.11 LED Indicators for Eva, Spider and Spider II

Artec scanners include built-in multicolor indicators. By explaining the meaning of these indicators, the list below enables you to keep track of the scanning process:

- **Steady blue**—scanner is booting up.
- **Flashing green**—Artec Studio cannot detect a 3D scanner.
- **Steady green**—scanner is connected to the application and ready to use.
- **Flashing red**—scanner is in *Preview* mode, or tracking in *Recording* mode is lost.
- **Steady red**—scanner is in *Recording* mode and object tracking is proceeding correctly.

3.1.12 Hardware Buttons for Eva, Spider and Spider II

Artec Eva and Artec Spider scanners have three-position buttons on their bodies.

- ▶ —press this button once to open the *Scan* panel and start *Preview* mode; press it once more to switch to *Recording* mode. Subsequently, pressing this button will switch between *Preview* and *Recording*.
- —press once during a scan to stop the scanning process; press twice to stop scanning and close the *Scan* panel.



Figure 23: Scanner buttons: Artec Spider on the left and Artec Eva on the right.

Artec Spider II scanner has a Play/Pause red button on its body.

- –Being in the open *Scan* panel, click the *Preview* button, direct the scanner at the object, then press the *Play/Pause* button on the scanner to switch from *Preview* to *Recording* mode. To pause scanning, press this button once more. To complete scanning, click the *Stop* button in the *Scan* panel.

3.1.13 Hardware Synchronization for Eva

Artec Eva is equipped with two jacks designed for 6P6C connectors (RJ12). By creating a bundle, you can link multiple Artec Eva scanners to each other. The master device is a leading scanner that sends signals to the next slave device. Each subsequent device is connected to the previous one sequentially as [Figure 24](#) shows. To connect the devices, you can use a standard phone cable (*RJ12 6P6C*) or any other cable that uses the conductor scheme shown in [Figure 24](#). Each scanner should also connect to the PC via USB.

Warning: Only Artec Eva scanners can connect to each other. Do not connect Artec Eva to a telephone wall port!

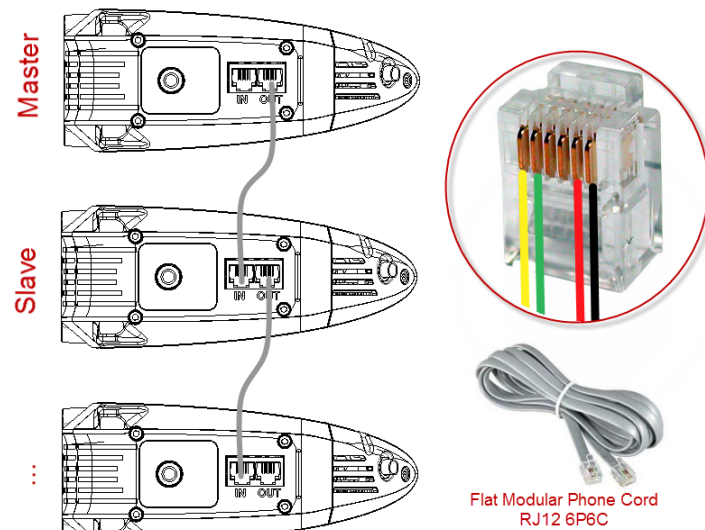


Figure 24: Synchronization scheme.

Jacks on the Artec Eva scanner shown at left and conductors in a 6P6C connector shown at right.

3.2 Artec Turntable

Artec Turntable is designed to ease scanning of small and midsize objects by eliminating the need to rotate them manually. Both the rotary plate and the mat that comes with the turntable feature a special pattern to ensure robust tracking with Artec scanners. The mat is made of silicone, which prevents objects from sliding off the rotary plate.

To scan using Turntable, follow the steps:

1. Ensure your computer has a Bluetooth adapter that supports the 4.0 standard.
2. Add a new Bluetooth device.
3. Open Artec Studio.
4. Access the *Scan* panel.
5. Select the *Use turntable* checkbox.
6. Place the object on the turntable.
7. Click *Preview*.
8. Click *Record* to start capturing. The turntable will start rotating.
9. Click *Pause* or *Stop*. The turntable will stop rotating.

3.2.1 Recovering Lost Tracking

If you experience a [tracking loss](#), Artec Studio will pause the turntable. It also turns the rotary plate back by about 15 degrees. Once the application has recovered tracking, it resumes rotation.

3.3 3D Mouse

Artec Studio can work with 3Dconnexion manipulators.

Basic support includes navigation in *3D View* and the following commands:

- Home
- Fit to view
- Undo
- Redo

For 3D mouse to function, you need to install drivers from the manufacturer's [website](#). Additionally, you can assign four currently supported commands to the mouse radial menu or at least two of them to the hardware buttons for Artec Studio.

To assign a command to the 3D mouse button, follow the steps:

1. Open Artec Studio
2. Then open *3Dconnexion Properties* utility from the Windows tray
3. Click *Buttons*
4. Click on the > arrow on the right side of either button field. A flyout window will open for that 3D mouse button.
5. Open the *Artec Studio* category
6. Select either of the currently supported command.

If you want to assign several commands, create a new *Radial menu* (use the eponymous category in the flyout menu). For more information, consult the manual for your 3Dconnexion mouse.

To get used to navigating 3D content, use *3Dconnexion Trainer* or *3Dconnexion Demo* from the *3Dconnexion Home* application.

Note: In Artec Studio, you move the camera around the object rather than the object itself.

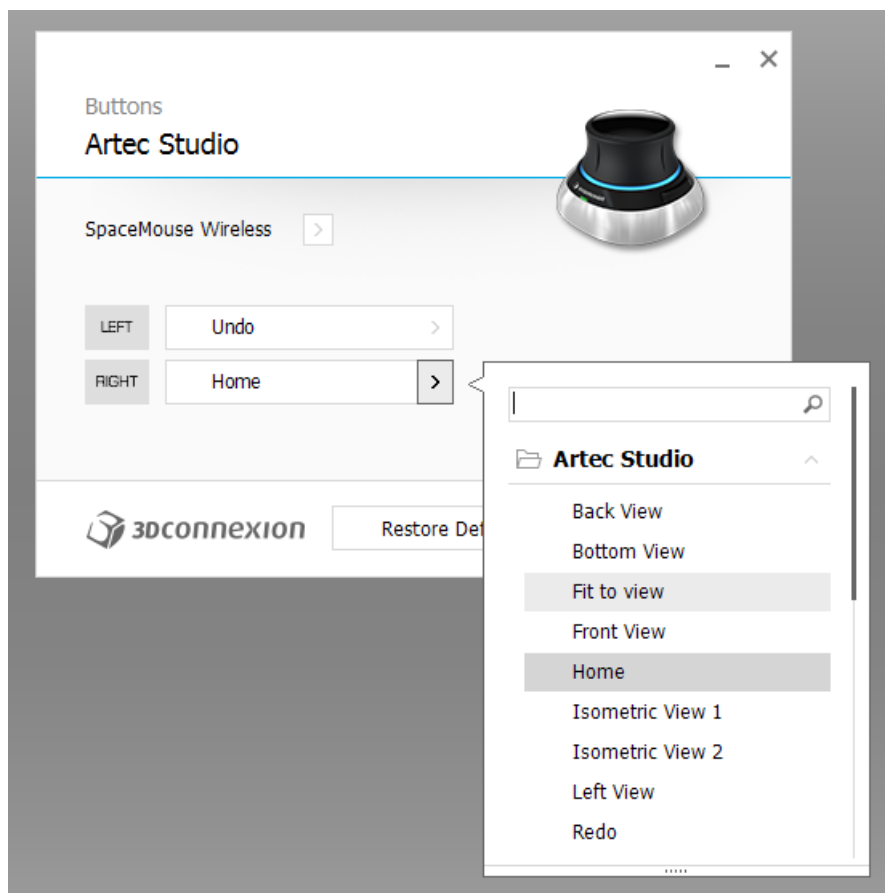


Figure 25: Assigning command to 3D mouse button.

3.4 Artec Battery Pack

Available as an accessory, battery pack allows you to scan anywhere without the need to be near a power outlet. Battery from this pack supports Artec Eva, Artec Spider and Artec MHT scanners and lasts for up to 6 hours of scanning.



Figure 26: Battery pack with Eva.

Battery pack includes the following items:

- Battery
- Battery pouch
- Power adapter (110–230 V → 19 V)

1. Fully charge Artec battery using its *Input* socket.
2. Plug the cable into the battery *Output* socket.
3. Then connect the cable to your Artec scanner.

Important: Never confuse battery ports when connecting scanner.



Figure 27: Battery ports from left to right: Input, Output.

INSTALLATION

4.1 System Requirements

Your computer must meet [the system requirements](#) to use Artec 3D scanners.

In addition, take note of the following:

- **Real-time fusion mode** ([Scanning With Real-Time Fusion](#)): ensure that your graphics card has at least 1 GB of memory or your Intel HD Graphics chipset is 4600 or higher (consult the [FAQ article](#) for more information).
- **Using multiple scanners** ([Multicapturing](#)) requires your workstation to integrate as many independent USB host controllers as connected scanning devices. Upgrading your hardware with PCI/PCI Express USB cards may provide the required number of hosts.
- **Using HD mode**
 - If you are going to use the scanner in the HD mode, ensure that your Nvidia GPU has a minimum CUDA compute capability of 6.1, 2 GB of memory (4 GB for Leo scans) or more and your computer's RAM is at least 32 GB.
 - If your computer does not meet these requirements, you can still perform the HD reconstruction, but it may take up to several hours. In this case, it is recommended to use lower values of *Point density* (see [Enabling HD Mode](#) for details).

4.2 User Account

To install Artec Studio and keep it up to date, register for a free account at [my.artec3d](#). Registration is also required to activate an Artec 3D scanner. In addition, the site allows you to track all your Artec devices and products.

Your account at [my.artec3d](#) will be valid for all Artec sites and services.

To register, follow these steps:

1. Go to [my.artec3d](#) and click *please sign up*.
2. Fill in all the fields in the registration form (by clicking *Next*) and click *Create account*.

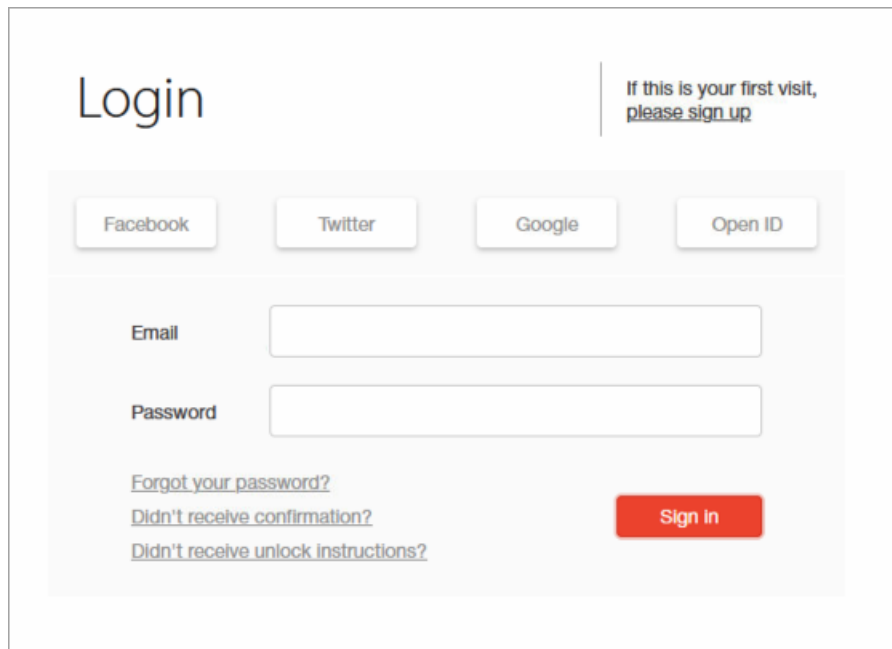


Figure 28: [my.artec3d](#) welcome screen.

3. Receive a registration email that contains a confirmation link.
4. Click the link or copy it to your browser to confirm your registration and go straight to your [my.artec3d](#) account.

4.3 Scanner Activation

Before using your new Artec 3D scanner, you must activate it and link it to an account at [my.artec3d](#). You can do so with the help of Artec Installation Center—a standalone utility available for download from [my.artec3d](#). If you're a new user and don't yet have Artec Installation Center, please read [Running Artec Installation Center](#) below. Otherwise, proceed to [3D Scanner Activation Using Artec Installation Center](#).

Warning: Do not connect your scanner to the USB port before installing Artec Installation Center.

4.3.1 Running Artec Installation Center

To use Artec Installation Center, first ensure that your computer is connected to Internet. Any computer with USB2.0 or USB3.0 ports will work. If necessary, you will be able to install and activate Artec Studio on a separate computer later. Also make sure that you already have a [my.artec3d](#) account; if not, see [User Account](#).

1. Log into your [my.artec3d](#) account and download Artec Installation Center. The link for the Artec Installation Center executable is available in the *My software* section.

2. After downloading, open the folder that contains the executable and run it. Follow the instructions on the installation screens. Once Artec Installation Center is installed, you will see a dialog requesting your email address and password. Use your [my.artec3d](#) account to log in as [Figure 29](#) shows.

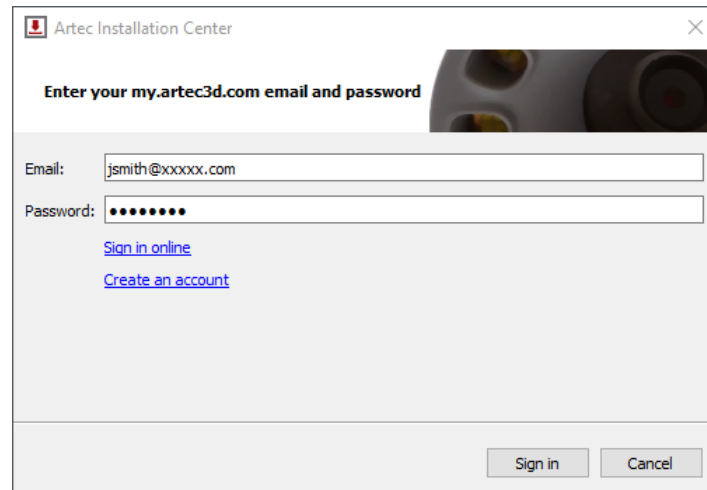


Figure 29: Authentication for Artec Installation Center

4.3.1.1 Logging Out and Switching Accounts

You may need to change [my.artec3d](#) account. Artec Installation Center displays the current user email in the top-right corner ([Figure 46](#)).

To log out of Artec Installation Center:

1. Click *Log out*.
2. Enter another user's email and password in the window that opens.
3. Click *Sign in*.

4.3.2 3D Scanner Activation Using Artec Installation Center

To activate a 3D scanner using Artec Installation Center, make sure your computer is connected to the Internet and that you have installed the application.

1. Run Artec Installation Center (go to the Start menu: click *Start* → *All Programs* → *Artec Group* → *Artec Installation Center*) to bring up the window shown in [Figure 46](#).
2. Connect your new Artec 3D scanner to the computer and wait until Windows detects the device and installs the necessary drivers. You may see a notification similar to one shown in [Figure 30](#).
3. Go to Artec Installation Center, click *Refresh* and wait for the new 3D scanner to appear in the hardware box. Click *Activate* (to the right of the serial number) to enable your 3D scanner. The status of the device should change to *Activated*, as [Figure 31](#) shows.

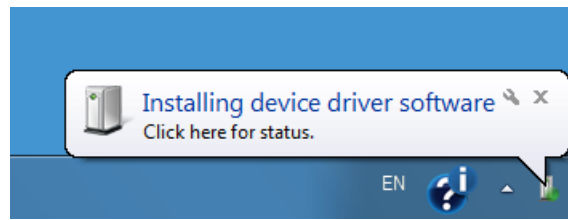


Figure 30: Windows notification indicating device installation.



Figure 31: 3D scanner activated

4.4 Artec Studio Installation

There are two ways to download and install Artec Studio:

- Through Artec Installation Center (either during the installation process or by clicking *Install* in the application, as [Figure 32](#) shows)
- From [my.artec3d](#)—log into the site, go to the *My software* page and download the executable (see [Figure 33](#))



Figure 32: Artec Installation Center is ready to install Artec Studio.

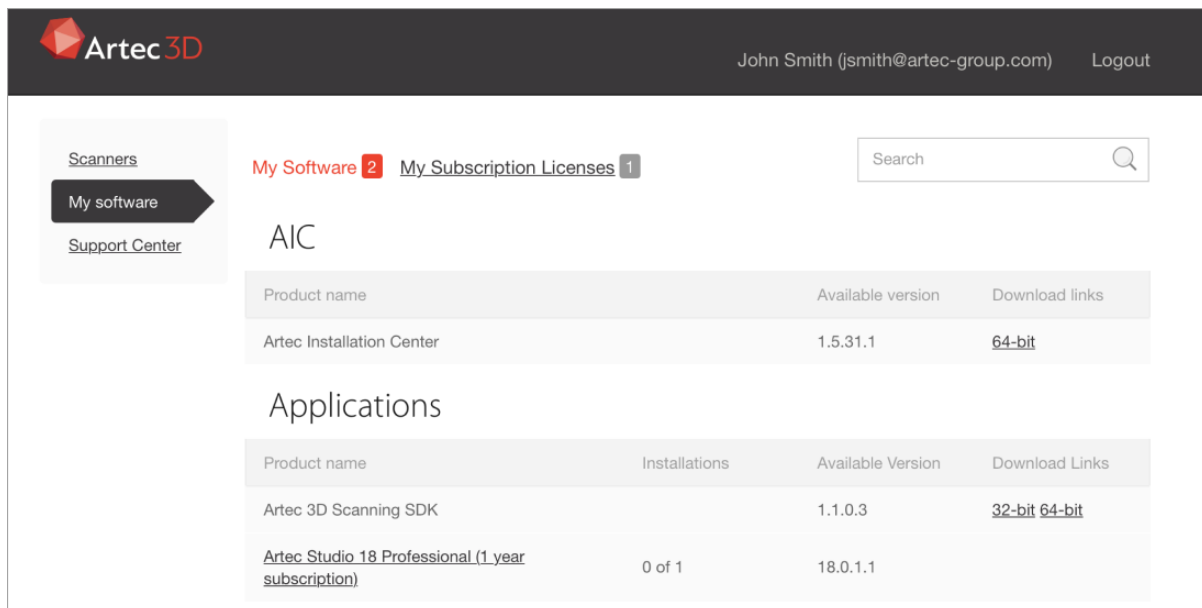
If you download the executable, run it to begin installation; otherwise, click *Install* in Artec Installation Center. To continue with the installation, click *Next* and proceed to the license agreement (see [Figure 34](#)). After reviewing the agreement, accept it by clicking *Yes*.

Note: The following figures are only for reference. Please follow these steps by selecting the particular version you want to install.

Specify the path to the installation folder (we recommend using the default location) as [Figure 35](#) shows, then select the components you would like to install (see [Figure 36](#)):

Program-menu shortcuts create icon in the Start menu

Desktop shortcut create icon on the desktop



Artec3D

John Smith (jsmith@artec-group.com) Logout

Scanners

My software

Support Center

My Software 2 My Subscription Licenses 1

Search

AIC

Product name	Available version	Download links
Artec Installation Center	1.5.31.1	64-bit

Applications

Product name	Installations	Available Version	Download Links
Artec 3D Scanning SDK		1.1.0.3	32-bit 64-bit
Artec Studio 18 Professional (1 year subscription)	0 of 1	18.0.1.1	

Figure 33: Portion of *My software* page at my.artec3d.com.

Figure 34: License agreement

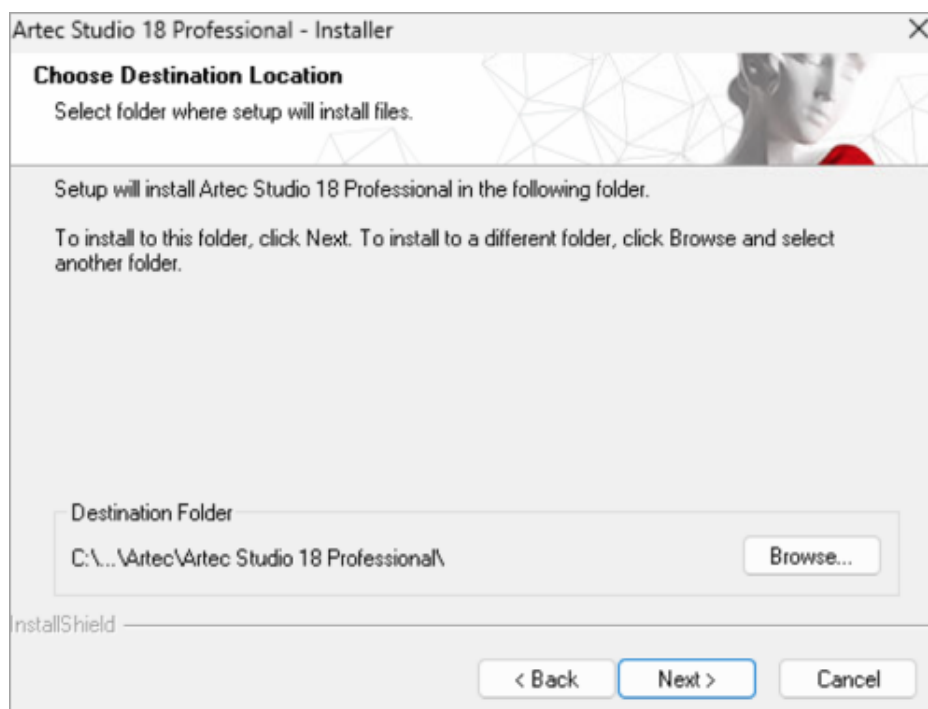


Figure 35: Installation location

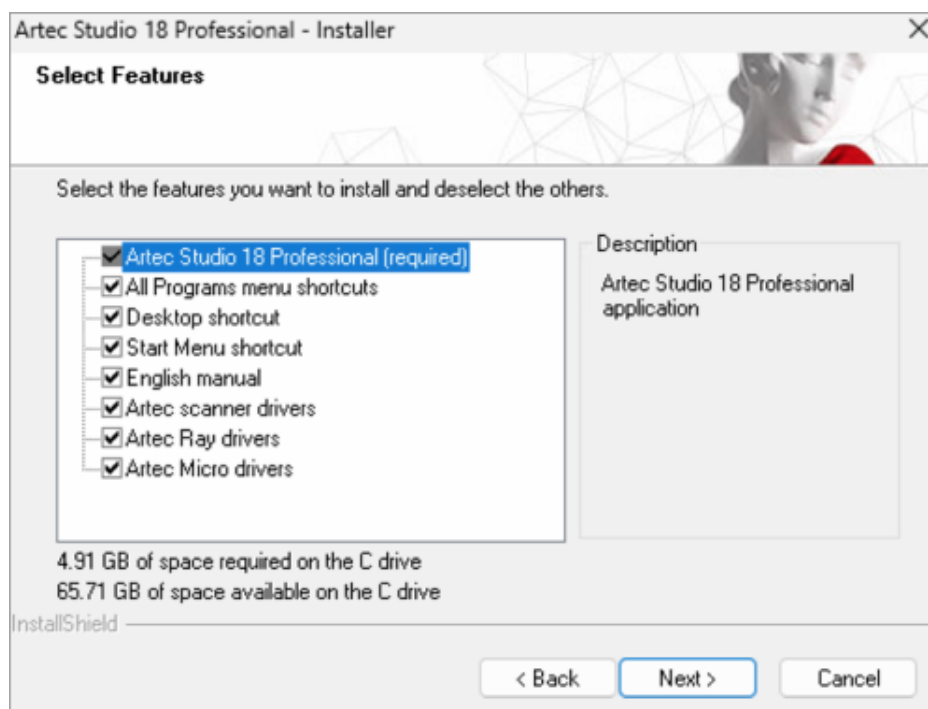


Figure 36: Select components to install

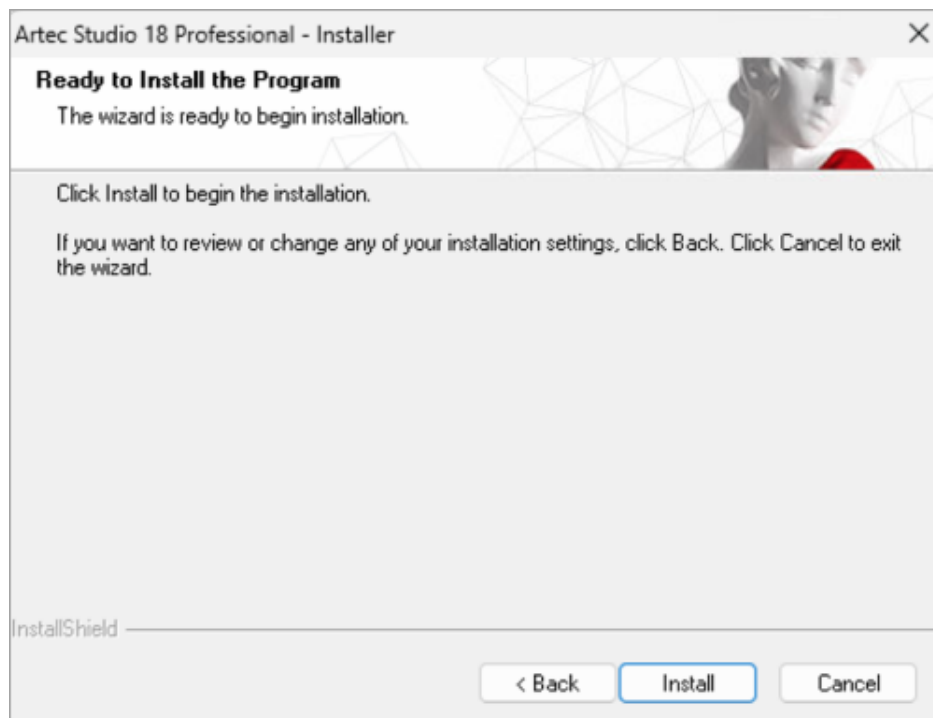
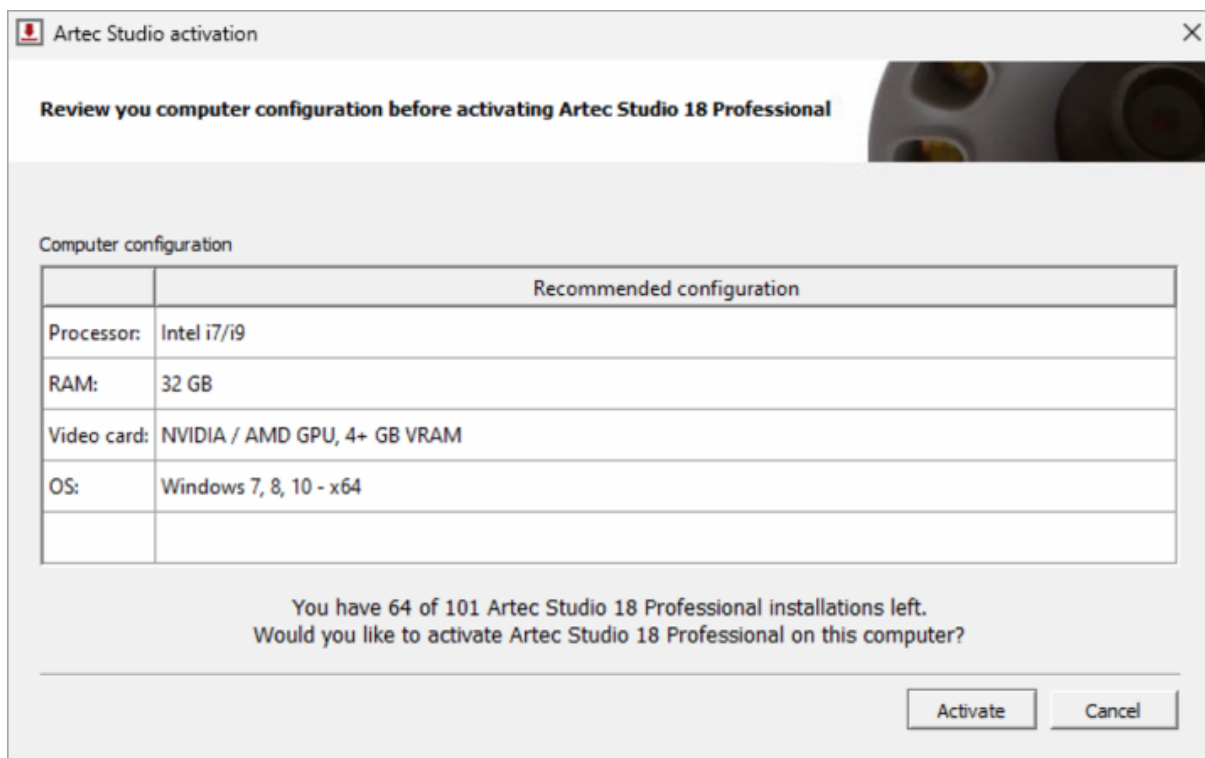
Figure 37: Click *Install* to begin the installation

Figure 38: Artec Installation Center showing Artec Studio activation window

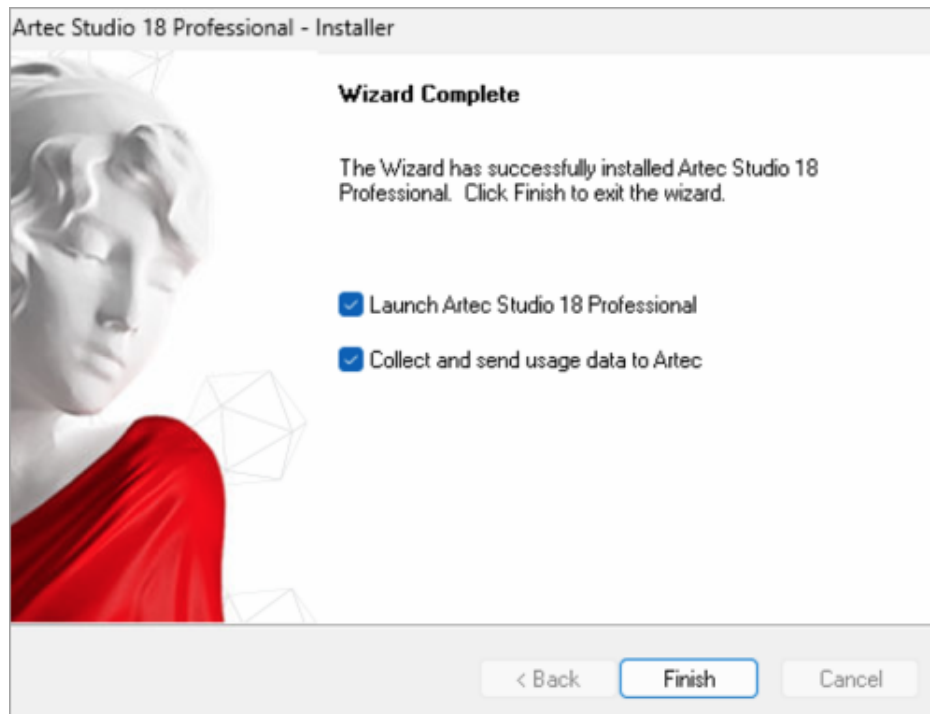


Figure 39: Finish installation

Start-menu shortcut add shortcuts to the Start menu and Quick Launch panel

English manual install user manual in English

Artec scanner drivers install drivers for Artec 3D scanners

Artec Ray drivers install drivers for Artec Ray 3D scanner

Artec Micro drivers install drivers for Artec Micro 3D scanner

Artec Micro II drivers install drivers for Artec Micro II 3D scanner

Artec Point add-on install Artec Point Add-on plugin

By default, the application will create all of the above icons and install the user manual and Artec 3D-scanner drivers. To continue with the installation, click *Next*.

If you have yet to install Artec Installation Center, a login dialog will appear, as [Figure 29](#) shows. If you are not connected to the Internet, consult [Offline Activation](#) regarding offline activation of Artec Studio.

If you have yet to link to your account the computer on which you are installing Artec Studio, you will see the activation confirmation shown in [Figure 37](#).

When the installation is complete (see [Figure 38](#)), the installer will offer to launch Artec Studio.

4.5 Offline Activation

If the computer on which you are installing Artec Studio lacks an Internet connection for security or other reasons, you may use the offline activation procedure to activate the software.

Note: Copies of Artec Studio activated offline cannot be deactivated, so use this option only if absolutely necessary.

Note: Before conducting offline activation, make sure the scanner (see [Scanner Activation](#)) and Artec Studio are tied to your [my.artec3d](#) account.

For offline activation, you need the following:

- Another computer connected to the Internet
- Artec Studio installation package (preferably, download it from [my.artec3d](#))
- Flash drive or another storage medium to transfer files from the Internet-connected computer to the computer that will run Artec Studio

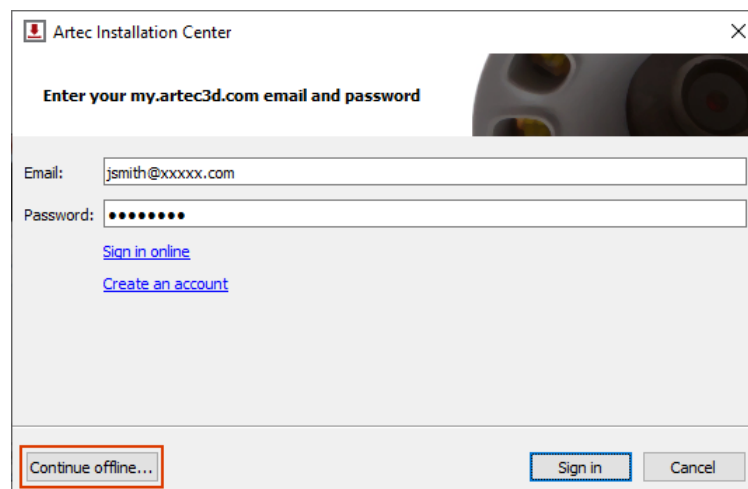


Figure 40: Artec Installation Center authentication dialog

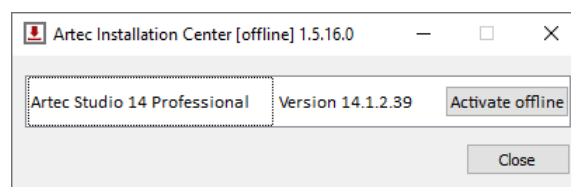


Figure 41: Artec Installation Center – Activate offline

Installation and activation procedure:

1. Start Artec Studio installation.

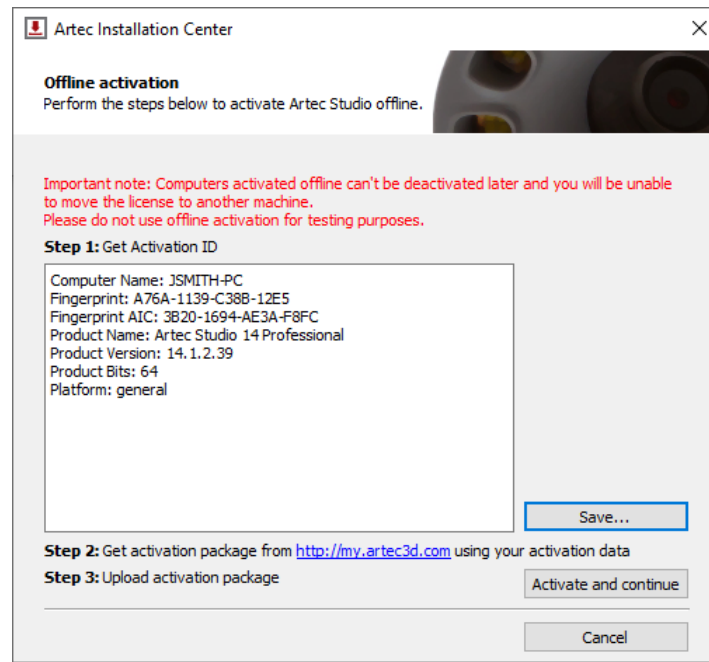


Figure 42: Offline-activation window

2. During installation the login/password dialog will be displayed as [Figure 40](#) shows. Click *Continue offline...*
3. Click the *Activate offline* button in the pop-up window.
4. In the offline-activation dialog ([Figure 42](#)), click *Save...* and save generated Activation ID file to a flash drive or other storage medium.
5. Log into your [my.artec3d](#) account and open *My software* page using the Internet-connected computer.
6. Find Artec Studio and click on it. A new page will appear, as [Figure 43](#) shows.
7. Click the *Activate application offline* link then the *Select file* button and specify the Activation ID file path. Next, click *Activate*.
8. A new dialog will allow you to download an Offline Activation Data file; save it to the flash drive.
9. Return to the computer on which you are installing Artec Studio. Click *Activate and Continue* and specify the Offline Activation Data file.

Note: Once you create the Offline Activation Data File, [my.artec3d](#) will decrease the number of available activations by one.

Once you complete all the steps described above, your copy of Artec Studio will be activated and all of your Artec 3D scanners will be installed on the non-Internet-connected computer.

Note: If later you purchase another Artec 3D scanner, you must reinstall the application

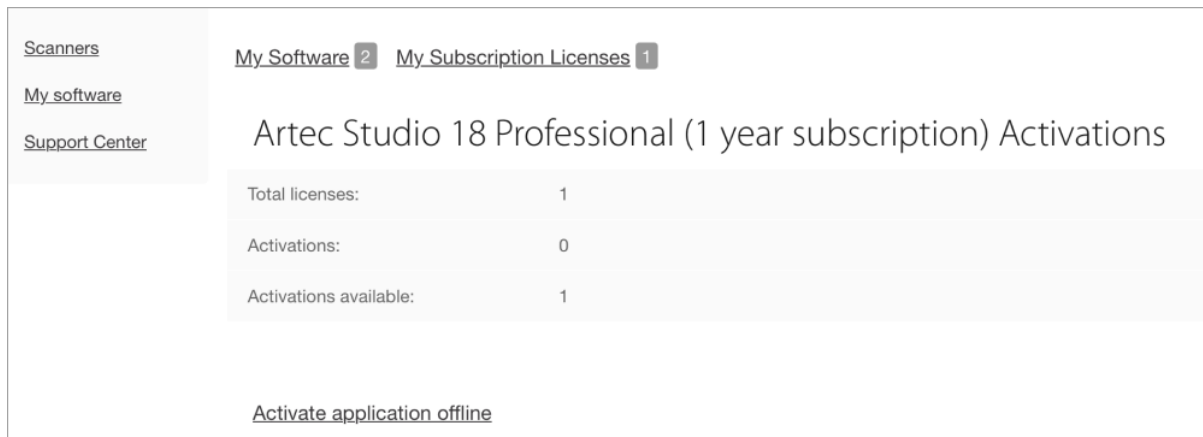


Figure 43: Offline activation at [my.artec3d](https://my.artec3d.com).

and repeat the activation procedure described above to copy the new scanner's data files to your computer.

4.6 Deactivation

Note that deactivation is only possible for computers on which you activated Artec Studio online as [Artec Studio Installation](#) describes. Artec Studio installations activated offline cannot be deactivated.

Note: The number of deactivations may be limited, so deactivate Artec Studio only if you absolutely must move it from one computer to another.

To deactivate a license on your computer, follow these steps:

1. Make sure the computer is connected to the Internet.
2. Go to *Control Panel* → *Uninstall Applications* and click on Artec Studio. The uninstallation process will start.
3. The dialog shown in [Figure 44](#) will appear. Select the *I understand. Deactivate Artec Studio* checkbox.
4. Click *Next* to complete the uninstallation.

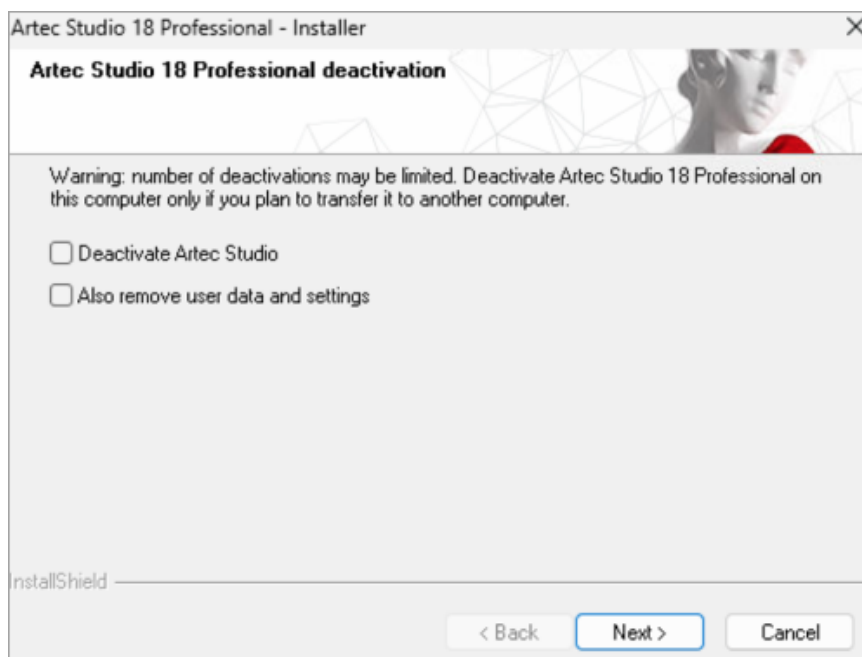


Figure 44: Deactivation of Artec Studio.

4.7 Managing Artec 3D Scanners and Products

Artec Installation Center manages applications and 3D scanners linked to your account.

It's a multifunctional supplement to Artec Studio that connects with [my.artec3d](#) and helps you install new applications, download updates and manage your 3D scanners. To launch Artec Studio for the first time, you must log into [my.artec3d](#). After this one-time authentication, you need not provide your email address or password each time you launch the application.

When Artec Studio launches, Artec Installation Center checks for new updates; if an update is available for any installed product, the software will display a notification like the one shown in [Figure 45](#).

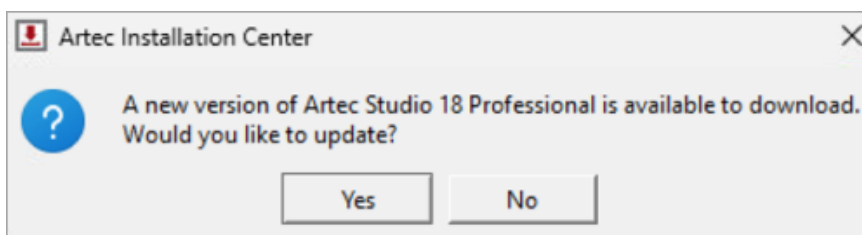


Figure 45: An Artec Studio update is available for download.

Once you log in, Artec Installation Center displays information about your products.

The *Software* section of Artec Installation Center provides all information about your software products:

- A list of all applications available to you

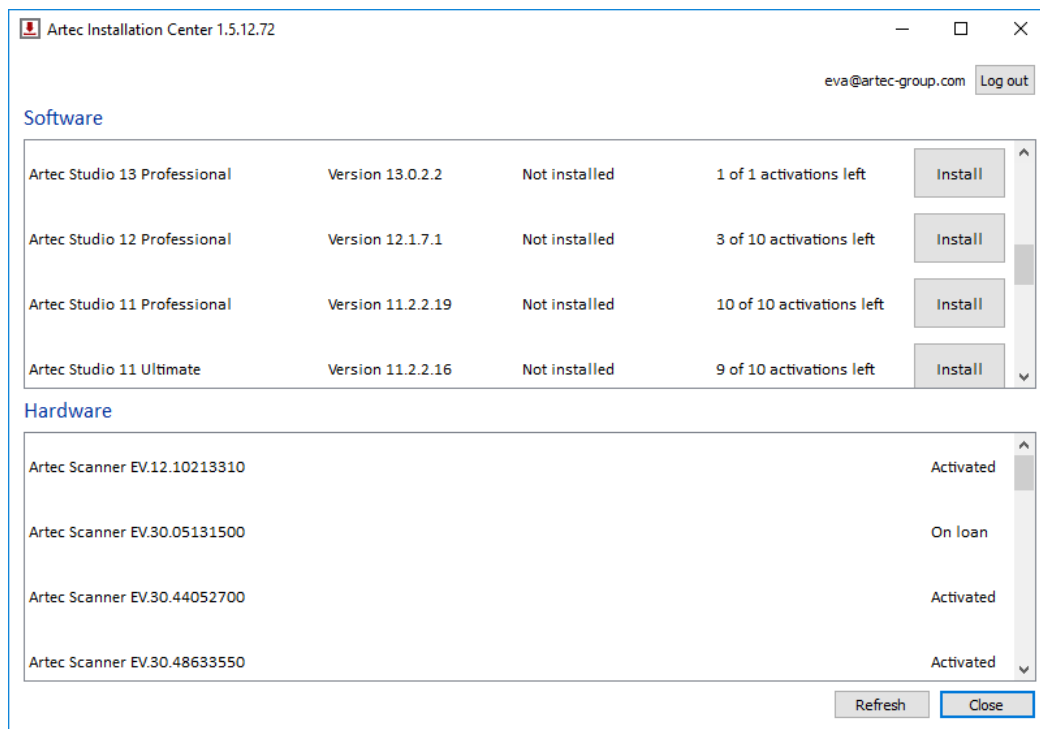


Figure 46: Artec Installation Center.

- Activation status of each application (application may or may not be activated)
- Total number of activations and number of activations you've used so far
- *Activate*, *Install* or *Update* buttons for any of these actions that are currently available to you
 - *Install*—appears if the software is not installed on the computer (installation usually means activation)
 - *Activate*—appears if the software is not currently activated on the computer. Activation decreases number of licenses by one for each computer.
 - *Update*—appears if a new version of installed software is available for download

The *Hardware* section contains a list of the scanners that you own or have otherwise connected to your computer. For the first case, the *Activated* status or *Activate* button will be displayed, while in the second case, the *On loan* status or *Rent* button will be displayed.

A row of buttons appears at the bottom of the Artec Installation Center window:

Refresh —refresh the data displayed by Artec Installation Center

Close —exit Artec Installation Center

SCANNING

5.1 Scanner Buttons and Capture Modes

Your 3D scanner may be in one of the following capture modes (each of which has a corresponding color and flicker rate of the LED indicator on the device):

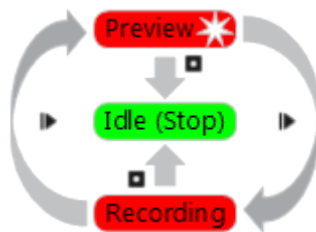








Figure 47: Understanding capture modes (colors correspond to scanner LED indicator colors).

Idle—the LED is steady green . This mode indicates either that the application has detected the scanner or that the user has clicked the *Stop* button in the *Scan* panel or pressed the  button on the scanner body (see [Figure 23](#)). In this case, the 3D scanner is not flashing.

Preview—the LED is flashing red . In this mode, the 3D scanner is capturing images, but the software is neither performing alignment nor recording captured frames. To start this process, either click the *Preview* button in the *Scan* panel (see [Figure 80](#)), press the  button on the scanner body or hit the **F7** key on the keyboard. This mode is useful when doing the following:

1. Checking the 3D scanner's field of view
2. Determining the best position for the object
3. Preparing to recording and developing a scan procedure
4. Adjusting texture brightness

Recording—the LED is steady red . Scanning takes place in this mode, with the software storing 3D data to disk or RAM. Activate this mode either by clicking the *Record* button in the *Scan* panel, hitting the **Space** key on the keyboard or pressing the  button (do so once for *Preview* and a second time for *Recording*). To pause recording,

either click *Pause* in the *Scan* panel, press ► on the scanner body or hit the *Space* key.

5.2 Selecting and Preparing Objects for Scanning

Artec 3D scanners employ the structured-light method of 3D reconstruction. Since they capture 3D frames using optical technology, some types of objects are difficult to scan. Certain techniques, however, enable successful scanning of such objects. For example, you can cover a transparent or dark object with a light paint or dust it with talcum powder. You can also use other easily removable substances or a special anti-glare spray.

Table 1: Hard-to-scan Surfaces

Surface Features	Possible Solutions
Black or very dark	Dust with anti-glare spray
Shiny or reflective objects	Dust with anti-glare spray, tilt scanner when capturing
Transparent (glass, certain kinds of plastic, etc.)	Dust with anti-glare spray
Thin edges	Add background geometry (e.g., crumpled paper)

Note: If your scanner supports the HD mode, then you can capture dark or shiny surfaces in high resolution, in their original shape and with no extra steps. See [HD Scanning and HD Reconstruction](#) for details.

5.3 Technique

Artec 3D scanners capture objects at a rate of 15 frames per second to ensure that adjacent frame areas overlap as you gradually move the scanner. Artec Studio uses features in overlapping areas to automatically align captured frames. It performs this task in real time, providing immediate access to the frames in a single coordinate system. You can evaluate the captured area after the scanning session to determine which parts of the object require additional scanning.

To accurately capture an object or scene, follow these steps:

1. Pay closer attention to the object on the screen rather than looking at the actual object.
2. Ensure that Artec Studio can accurately register frames from the scanner. To this end, do the following:
 - Don't move the scanner too fast

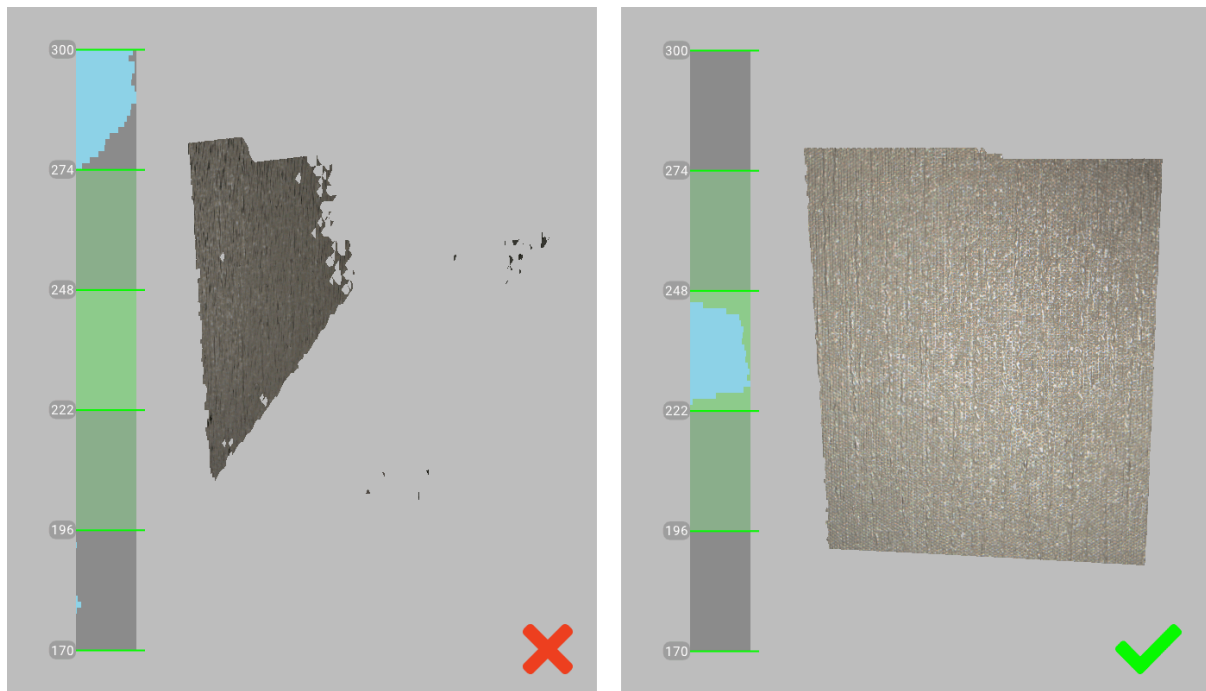


Figure 48: Scanner orientation and reconstructed surfaces.

- Keep the object as close to the center of the field of view as possible
 - Maintain the scanner orientation in such a way that the field of view is sufficiently filled with surfaces (see [Figure 48](#))
 - Try to position the scanner in the way the most surfaces in the field of view are colored in green which corresponds to the center of the range meter¹ ([Figure 49](#))
3. If you're capturing an object over several scans, remember to capture a common area in each one to ensure successful alignment
 4. If you're capturing an object in one scan, do so all the way around the object—regardless of direction—plus a little more (360+ degrees)
 5. Avoid capturing any objects that may change shape during the scanning process. When the geometry of the scene is changing, the system may fail to find the correct position of new frames relative to previously aligned ones. If you have captured unwanted objects, you must remove them later during the editing stage (see [Editing Scans](#)).
 6. Don't record too many frames: ensure that you have sufficiently scanned all regions,

¹ Technically, the center of the range meter is the center of the depth of view. The 3D scanner has near and far cutting planes (see [Figure 22](#)) that determine the optimum distance between the scanner and the target object. Artec Studio offers the *Range meter* feature so you can easily visualize the distance between the scanner and the object during the recording process. The *Range meter* comprises a set of semitransparent diagrams located on the left side of the *3D View* window (see [Figure 49](#)). Each histogram displays the distribution of captured surface points by distance from the scanner. The color corresponds to the set of surfaces from which it was obtained: by default, gray indicates registered key frames, dark green indicates the last successfully registered frame and red indicates a registration error.

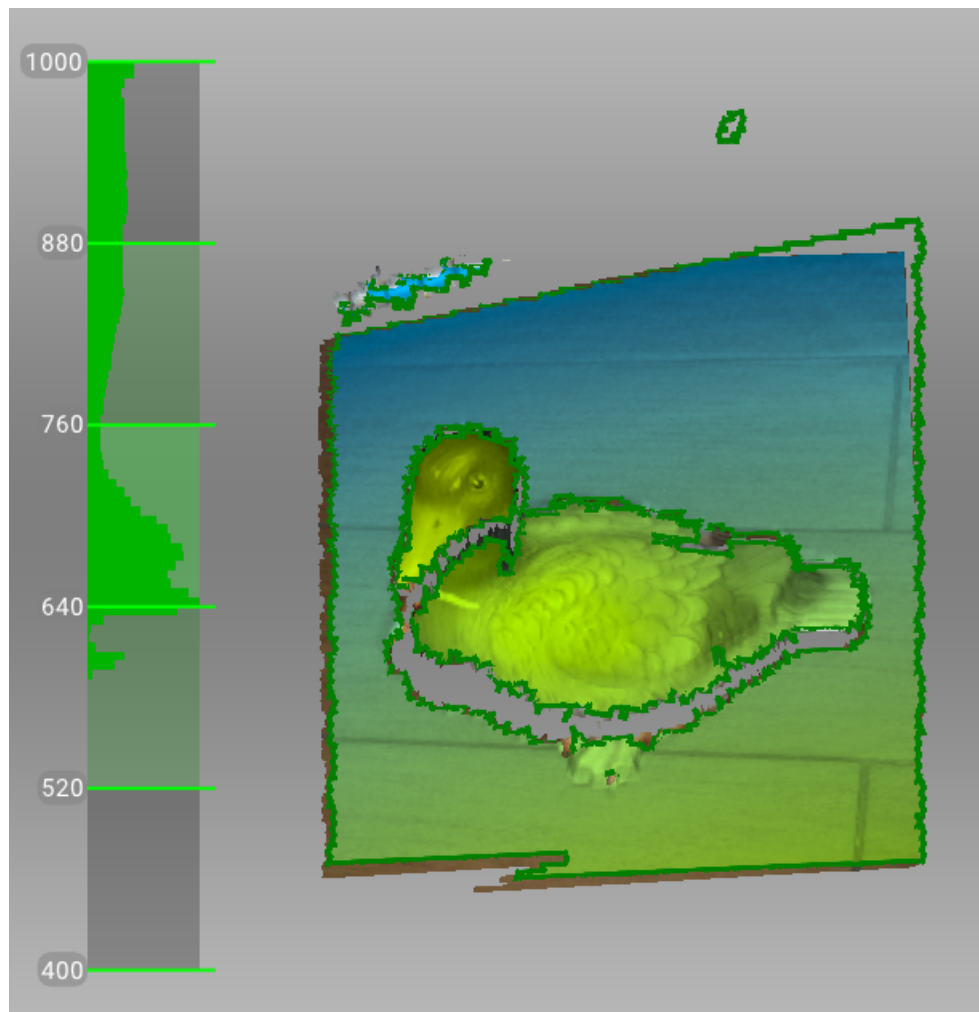


Figure 49: Distance meter and distance color showing surfaces that fall within the optimal range for Artec Eva.

but avoid scanning them twice, except when providing overlapping areas for subsequent alignment.

5.4 Scanning Procedure


Ins and Outs

- Artec Studio creates a new scan in the *Workspace* panel at the beginning of each session.
- When you start *Preview* mode, Artec Studio will hide all uploaded scans. This mode helps you to determine how well the 3D scanner sees the object, and it helps you to identify areas that may cause trouble during the scanning session. To begin the scanning process, click the *Record* button in the *Scan* panel or press the ► button on the device body.
- If your 3D scanner is equipped with a texture camera, Artec Studio will activate the scanner's texture flash and capture color images that it will later use to texture the 3D model.

1. Prepare the object and make sure it has enough geometry and texture details (see [Selecting and Preparing Objects for Scanning](#)).
2. Provide even lighting without using direct sunlight.
3. If you have connected just one 3D scanner to the computer, Artec Studio will select it automatically; otherwise, you must select the appropriate device from the dropdown list under the *Advanced* section of the *Scan* panel.
4. If your selected 3D scanner supports the HD mode (such as Artec Eva) and you want to get the scanned images in high-definition resolution, you need to turn the HD mode on (see [Enabling HD Mode](#) for details).
5. Create a new project before getting started: select *File* → *New project* from the menu, or use the shortcut `Ctrl+N`.
6. Decide how many sessions you need in order to capture the entire object. By using the Artec turntable, you may be able to avoid interrupting the session and eliminate the need to turn the object by hand. Depending on your choice, you may
 - Turn the object
 - Position yourself to gain access to the other area
 - Use a rotating table
7. Click *Preview* or press ► on the scanner. Direct the scanner at the object and practice your movements around the object, taking into account the proper [Technique](#).

Note: If you have checked the *Enable automatic base removal* option (it

is disabled by default), then first direct the scanner at the surface that supports the object.

8. Click *Record* to start capturing.
9. Gradually move the scanner while monitoring the process in the *3D View* window
10. Capture what you can and pause or cease recording by clicking the *Pause* or *Stop* button, respectively. Choose *Stop* if you must make adjustments to the object's positioning (see the next step).
11. Turn the object or otherwise adjust it as necessary, then capture any remaining un-scanned regions.
12. Once you have successfully captured the object from all sides, click the *Stop* button or press  on the scanner body.

5.5 HD Scanning and HD Reconstruction

While all Artec scanners can scan 3D objects in the standard-definition (SD) resolution, Artec Eva and Artec Leo also support an HD mode – AI-powered scanning technology for ultra-sharp, clean, and detail-rich scans.

Key advantages of the HD mode:

- Scanning with a high resolution of up to 0.2 mm
- Broad range of objects that can be scanned flawlessly and in high detail: from smaller, intricate parts like valve handles, to larger areas with fine details like car engines
- Little to no noise in raw data for cleaner post-processed data and saved time for your final 3D model
- Capability to capture dark or shiny surfaces in high resolution, in their original shape and with no extra steps

To obtain HD scans from the data captured in the HD mode, Artec Studio provides you a special algorithm of HD data processing – HD reconstruction. This algorithm generates large, high definition frames with more details to give you complete surface geometry.

In general, the HD reconstruction is a time-consuming and resource-intensive operation. It requires:

- Powerful Nvidia video card
- Sufficiently large RAM

However, you can optimize the HD reconstruction by properly choosing its main parameters:

- *Point density*, which determines the number of points per frame used for data processing

- *HD frames frequency*, which determines the fraction of captured HD frames to be used for the HD reconstruction

See [Enabling HD Mode](#) for details.

Important: To obtain HD scans with your 3D scanners, the HD mode should be enabled in advance, before scanning or importing the HD data.

To find out more on the HD scanning and HD reconstruction with Artec Eva, see [Notes on HD Scanning With Eva](#).

Setting the HD mode for Artec Leo is described in the [Artec Leo manual](#). For information on importing the HD data from Artec Leo, see [Opening Project from Leo](#).

5.6 Tracking Modes

Ins and Outs

- Artec Studio still records texture in *Geometry* tracking mode if the scanner incorporates a texture camera
- Continuous scanning in the hybrid tracking mode is easier with the *Scan using auto-alignment* option.

The software provides three [tracking](#) modes and one option:

Geometry + Texture, or hybrid The optimal (and default) algorithm for 3D scanners equipped with a texture camera. It uses features from images obtained using the texture camera as well as geometrical features of the object and thus is more likely to successfully capture flat or textureless objects. The only possible drawback is greater CPU utilization compared with other algorithms, potentially decreasing the frame rate for less powerful computers. You can use this mode with Artec MHT, Artec Eva, Artec Spider, and Artec Spider II.

Geometry The default algorithm for all 3D scanners that lack a texture camera (Artec Eva Lite). It uses only object geometry to align the scanned frames, making it suitable for objects that have a rich geometry but not objects with large flat, spherical or cylindrical parts. The Geometry tracking algorithm is the least CPU hungry.

Targets A special algorithm for scanning objects with special targets placed on their surfaces. See [Target-Assisted Scanning](#).

Real-time fusion (option) Available for Artec 3D scanners, this option fuses the results immediately after scanning.

See also:

[Tweaking Scanning Options](#)

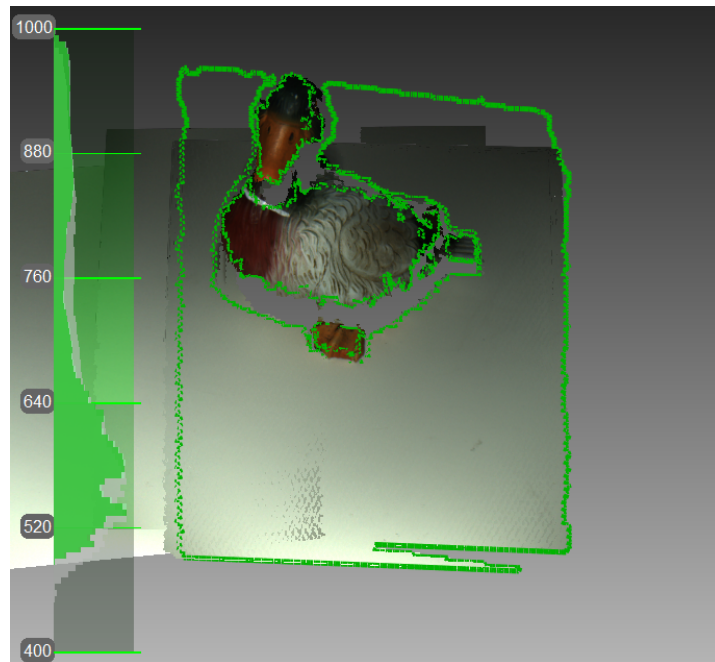


Figure 50: Texture tracking renders color object (scanner's current field of view outlined in green).

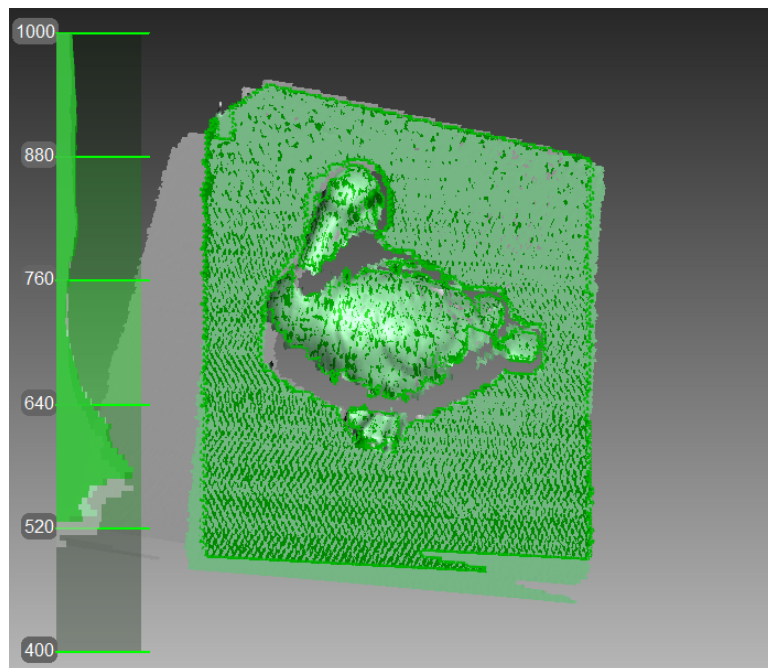



Figure 51: Main window when using Geometry tracking to scan objects.

5.6.1 Base Removal: Erasing a Supporting Surface


Ins and Outs

- Base removal is available for all tracking modes.
- If you click *Stop* or press , you should again identify the supporting surface.
- If the scene remains unchanged, you can also use the *Auto-align new scans with those marked in Workspace* option. In this case, the application won't prompt you to identify the base.
- If base detection is successful, the base will always render in *Recording* mode.

When you capture an object, you can often omit from the scan any surface that supports the object. The *Base removal* option serves this purpose. To employ this option, first indicate the surface on which the object is resting and then capture the object. If this approach is unsuitable for your situation, clear the *Enable automatic base removal* checkbox.

1. Open the *Scan* panel.
2. Check the *Enable automatic base removal* option (it is disabled by default).
3. Click *Preview* and direct your scanner at the surface that supports object (e.g., a table or the floor). A gray wireframe plane will appear, indicating the scene's base.
4. Once the application detects the base, it will display a message: "Now scan the object."

Important: If Artec Studio fails to detect a supporting surface, you can still start recording.

5. Click *Record* () and then direct the scanner at the object.
6. Scan the object freely. You can pause and resume the session as necessary.
7. Click *Stop*; all scans will move to the coordinate system with the Z axis normal to the base.
8. Close the *Scan* panel. The *Base removal* algorithm will remove the previously detected supporting surface. If not, *erase it manually*.

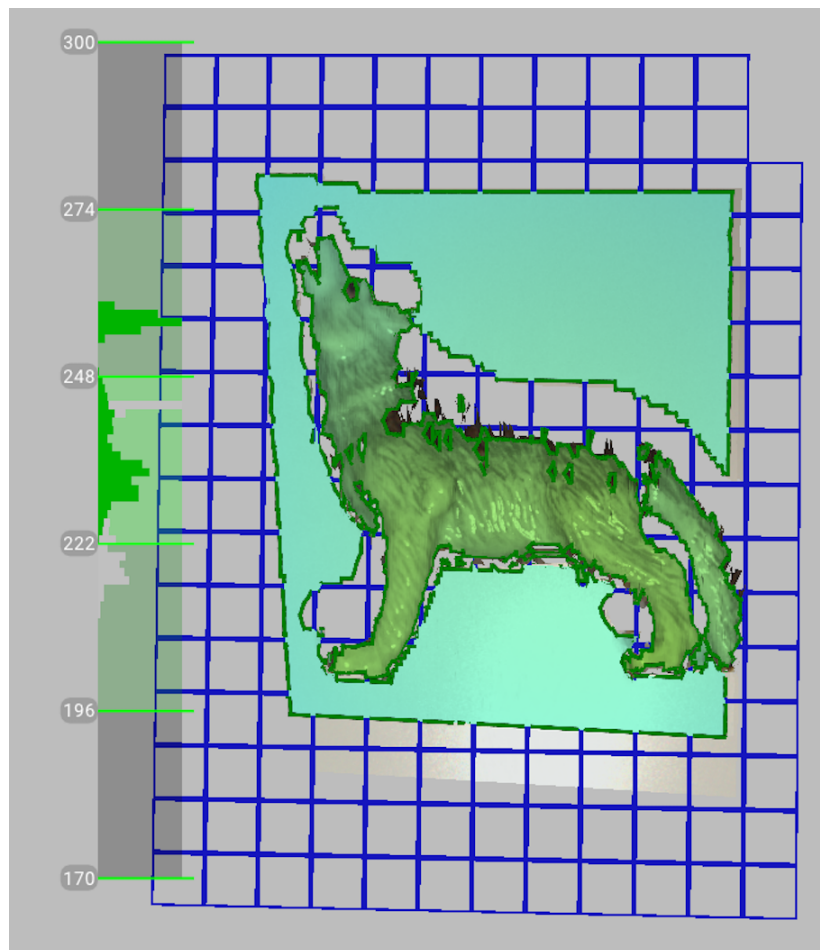


Figure 52: Scanning with the *Enable automatic base removal* option.

5.6.2 Resuming Scan After Lost Tracking

Artec Studio records adjacent frames on the basis of common surface features. If the scanner stops recognizing common features, it will stop capturing the scene. This situation is called lost tracking; if it happens, just direct the scanner at a recently captured region. There are, however, nuances, which we address below.

[Table 2](#) lists several causes of lost tracking. The most common is moving the scanner too fast.

Table 2: Causes of lost tracking.

Reason	Possible Solutions
Moving the scanner too fast	Move the scanner more slowly or increase the <i>Scanning speed</i>
Scanner sees too few surfaces	Apply an anti-glare spray or direct the scanner at a larger part of the object; increase <i>Sensitivity</i> of Artec Spider
Object doesn't have enough features for successful tracking	Apply masking tape or draw markers on the surrounding surfaces, and/or move the scanner more slowly


The *Scan using auto-alignment* option may ease the process of resuming tracking (this option is enabled by default in the application settings). Note the following:

- Artec Studio switches almost instantly from displaying *Tracking lost* mode (see [Figure 53](#)) to *Searching for position*, which appears on a green background.
- To continue scanning, direct the scanner at a region you've already captured.
 - Try to maintain the original scanner orientation toward this region
 - You need not necessarily use the most recent one, but it should have sufficient texture features.
- If the application successfully resumes tracking, it will start recording in a newly created scan. This new scan will already be aligned with the previous one. All the scans will also be grouped.

The [Scan Using Auto-Alignment](#) section describes system behavior when this option is disabled.

5.6.3 Auto-align new scans with those marked in Workspace

Auto-alignment is a great timesaver and may help simplify further processing. But for projects that involve scans using *Geometry + Texture tracking* and for which the actual scene is unchanged, you can continue scanning immediately:

1. Ensure that the *Scan using auto-alignment* option is turned *on* in *Settings* (see [Capture](#)).
2. Mark previously captured scans using the  icon in the *Workspace* panel.

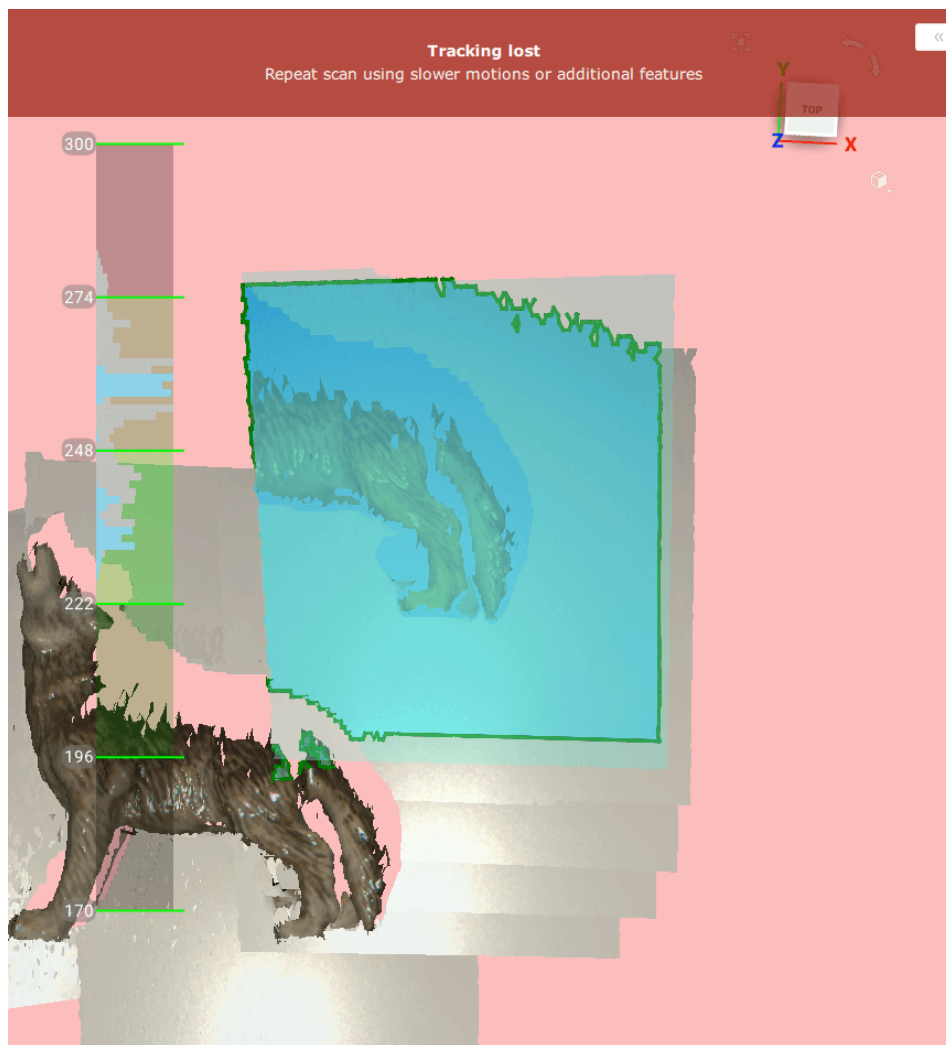


Figure 53: Alert message: tracking lost.

ALL OBJECTS ▾					
✓	Name		Error	Frames	Size 🔒
	Group1	🗑️			
	Spider Scan 1	■	0.0	343	149 MB
	Spider Scan 2	■	0.0	399	159 MB
	Spider Scan 3	■	0.0	208	93 MB

Figure 54: *Workspace* panel after resuming tracking.

3. Select *Geometry + Texture tracking* as well as the *Auto-align new scans with those marked in Workspace* checkbox in the *Scan* panel.
4. Click *Preview*, direct the scanner at a textured region you've already captured textured region—maintaining the original scanner orientation—and then click *Record*.
5. If tracking resumes successfully, Artec Studio will align the newly recorded scan with the selected ones.

5.6.4 Scanning With Real-Time Fusion

Real-time fusion is a special mode in which Artec Studio renders a 3D model in real time while you're scanning. It provides several helpful advantages during scanning:

- The ability to use the quality visualization during scanning, which helps identify missing areas (available only for *Real-time fusion*)
- A smoother and more presentable surface during scanning, which can be useful for live demonstrations
- The surface does not disappear when the number of frames exceeds 10,000

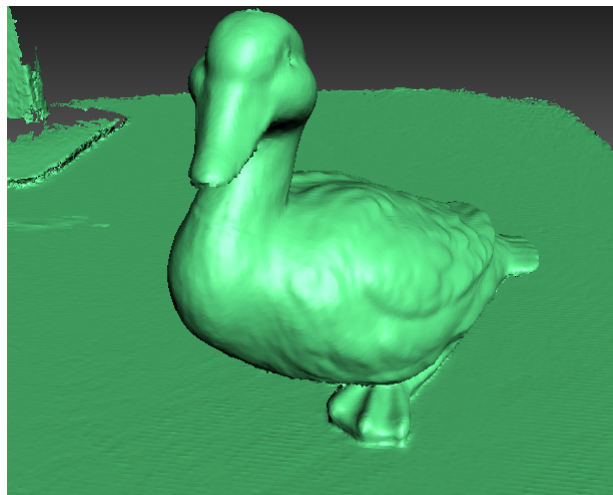


Figure 55: Real-time fusion model.

The *Real-time fusion* feature is available for each tracking method.

1. Open the *Scan* panel.
2. Select the required tracking mode.
3. Select the *Real-time fusion* checkbox².
4. Click *Preview* and then *Record*. Observe the recommendations in [Scanning Procedure](#).
5. Pause and resume the session as necessary.

² If you selected the *Targets* mode and cleared the *Disable hybrid tracking for .obc* checkbox (see the [Photogrammetry Settings](#) section), Artec Studio will clear the *Real-time fusion* checkbox because it doesn't support this combination of options.

You can access the *Settings* window and use the *Performance* tab to configure the following *Real-time fusion* setting (see [Real-Time Fusion Setting](#)):

Voxel size 3D resolution of the model (i.e., the size of the triangulation-grid step in millimeters). The smaller the value, the more geometric details you can detect and capture in 3D.

5.7 Target-Assisted Scanning

Generally, you don't need any special equipment to record using an Artec scanner. If the object has hard-to-scan regions, however, [targets](#) may be useful. In some cases, they can improve tracking and further registration.

Targets address the problem of increased deviation when scanning large objects and provide more scanning accuracy by very precise ongoing alignment. Starting from version 17, Artec Studio gives you the ability to evaluate the quality of reference targets capturing when scanning. You can view the distribution of error deviation across the whole set of the reference targets (see [Inspecting Quality Of Targets Clouds Registration](#)).

5.7.1 Placing Targets

Whatever the method chosen, you should place at least non-coded [targets](#) on the object.

Attach non-coded targets ([Figure 56](#)) to the object using the following rules:

- Try to place them on flat elements
- Avoid uneven surfaces
- Avoid obstructing significant geometric elements



Figure 56: Non-coded targets placed on an object.

Note: You can specify the target size in the *Settings* dialog of Artec Studio, as [Photogrammetry Settings](#) describes. If you use non-coded targets from the *Scan Reference* kit, specify 5 mm for the inner diameter and 10 mm for the outer diameter. You should measure

targets from other suppliers and specify both diameters in the appropriate fields of the *Settings* dialog.

Place coded targets if your choice is photogrammetry ([Photogrammetry Solution](#)).

1. Prepare the objects and surrounding scene. All objects must remain stationary during measurement and capture.
2. Place the cross ([Figure 58](#)) on the scene, ensuring that it rests firmly, and it is seen from most points of view. Also double check that all targets on the cross are clearly visible.
3. Place the coded targets on the object and the surroundings. Note that you should distribute them such that at least six to eight coded targets are visible in each image. Random placement is preferable; avoid symmetry and target alignment.



Figure 57: Coded targets.

5.7.2 Using Artec Scanners Only

You don't necessarily need a photogrammetry kit to benefit from targets placed on the object you're scanning; Artec 3D scanners can do all the work. This mode employs extra-hybrid (Geometry + Texture + Targets) tracking and doesn't require you to upload an *OBC* file.

1. Open the *Scan* panel in Artec Studio. Select *Targets* under *Features to track*.
2. Scan the object from all sides
3. Run [Global registration](#)

Note: As you scan (without having uploaded an *OBC* file), the application registers the target coordinates. You can then [save an OBC file](#) and use it in later scanning sessions. We strongly recommend running *Global registration* first, however.

5.7.3 Photogrammetry Solution

By using a combination of special reference [targets](#) and photogrammetric measurements, you can scan large areas in one session, improve the accuracy of captured surfaces and boost productivity by reducing postprocessing time. The only downside of this method is the preparation. After scanning, however, you need not align the scanned surfaces, so you can immediately proceed to *Fusion* (see the order of postprocessing steps in [3D Scanning at a Glance](#)).

This synergy of technologies is possible thanks to Artec 3D-scanner and photogrammetry solutions. Several third-party photogrammetry offerings are available on the market. *Scan Reference* photogrammetry is one example. The *Scan Reference* kit includes hardware and software (see [Figure 58](#)), a digital camera, a reference-scale cross, non-coded sticky [targets](#) (which Artec Studio uses to match the captured 3D data to the photogrammetric measurements), and reusable magnetic coded targets (required to automatically carry out measurements in the *Scan Reference* software).

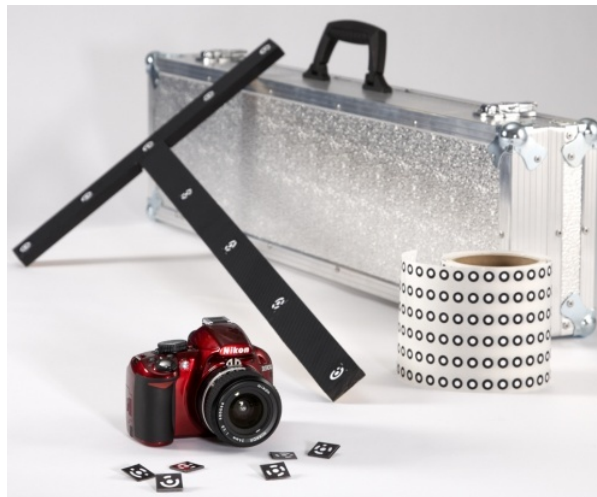


Figure 58: *Scan Reference* kit

The kit includes (from left to right) coded targets (foreground), a digital camera, a scale cross, a roll of tape with non-coded targets and a carry case.

5.7.4 Preparing To Scan With Targets

1. Take several photos of the object from different angles. To determine the appropriate number of photos, angles and targets for each image, as well as required settings for a calibrated digital camera, consult the *Scan Reference* user manual and [FAQ article](#). General recommendations are as follows:
 - a) Take photographs at a distance of 0.5–1.5 meters with enabled flash
 - b) Each photograph should contain as much targets as possible and each target should be captured at least in 10 photos
 - c) Entire cross should be captured in first 10–12 photographs
 - d) Capture the object from all sides

2. Move the cross and the coded targets away from the scene.
3. Connect the camera to a PC, then transfer and process the photos using the *Scan Reference* software. Once the calculations are complete, the software will display measurement results on the screen. These results can appear as a point table or a 3D model.
4. Save the table of points in an *.OBC file. This format is the software's default.

5.7.5 Scanning Procedure With Targets Clouds

To perform scanning using targets, follow these steps:

1. Import one or more *target clouds* (OBC files), using the *File* → *Import* → *Scans, meshes or point clouds* menu option or press **Ctrl+I**. You can also drag and drop the files to the area of the *3D View* window. The imported objects will appear in the *Workspace* panel and will be rendered in the *3D View* window.
2. Open the *Scan* panel in Artec Studio. Select *Targets* under *Features to track*.
3. Select a targets cloud to use as a reference from the dropdown list below.

Important: If you don't want the texture and geometry features to assist target scanning, select the *Disable hybrid tracking for .obc* checkbox (*Photogrammetry Settings*).

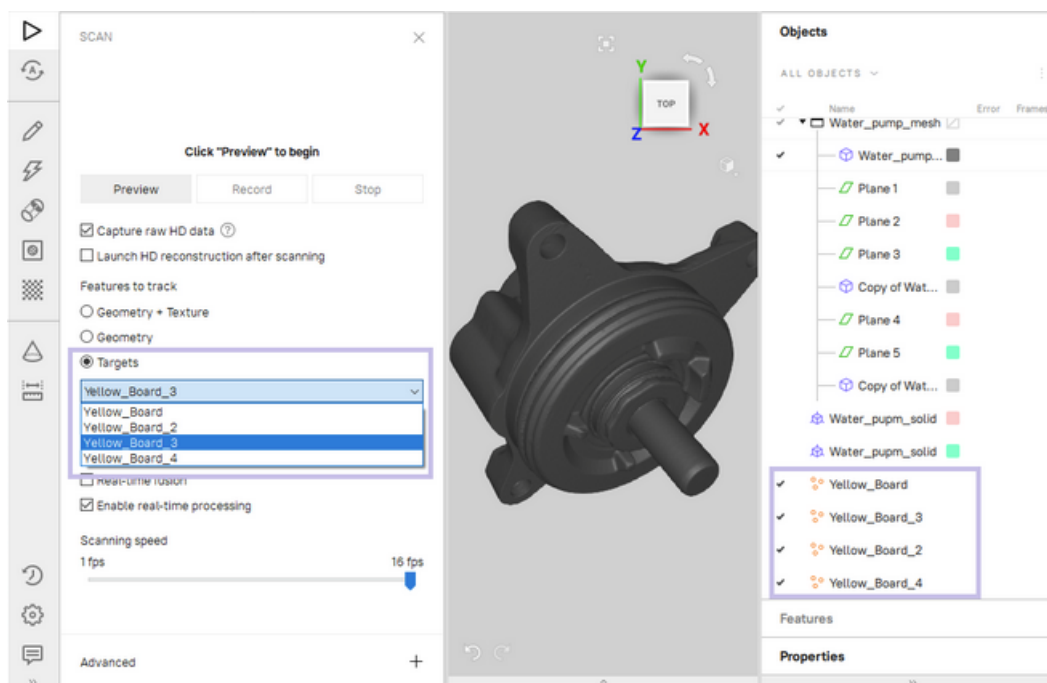


Figure 59: Example of targets clouds uploaded.

4. Scan the object. When you finish, the software will automatically align and register all scans.

5. Check the quality of targets' registration (see [Inspecting Quality Of Targets Clouds Registration](#)).
6. If you have introduced changes to the captured targets cloud on step 5, run [Global registration](#).
7. If necessary, repeat steps 5 and 6.

5.7.6 Inspecting Quality Of Targets Clouds Registration

To increase the accuracy of scanning with targets and give users more control and flexibility, an ability to manually inspect the quality of [target clouds](#) registration is implemented in Artec Studio.

During scanning, each reference target is captured in a number of frames. The result of target capturing in a particular frame is called an instance. All instances representing the same target are grouped into a cluster. During global registration, Artec Studio calculates the deviations of each captured instance and cluster from the corresponding targets of the reference [target cloud](#).

The deviation values are listed in the [Features Panel](#). They are also shown in the *3D View* window. For every instance, its position, its center and deviation can be viewed. The size and the color of the target represents how much it deviates from the reference position.

You can [evaluate the deviation](#) of each instance or cluster and [exclude badly registered targets](#) from the consideration of the global registration algorithm.

5.7.6.1 Features Panel

By default, the *Features* panel is available above the *Properties* panel at the bottom of the *Workspace* panel. It contains the list of clusters and instances of all targets captured during scanning, including deviations from their reference positions.

For the *Features* panel to display the list of captured targets, you need to select proper objects in the *Workspace* panel. These can be one or more scans with the global registration applied and/or the reference [target cloud](#).

Tip: To work easier with the *Features* panel, drag it to the area of the *3D View* window.

5.7.6.2 Evaluating Deviations

For each cluster and each instance inside the cluster, Artec Studio calculates its deviation. The value of the deviation depends on the type of objects selected in the *Workspace* panel:

- With one or more scans and the reference targets cloud selected, the deviation is calculated against the position of the corresponding reference target.
- With only scans selected, the deviation is calculated against the average position of the captured instances of the reference target.
- With only the reference targets cloud selected, no deviation is provided.

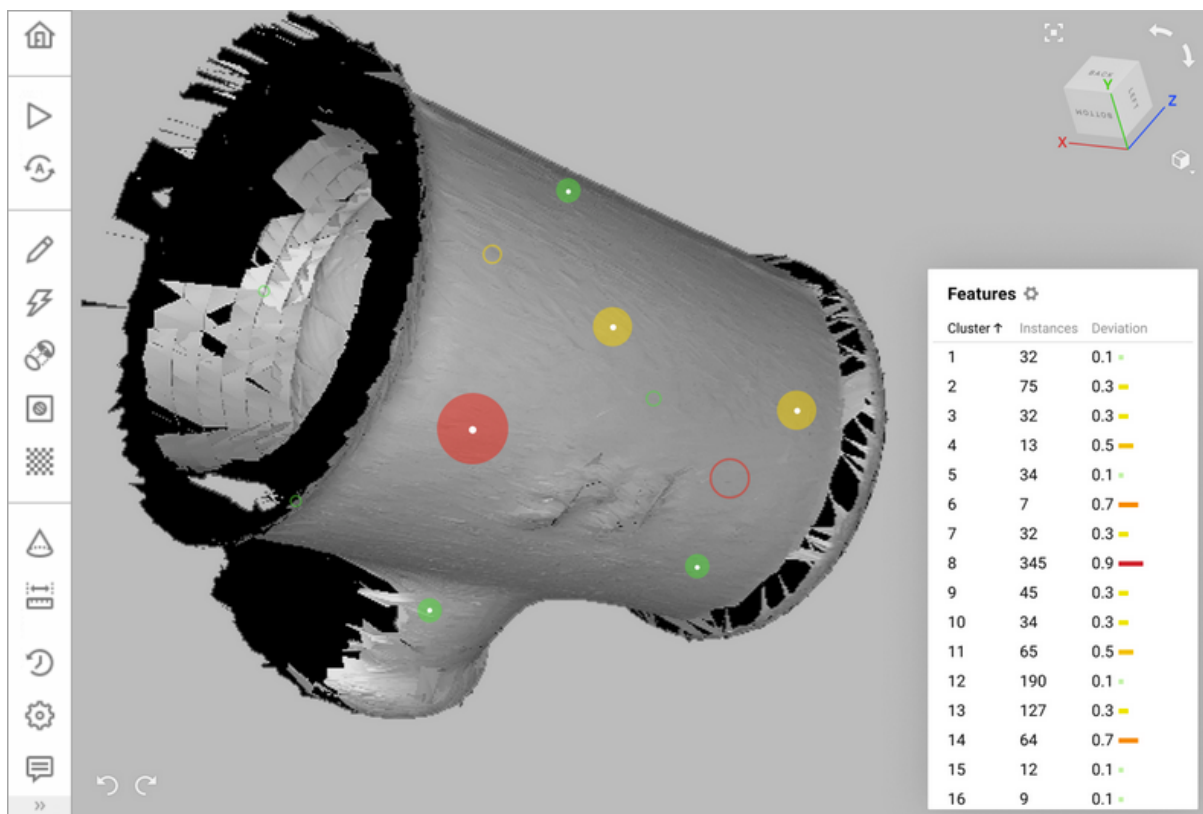


Figure 60: The list of instances belonging to a cluster and their deviations are displayed in the *Features* panel and in the *3D View* window.

You can inspect the deviation of the entire cluster or analyze any of its instances separately. To view the list of instances inside a cluster, click the → icon to the right of the number of instances. To return to the list of clusters, click *All clusters*.

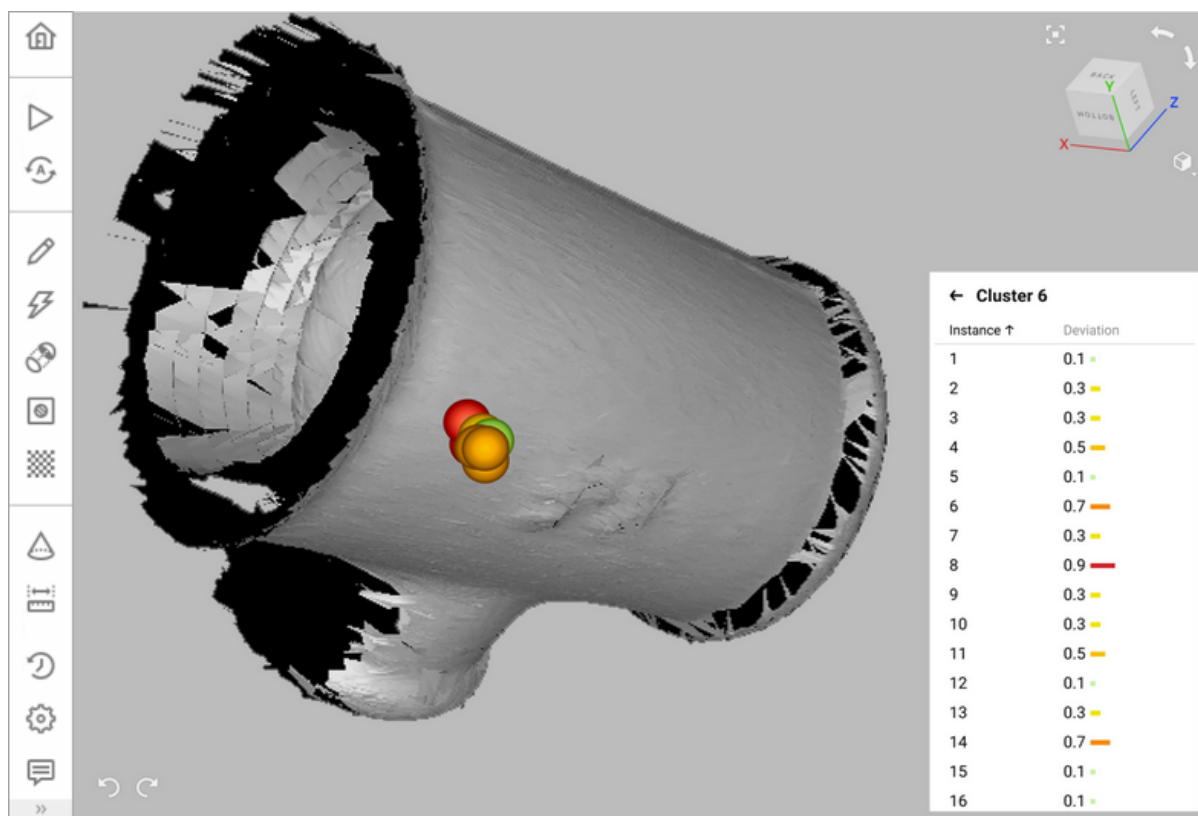


Figure 61: The list of clusters and their deviation displayed in the *Features* panel and in the *3D View* window.

5.7.6.3 Removing Badly Registered Instances/Clusters

To remove a badly registered target instances or clusters from further registration process, follow these steps:

1. In the *Features* panel, select one or more instances or clusters of the desired scans.
2. Open the context menu by clicking RMB on the selected object(s) and click *Delete*. You can also press `Delete` on the keyboard.
3. After you have excluded the selected targets, re-run *Global registration*.

Note: You can also measure distances between individual instances in the targets cloud. See *Measurement Tools*.

5.8 Artec Metrology Kit

Artec 3D introduces the new Artec Metrology Kit available for Artec Studio versions 17 and above. The kit is basically a camera-based photogrammetry system that enables you to both generate a reference target clouds (.obc) and evaluate results directly in Artec Studio, with an integrated software. Using the kit, you can measure objects of any size, and the resulting target cloud can be used for applications like deformation analysis, flatness inspection, general dimensions measurement, or your own specific engineering use case.

The kit has been developed to complement the photogrammetry-based Artec product line. It can be used in conjunction with our scanners to attain maximum accuracy and error-reduction.

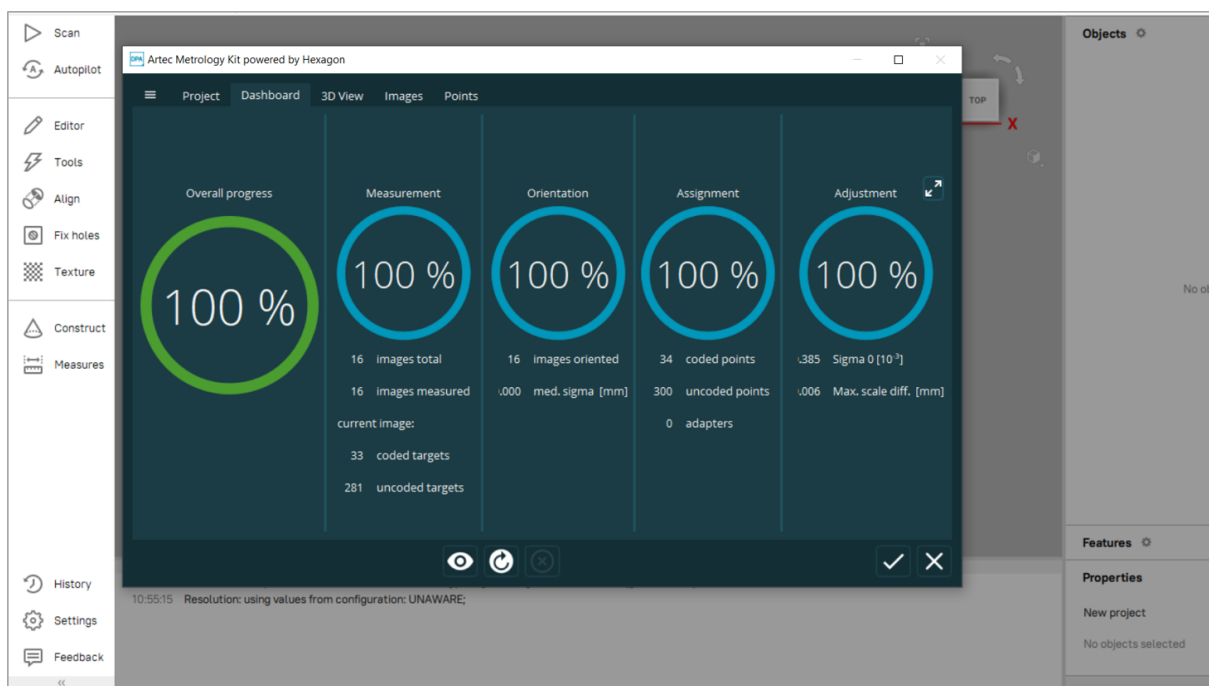


Figure 62: The Artec Metrology Kit software integrated into Artec Studio.

There are two types of kits available:

1. The Artec Metrology Kit Entry and
2. The Artec Metrology Kit Professional

The difference between the two is only the hardware that comes with the kit - the camera and reference objects.

Each kit contains the following hardware:

1. Camera and camera Flash
2. Reference crosses and scale bars
3. Coded and non-coded targets
4. Batteries and SD card reader

Important: The Artec Metrology Kit software is integrated into Artec Studio, immediately after the kit is activated.

The Artec Metrology Kit can be used independently or along with other Artec scanners.

5.8.1 Activating the kit

The first step requires you to activate your Artec Metrology Kit using the Artec Installation Center. Activating the kit automatically enables the Artec Metrology Kit software in your system.

5.8.2 Capturing photos

1. Prepare the object to be captured by placing the reference crosses, scale bars and targets on surfaces, ensuring that they don't move relative to the object.
2. The scale bars must be placed perpendicular to each other.
3. Make sure there are non-coded and coded targets in each photo. Capture each target at least 6 times, and the reference cross from four perpendicular angles.
4. Follow the best practices of photogrammetry (See section on placing targets above).

5.8.3 Creating reference cloud

After capturing all the photos, to generate a reference target cloud, follow these steps:

Make sure you have activated your Artec Metrology Kit in the Artec Installation Center. Doing so, automatically activates the Artec Metrology Kit software in Artec Studio.

1. In Artec Studio, go to Files → Generate reference cloud... option. This will launch the Artec Metrology Kit software.
2. Enter an appropriate project name and select the respective project template from the drop-down list. Every kit has a unique template.
3. Click on the Next button, and on the next window, the DPA pilot measurement dialog box opens up.
4. Select and upload all the captured photos (from the file system or an SD card), and click on the OK button (tick mark).
5. Set a target thickness value in open dialog. This value will be automatically subtracted from the surface for precise result. You can find the set value in the *Properties* panel of the *Workspace* (See [Figure 64](#)).
6. Wait for the software to perform the calculation and generate a target cloud.

Note: You can use the 3D View, Images and Points options in the menu bar to assess the targets, photos etc. You can also redo the calculation by adding more photos, or changing the settings.

7. Click on the OK button (tick mark) to generate the reference cloud, which then appears as an object in your Artec Studio workspace.

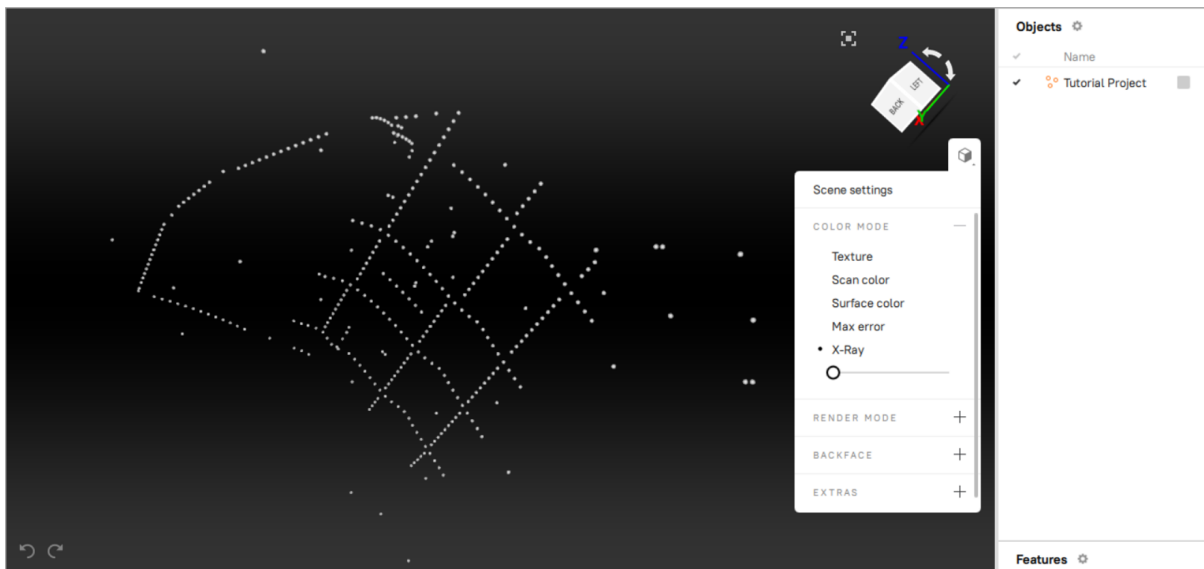


Figure 63: Reference target cloud generated using the Artec Metrology Kit.

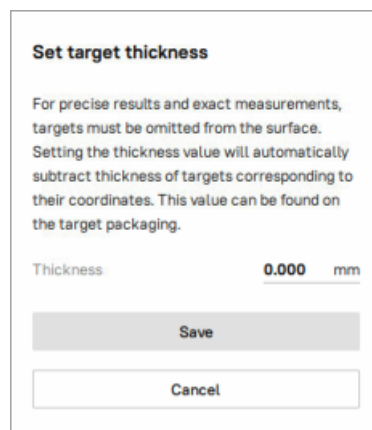


Figure 64: Target thickness compensation dialog.

5.8.4 Metrology Kit applications

After creating a reference target cloud, you can:

1. Use the Artec Metrology Kit software to perform inspections or measurements like deformation analysis, flatness inspection etc.
2. You can also carry on with target-assisted-scanning, or process your scan data in Artec Studio using the generated target cloud. For the detailed workflow, see [Target-Assisted Scanning](#).

5.9 Using Certain Scanner Types

5.9.1 Notes on Scanning With Artec Micro II

Artec Micro II is a second-generation, highly automated desktop 3D scanner engineered to capture small objects with metrology-grade precision. Objects are securely affixed to the rotating table via interchangeable fixtures inside the scanner's enclosed chamber. Its highly automated scanning process requires almost no user involvement or prior scanning experience, making Micro II ideal for quality inspection, reverse engineering, jewelry design, cultural-heritage preservation, and dental applications.

5.9.1.1 Adjusting Settings

Basic settings

- *Brightness*: Adjusts the intensity of the projected light to improve object visibility during scanning.
- *Resolution*: Sets the resolution of the output scanned data. *High* resolution mode generates four times more points than *Standard* mode, but at a slower speed.
- *Scanning path*: Defines the sequence of scanning table positions. Artec Micro II captures the object's shape from each position to ensure full coverage. Choose from default paths optimized for different object types, or create a custom path.

← Path sequence

Swing start angle

Swing end angle

Swing interval Positions

Rotation interval Sectors

FRAME COUNT: 0 / 250

Figure 65: Creating custom path

Advanced settings

To adjust advanced settings, toggle the *Advanced* switch on:

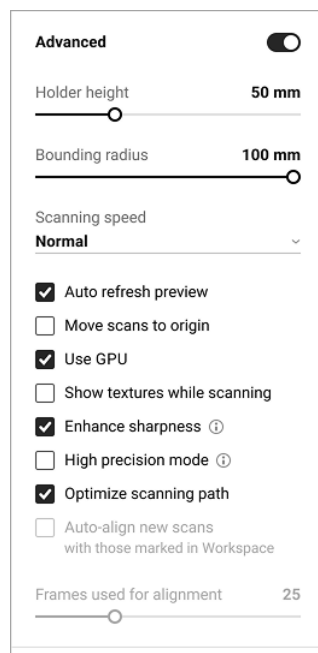


Figure 66: Advanced settings

- *Holder height*: Sets the height of the excluded area from the cylinder's bottom. Points within this height are omitted. Default: 50 mm.
- *Bounding radius*: Defines the scanning area's radius. Points outside the specified radius are excluded from the output. Default: 100 mm.

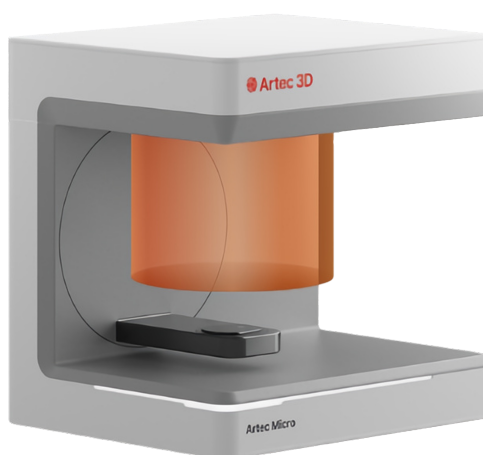


Figure 67: Bounding radius with holder height - default values.

- *Scanning speed*: Controls the rotation speed and affects the overall scanning duration. *Slow* speed ensures smooth and gentle motion, suitable for fragile or loosely mounted objects. *Rapid* speed reduces scanning time but involves more abrupt

movements, which may cause unstable items to shift or fall. Choose the appropriate setting based on object stability and time requirements.

- *Auto refresh preview*: Automatically updates the object preview in the Scan panel, helping you monitor positioning before scanning.
- *Move scans to origin*: Positions scans in the coordinate origin. The possible drawback is that the scans might be slightly misaligned.
- *Use GPU*: Determines whether the CPU or GPU resources are used during scanning. In most cases, GPU is the preferred option, as it enhances the quality of resulting scans.
- *Show textures while scanning*: Displays the object's texture in real time during scanning to help monitor surface coverage and scanning quality.
- *Enhance sharpness*: Improves fine detail capture in small objects, but may not work well on reflective surfaces.
- *High precision mode*: Ensures higher scanning accuracy for metrological measurements, with lesser focus on difficult-to-scan surfaces reconstruction.
- *Optimize scanning path*: Reduces scanning time by optimizing the movement between positions in the scanning path. In addition, this setting often improves the alignment of frames within a scan by capturing them in a more consistent and sequential order.
- *Auto align new scans*: Automatically aligns newly captured scans with the selected reference scans in the Workspace, streamlining multi-scan workflows and ensuring consistent positioning.
- *Frames used for alignment*: Sets the number of frames the algorithm should use for alignment, balancing speed and accuracy.

5.9.1.2 Automatic Scanning

Micro II can create a path automatically by analyzing the affixed object and ensuring sufficient surface coverage with a minimum of frames.

1. Adjust *Brightness* as necessary.
2. Select the *Automatic* path from the *Scanning path* dropdown list.
3. Wait for the scanner to finish capturing.
4. Examine the scan and [add one frame](#) as necessary.
5. Flip the object, affix it, select the *Auto-align new scans with those marked in Workspace* checkbox and repeat these steps again.

5.9.1.3 Scanning Paths

Scanning path is a set of turntable positions relative to the camera due to the scanner's rotary mechanisms.

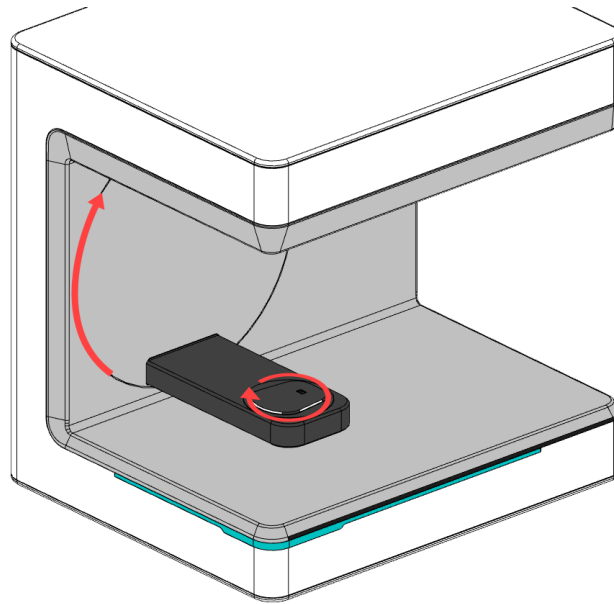


Figure 68: Fixture platform and swivel bracket's rotation.

There are two main parameters that affect the number of these positions and the number of frames:

- Object's size
- Geometry complexity

5.9.1.4 Default Paths

Artec Studio provides the set of the predefined scanning paths. Click the *Scanning path* drop-down list and select a suitable item from the *Default paths* nested list.

The tables below provide a description of the default paths.

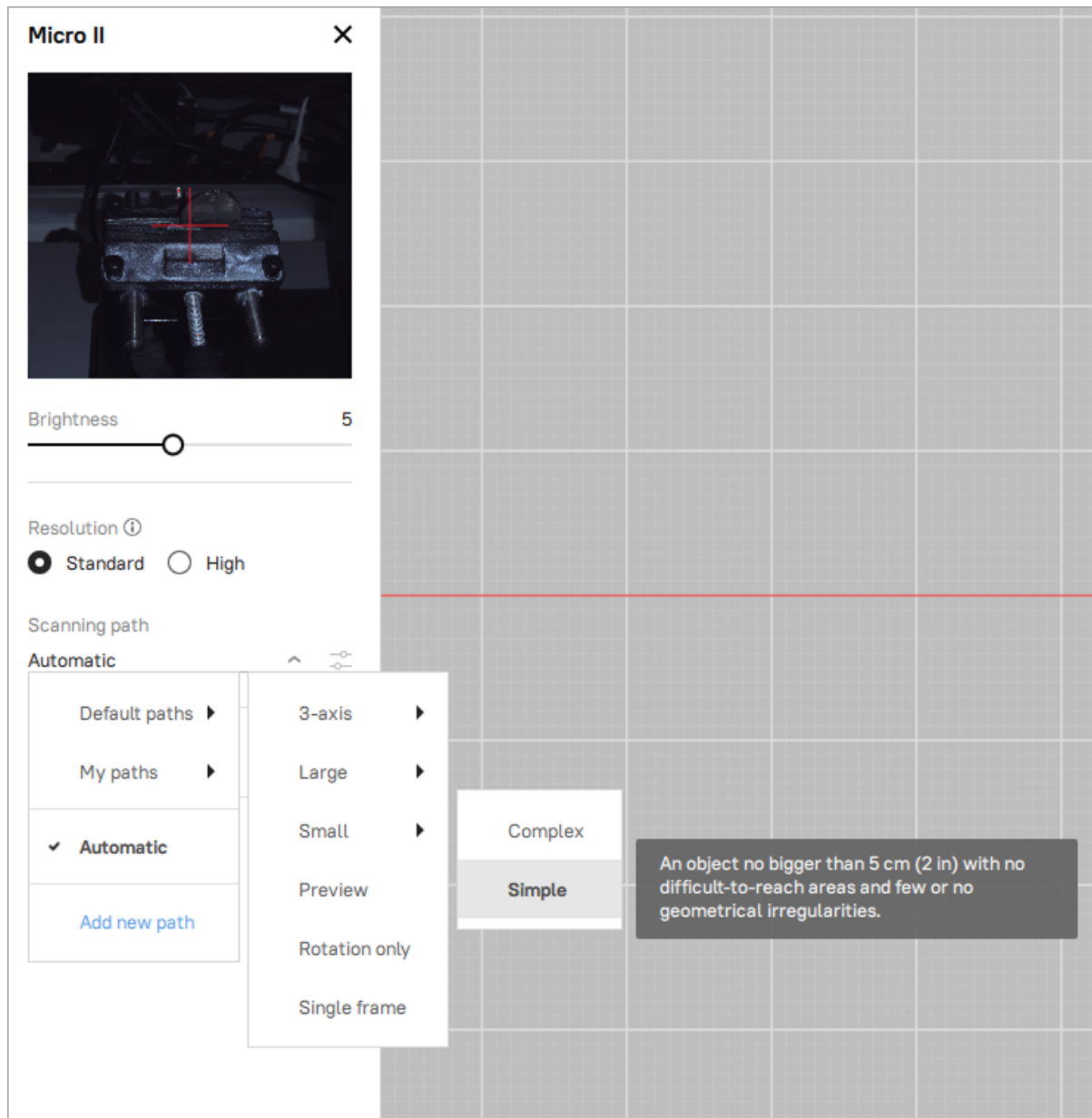


Figure 69: Default scanning paths.

Size- and complexity-based paths	
Small → Simple	An object no bigger than 5 cm (2 in) with no difficult-to-reach areas and few or no geometrical irregularities
Small → Complex	An object no bigger than 5 cm with many difficult-to-reach areas and numerous geometrical irregularities
Large → Simple	An object that's at least 5 cm with no difficult-to-reach areas and few or no geometrical irregularities
Large → Complex	An object that's at least 5 cm with many difficult-to-reach areas and numerous geometrical irregularities
Preview	A quick preview from six different angles. Use to check how well the object surface can be scanned or how many scanning angles it requires.
Rotation only	Objects that are ring-shaped or that can't be properly affixed to the turntable can fall off when the arm swings. This path instructs Micro to rotate the turntable only, without tilting the arm (see Figure 68).
Single frame	Capture just one frame without rotating the turntable. Use this mode to cover blind spots from other trajectories—simply rotate the object to face the camera.
3-axis	For objects 2–9 cm wide with complex geometry that can be clamped off-center in the 3-axis holder. The third rotation axis allows reaching areas inaccessible with the 2-axis holder and can save scanning time.

Note: Starting from Artec Studio 20, when you double-click a scan to view all Frames in the *Workspace* panel, three columns are available to display the scanning angles for all three axes.

5.9.1.5 Adding One Frame

After scanning an object, you may need to add separate frames from certain angles to fill in unscanned areas.

To add a frame into the existing Micro II scan captured using either of the [paths](#), follow the steps:

1. In the *3D view* window, orient the object in the way the unscanned area is facing your view direction.
2. Click *Add one frame*.

If the current scan orientation doesn't allow adding a frame, this button will be grayed out. To resolve this issue, try reorienting the scan in the *3D view* window.

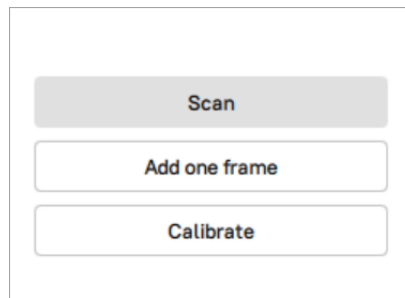


Figure 70: Adding one frame.

5.9.1.6 Creating New Path

You can create a custom scanning path if the default paths aren't optimal for the object. For this purpose, the *Scanning path* drop-down list contains the *Add new path* item.

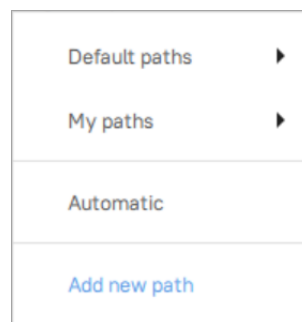


Figure 71: Add new path.

After selecting *Add new path*, the path editor will open.

By clicking to the right of the step row, via the pop-up menu you can delete, duplicate steps, and create a path sequence.

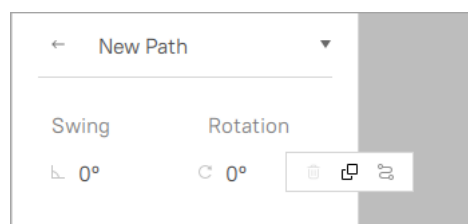


Figure 72: Creating new path.

Each step defines a position of the turntable relative to the Micro cameras using two parameters:

- **Swing** defines an angle of the turntable tilt. The value is in range of -180° to 90° . The default value is 0° , which means there will be no tilt of the turntable.
- **Rotation** defines a rotation angle of the turntable (clockwise). The value is in range of -180° to 180° . The default value is 0° , which means that the turntable will not rotate.

Thus, by setting rotation angles in each tilt position, you create a new scanning path.

Creating Path Manually

Adding a new path manually is reduced to a combination of the following operations:

- Filling in the parameters of a certain step.
- Duplication of the step and editing of the created one.
- Removing unnecessary steps.

All these operations are performed using the pop-up menu described [above](#).

After you have created the necessary steps, click *Save*. Your path will now be available in the *Scanning path* → *My paths* list.

Creating a Path Sequence

Artec Studio provides the ability to automatically generate a scanning path by setting only key parameters of a path sequence.

Click *Add new path* in the *Scanning path* drop-down list. Then, click to the right of the step row and select *Create sequence* from a pop-up menu.



Figure 73: Creating the sequence.

The following parameters must be set to generate the path sequence:

- **Swing start angle** is the largest inward tilt of the turntable.
- **Swing end angle** is the largest outward tilt of the turntable.
- **Swing interval** controls the amount of the tilt positions.
- **Rotation interval** controls how many turns the turntable will make in each tilt position.

Once all parameters have been set, Artec Studio will automatically count how many positions and frames the sequence will create.

Caution: If you set the intervals too short, Artec Studio will inform you that the frame count is exceeded (see figure below).

Click the *Generate* button to get back to the path editing menu with the generated path.

←

Path sequence

Swing start angle

↙

-180° to 90°

Swing end angle

↙

-180° to 90°

Swing interval

↙

1° to 270°

Positions

Rotation interval

↻

1°

Sectors

360

Figure 74: Generating the sequence.

↙

-60°

↻

-90°

...

↙

-60°

↻

-60°

...

↙

-60°

↻

-30°

...

↙

-60°

↻

0°

...

FRAME COUNT: 64 / 250

Save

Figure 75: Save the sequence.

If the automatically generated path sequence satisfies you, click *Save* and now your custom path will be available through the *Scanning path* → *My paths* nested list.

Note: It is possible to add a subsequence to an existing sequence, for example with the specific rotation interval for a certain tilt position. Select the desired step in the sequence, click to the right of the step row and select “Create sequence”. Perform the same operations to create the sequence as described above.

Any step from the sequence can be edited manually, which allows to create a perfect scanning path for a specific object.

5.9.1.7 Editing Paths



Each custom path can be edited via button .



Figure 76: The edit  button.

Next, you can do any available operations on the paths as described above. Also note the drop-down list at the top right of the path editor, which allows you to save, duplicate, rename and delete the path.

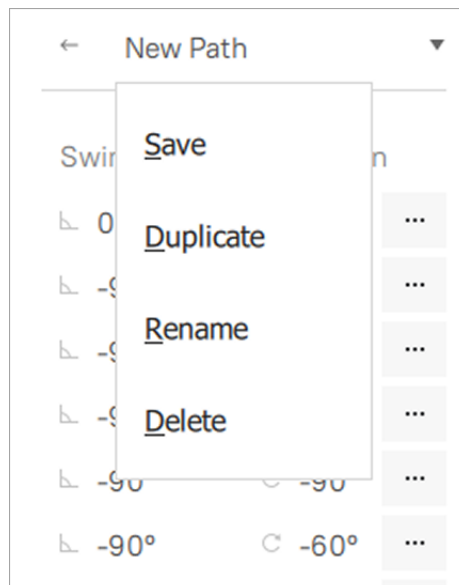



Figure 77: Operations with the path.

You can also use button  with the default paths. You can't edit them directly, but you can create your custom paths based on them. Use the *Duplicate* item in the drop-down list as shown below:

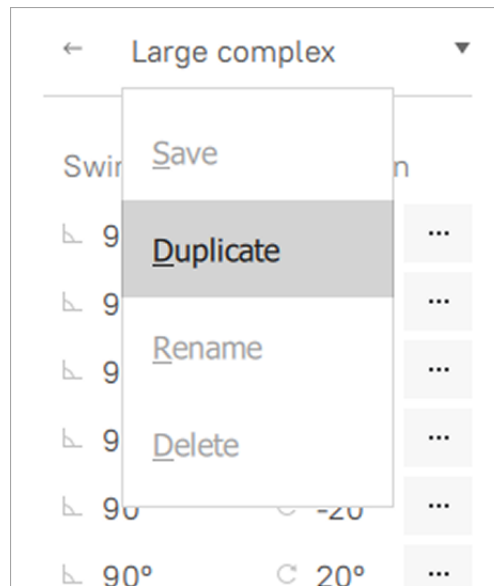


Figure 78: Duplicating the default (Large complex) path.

Note: Regardless of the object type and the way it was attached to the turntable, the bottom part will always be inaccessible to Micro II, so, if you need the object to be fully scanned, flip the object and make a second scan after the first one. Depending on the object's complexity, some objects may need more than two scans to be complete.

5.9.2 Notes on Scanning With Artec Point

Starting from Artec Studio 18.5, Artec introduces Artec Point, a new automated desktop 3D scanner for digitizing small parts with metrology-grade accuracy. Artec Point uses a blue laser for scanning. The two cameras of the scanner are positioned at specific angles, and their fields of view intersect to form a common field of view. During the scanning process, more than four marker points must be present in this common field of view.

- Avoid placing targets on prominent features to prevent the loss of key feature data and ensure there are neither too many nor too few targets.
- Double check that objects don't change their shape and position.
- If you feel that the entire object has not been fully scanned, you can scan it again. Each new scanning session will create a new point cloud.

Basic settings

- *Resolution:* Sets the resolution of the output scanned data.
- *Remove base:* Isolates and removes the base that is scanned as part of the object. This feature allows for the base to be identified and deleted while keeping the object intact.

Note: Base removal is only possible when scanning is based on a previously created target cloud and requires at least four targets attached to the base on which the object is placed. If the object is placed on an additional stand that rests on the base as shown in the image below, targets attached to the stand cannot be used for detecting or removing the base.

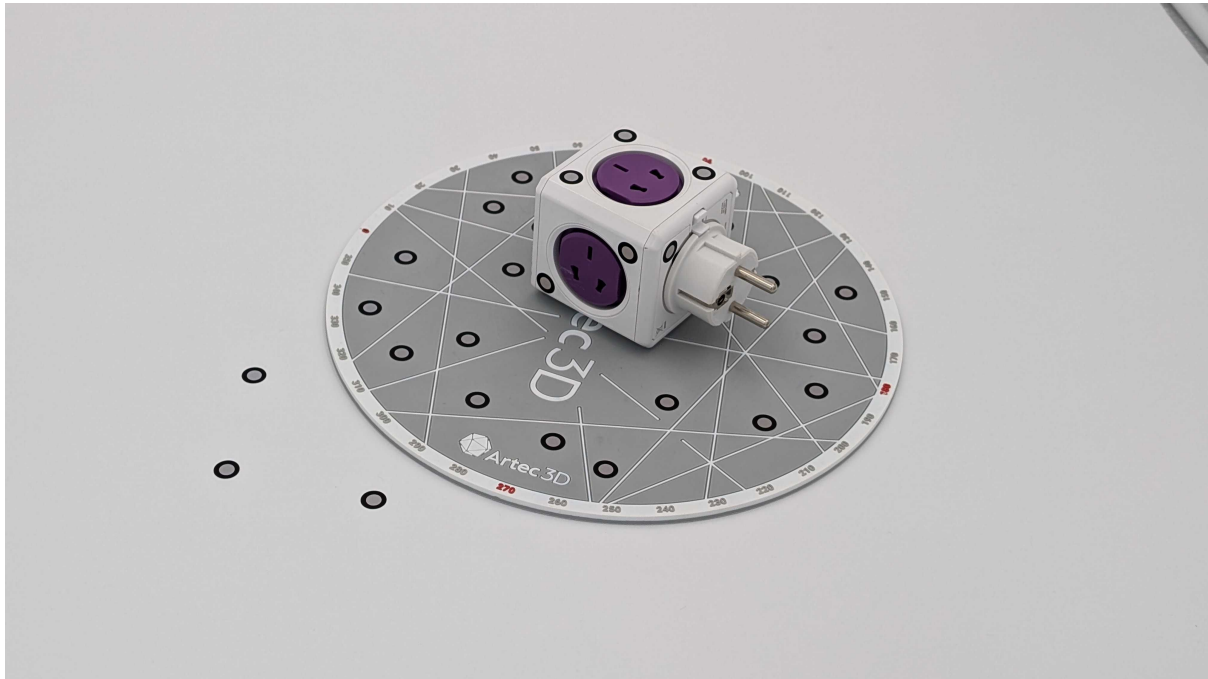


Figure 79: Insufficient amount of targets on the base.

Advanced settings

- *Target size:* Determines the size of attached reflective targets:
 - 3 mm
 - 6 mm
 - 12 mm
- *Target excision:* Defines the value for removing points around targets in the point cloud to create smoother edges; the higher the value (0 to 3 mm), the larger the hole but the cleaner the edges.
- *Base cut-off threshold:* Defines the threshold for automatically detecting the base using targets and allows adjustment of the cut-off position upwards from this point, typically within 1–2 mm; the value range varies from 0 to 25 mm.
- *Laser exposure:* Controls the laser illumination time. Decrease it for highly reflective objects. The default value is 1 ms for regular objects, 0.5 ms for larger ones. For capturing finer details, set it lower. The value range is from 0.1 to 10 ms.

Note: When working with data from Artec Point, please follow the standard post-

processing workflow as outlined in the user manual. If there are any deviations from the standard workflow specific to Artec Point, these will be clearly indicated in the respective sections of the user manual. Always refer to these sections for any specialized instructions.

5.9.3 Notes on Scanning With Spider/Spider II

Because Artec Spider and Artec Spider II have smaller field of view and provides higher accuracy in comparison with Artec Eva, scanning using it can pose difficulties. Consider the recommendations given in [Technique](#) and also the following:

- Opt for rotating table if possible
- Use a piece of paper with text on it as artificial texture
- Double check that objects don't change their shape and position
- Try tuning sensitivity in particular cases (see [Sensitivity](#)). Avoid extreme values.
- For the Artec Spider II scanner, we recommend increasing the *Geometry gain* slider for better scanning of dark surfaces, as it improves pattern visibility. However, avoid setting it too high to prevent excessive noise on light surfaces. Adjust as needed based on surface color for optimal reconstruction. This setting controls the brightness of the geometry cameras. However, it does not affect the texture camera).

Artec Spider and Artec Spider II scanners work best once they reach their normal operating temperature. As soon as you plug Artec Spider/Artec Spider II in or connect it to a PC, they begin warming up. In the *Scan* panel, you can see two lines indicating the device's current and optimal temperatures. Artec Spider/Artec Spider II will warm up faster in *Preview* mode. The *Scan* panel also displays additional information about the time remaining until the scanner reaches its optimal temperature.

Note: Artec Spider and Artec Spider II can operate at temperatures beyond its optimal range, but the accuracy of captured surfaces may be lower.

5.9.4 Notes on Scanning With MHT


The flash feature in an Artec MHT scanner has a very large but limited number of operation cycles, so ensure that you disable the scanner when it's not in use. Avoid leaving the Artec MHT on for a long time when using the maximum capture rate (15 frames per second). Artec Studio will automatically turn off the Artec MHT after five minutes of continuous operation. Normally the active mode/rest mode is 3 minutes of scanning and 7 minutes of rest; this mode is optimal and significantly increases the lifetime of the flash.

5.9.5 Notes on HD Scanning With Eva

To obtain a scan of high-definition resolution with the Artec Eva scanner, the HD mode must be turned on before scanning. Find out how to do this in [Enabling HD Mode](#).

After the HD mode is enabled, perform your scanning as usual.

Once you finish scanning, the following will happen:

1. Two new objects will appear in the *Workspace* panel: a conventional scan of SD resolution and a raw data scan. The latter can be identified by its icon () . Using the obtained raw data scan, you can launch the reconstruction of the HD scan at any time (see [Reconstructing HD scans from saved raw HD data](#) for details).
2. If the *Launch HD reconstruction after scanning* option has been selected before scanning, the HD reconstruction will start automatically. The corresponding progress bar will be displayed on the *Status bar*.
3. When the HD reconstruction is complete, an HD scan will appear in the *Workspace* panel in addition to the SD one. Its name will be marked with the letters “HD”, for example: *Eva HD Scan 1*.

5.10 Tweaking Scanning Options

5.10.1 Enabling HD Mode

To perform HD reconstruction, you need to compile the neural network model before using this algorithm. You can do this during your first launch of Artec Studio, or by navigating to the *Performance* tab in *Settings* and clicking the *Set up neural network* button.

If the scanner connected to your computer supports the HD mode (such as Artec Eva), it will be enabled by default. You will see the *Launch reconstruction after scanning* option selected. The specifics of each of these options are described below.

5.10.1.1 Launching reconstruction after scanning

If the *Launch reconstruction after scanning* option is selected, HD reconstruction will automatically start as soon as your scanning is complete. Therefore, before you start scanning, you have two options:

- To use the common *Scan reconstruction* slider which adjusts the final quality of reconstructed scans and is the default one.
- To use the advanced mode and configure the HD reconstruction parameters: *Point density* and *HD frames frequency* manually. To do this, use the eponymous sliders.

The *Scan reconstruction* slider has four different options:

- SD (equivalent to the *No HD* option for the *HD frames frequency* and zero *Point density* respectively)

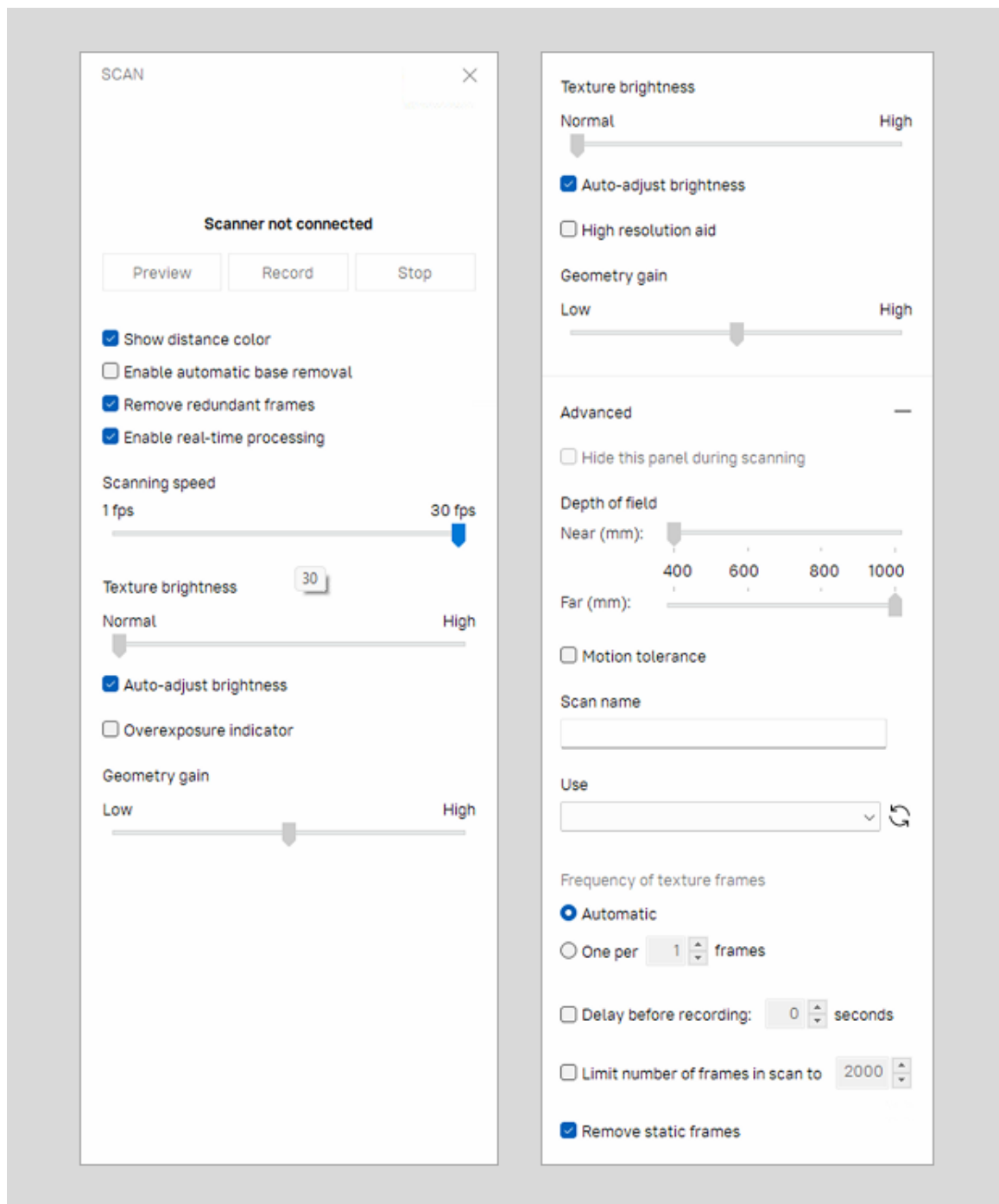


Figure 80: Scan panel: *Advanced* section hidden (on the left) and revealed (on the right).

- Normal (equivalent to the $1/8$ for the *HD frames frequency* and *Point density* of 1.78x)
- High (equivalent to the $1/4$ for the *HD frames frequency* and *Point density* of 4x)
- Ultra (equivalent to the $1/2$ for the *HD frames frequency* and *Point density* of 7.11x)

To adjust the *HD frames frequency* and *Point density* parameters, check the *Advanced* option above the *Scan reconstruction* slider.

The *Point density* determines the number of points in the resulting HD scan. The higher the point density, the greater the number of polygons in the resulting HD scan.

The *Point density* varies in the range from 1× to 16× and is represented by the following values:

- *Normal*
- *High*
- *Ultra*
- *Extreme*

With the value of 1×, the number of points per scan is of the same order as in the case of the SD resolution. However, the surfaces reconstructed from the 1× HD data are cleaner than the ones based on the SD data. The density of 16× corresponds to ~3 million polygons per frame. The default *Point density* is 4×. This means that the resulting HD scan will contain four times as many points as the SD scan.

Increasing the *Point density* results in higher degree of resolution, coverage, and detail, but requires more memory and time for the HD reconstruction.

The *HD frames frequency* determines how many of the captured HD frames you are going to use for the HD reconstruction. For example, if you select $1/4$, then only every fourth HD frame from the captured ones will be used to build the HD scan. The fewer HD frames you use, the fewer polygons the resulting scan will have (i.e., it will require less memory) and the less CPU time the processing will take. On the other hand, it is more likely that you will lose some of the scanned surface and the resulting HD scan will have holes. The *HD frames frequency* parameter is represented by the following values:

- No HD frames
- Every 8th frame
- Every 4th frame
- Every 2nd frame
- Only HD frames

When scanning complex objects, shiny surfaces with insufficient data, or scanning at a high scanning speed, it is preferable to use high *HD frames frequency* values: from $1/4$ to 1. For simple objects with few details, we recommend choosing *HD frames frequency* with the $1/8$ value.

Important: The HD reconstruction is a time-consuming and resource-intensive operation.

On slow computers, it can take up to several hours. If Artec Studio evaluates your computer's resources as insufficient for the selected values of the *Point density* and *HD frames frequency* parameters, then the corresponding warning will be displayed. For information on resources requirements, see the *Using HD mode* section in [System Requirements](#).

To learn about additional options for adjusting the HD reconstruction, see [HD Reconstruction](#) in the Settings section.

See also:

[HD Scanning and HD Reconstruction](#)

5.10.2 Disabling Distance Color

The *Show distance color* option ([Figure 49](#)) highlights the reconstructed surfaces in the field of view based on the working range of a particular scanner.

Red	Surfaces are too close to the object.
Orange, green	Corresponds to the middle of range. Green represents the optimal distance.
Blue	Surfaces are too far away from the scanner and about to disappear.
No color	Surface is not being recorded.

In some cases you may need to observe how well texture is being recorded. Disabling this feature would then help. Clear the *Show distance color* checkbox in the *Scan* panel to this end.

5.10.3 Real-time Processing

The *Enable real-time processing* option is ON by default. This option enables Artec Studio to perform real-time operations like saving, mapping textures and surface optimization, during the scan process. These simultaneously occurring operations may sometimes, depending on your system's CPU model, significantly reduce the scanning speed (FPS). In order to optimize CPU usage and restore FPS during scanning, you can uncheck the *Enable real-time processing* option in the *Scan* panel.

Disabling *real-time processing* can prevent decline in scanning speed. The real-time operations are then automatically performed immediately after scanning.

5.10.4 Removing Redundant Frames

The *Remove redundant frames* option is ON by default. This setting removes redundant frames after scanning by analyzing the entire scan and deleting similar frames, even if they are not consecutive. It optimizes data and reduces unnecessary frame accumulation.

5.10.5 Tuning Texture Brightness

Note: This option is available only for Artec 3D scanners equipped with texture cameras.

You can adjust the *Texture brightness* setting in *Preview* mode. Use the slider to increase or decrease the brightness of frames captured by the color camera (see [Figure 81](#)). Note that the texture brightness affects texture quality as well as tracking steadiness. Observe the recommendations in the [Table 3](#).

Table 3: Adjusting texture brightness.

Surface Color	Recommendation
Dark or black	Increase brightness
Light-colored or white	Decrease brightness

5.10.5.1 Preventing Overexposure

Artec Studio has error-proofing against overexposure. If the *Auto-adjust brightness* checkbox is selected and the specified value of *Texture brightness* causes texture to overexpose, the application will automatically decrease brightness to avoid damaging texture.

5.10.5.2 Overexposure Indicator

Artec Studio provides an indicator to highlight overexposed areas during scanning with Artec Spider II. If the *Overexposure indicator* checkbox is selected, the last frame will display areas that are too bright, helping users adjust the *Geometry gain* slider.

This feature is only useful when capturing submillimeter details and planning a fusion with a resolution of 0.09-0.05 mm. Consider the following recommendations:

- If highlighted areas do not contain fine details, reducing *Geometry gain* is unnecessary—these scans remain valuable.
- It is acceptable to scan an area of interest twice: first with higher *Geometry gain* and then with lower settings to ensure some frames have no overexposed regions.
- The resolution remains optimal as long as at least one frame in the set is properly exposed.

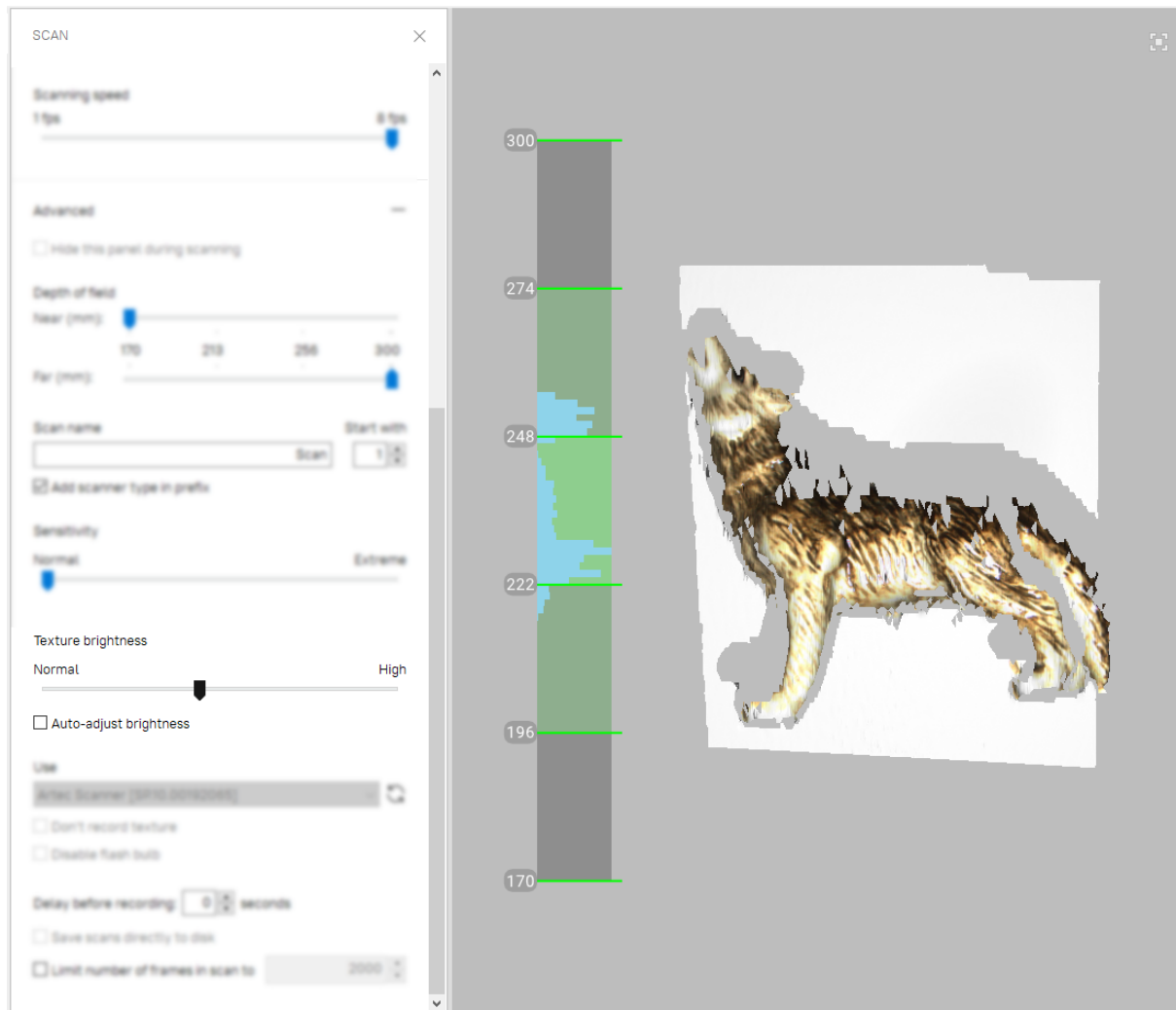


Figure 81: Increasing *Texture brightness* during *Preview*.

The indicator visually represents point weights computed by the reconstructor. Points with lower weights (below 0.1) may appear in a warning color due to factors such as oversaturation or poor surface contrast.

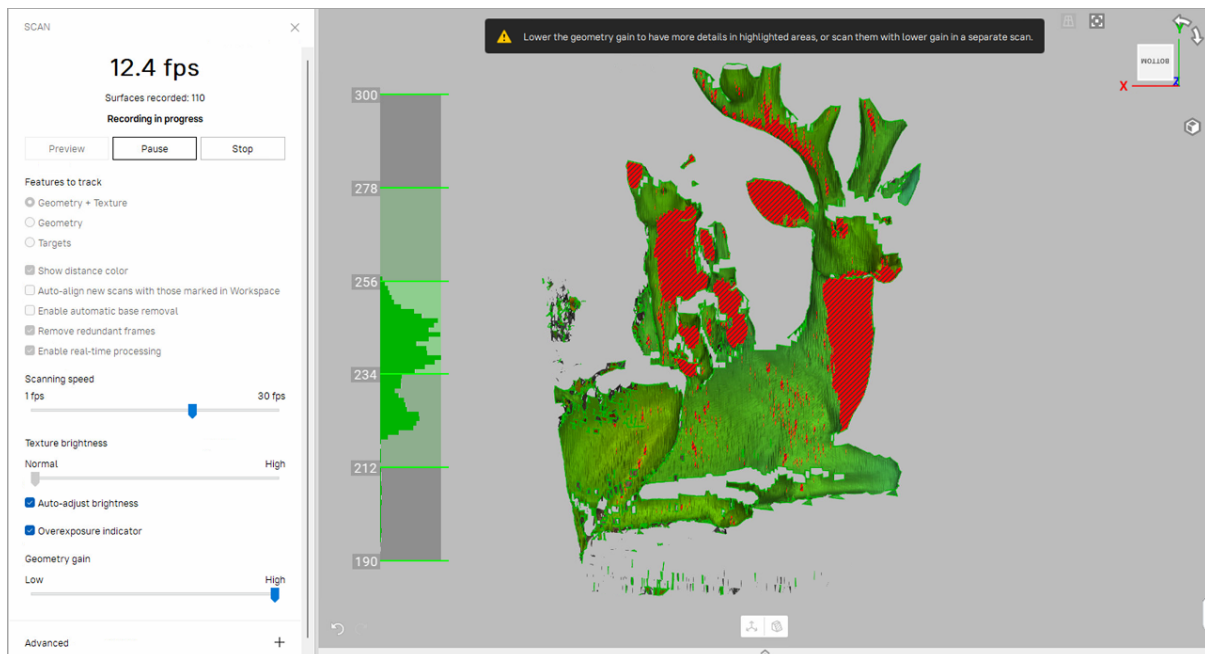


Figure 82: Overexposed areas highlighted in red

5.10.6 Sensitivity

You can tune the *Sensitivity* of Artec Spider scanner if the application fails to reconstruct particular surfaces. Increasing this setting enables the scanner to more easily capture black, reflective, translucent and fine objects (such as human hair). The higher the sensitivity, the noisier the recorded surfaces will be. Higher values may also reduce the scanning speed. For Eva and other Artec scanners, this setting is automatically adjusted.

5.10.7 Frequency for Capturing Texture Frames

By default, the *Frequency of texture frames* option is set to *Automatic*. In this mode, Artec Studio does not capture texture for every frame. To specify the frequency for capturing texture frames manually, do the following:

1. Check the *One per ... frame* radio button (see [Figure 80](#), right).
2. Using the spinner near it, specify the desired frequency: n .

After that, the texture will be captured for every n -th frame.

5.10.8 Deactivating Scanner Flash

If circumstances prohibit you from using the scanner flash, follow the directions below.



Figure 83: Influence of ambient light on captured results.

On left: flash is turned off; ambient light is poor; results—dark texture. On right: flash is turned off; lighting conditions are improved; results—good texture.

Note that if you disable the flash, you should compensate by using bright ambient light. According to our tests, acceptable texture quality is obtainable with the flash disabled if the surface illuminance is at least 1 000 lux. Compare the models shown in [Figure 83](#), which were recorded under different lighting conditions.

The following procedure captures the textured model without using the scanner flash:

1. Open the *Scan* panel and click the *Advanced* link
2. Turn off the texture flash by selecting the *Disable flash bulb* checkbox
3. Use good illumination. Avoid fluorescent lamps.
4. Click *Preview* and direct the scanner at the object
5. Adjust *Texture brightness* and *Texture exposure time*. In most circumstances, values should be as low as possible, because increasing the brightness also increases a texture noise, whereas increasing exposure time can blur the texture. Instead of adjusting sliders, try to further improve the lighting conditions.
6. Capture the scene
7. Perform required postprocessing as described in [Data Processing](#) to get a textured model
8. Adjust texture parameters for this model as described in [Texture Adjustment](#). Pay particular attention to the *Hue* and *Saturation* sliders. The *Hue* slider allows you to correct unwanted texture color.

5.10.9 Tuning Exposure Time

You can alter texture exposure time in the *Preview* mode. Adjust this parameter in tandem with the *Texture brightness*. Increasing exposure time can blur the texture. Don't alter the default value unless it's necessary.

5.10.10 Disabling Texture Recording

Select *Don't record texture* checkbox if you don't want to store texture information in your scans. It is located in the *Advanced* section of the panel and disengages both texture camera and texture flash in the scanner. Note that this option is unavailable for Artec Eva Lite. Don't forget to select this checkbox once you have completed textureless scanning; otherwise, next time you want to start regular scanning the hybrid tracking mode could be unavailable.

Important: Just using the *Geometry* tracking mode it is still not sufficient for the application to don't record texture. Make sure you clear the eponymous checkbox.

5.10.11 Decreasing Scanning Speed

Artec Eva captures objects at up to 16 frames per second, whereas Artec Spider at 7.5. Default values ensure comfortable scanning with smooth movements. However, if you find scanning speed inappropriate, you can decrease it. In this case, Artec Studio will record fewer identical frames and register them faster. To this end, use the *Scanning speed* slider in the *Scan* panel.

Important: Decreasing scanning speed may hinder scanning. Don't use this slider unless it is absolutely necessary.

5.10.12 Limiting Number of Frames in Scans

Processing extra large scans might be problematic. To prevent Artec Studio from creating scans with an excessive number of frames, use the *Limit number of frames in scan* to counter. This counter defaults to 2000 frames in each scan.

5.10.13 Supplementary Settings

5.10.13.1 Scan Names and Starting Number

Customize scan names and starting number by entering your own values in the *Scan name* and *Start with* fields and changing the state of the *Add scanner type in prefix* checkbox. The software uses these values to create a scan title in the *Workspace* panel (see [Figure 84](#), left). You can change the default values *Eva Scan* and *1* to, for example, *Capture* and *14*.

5.10.13.2 Saving Scans to Disk

Trigger a capture mode that simultaneously records scanning results to a disk by selecting the *Save scans directly to disk* checkbox. This option is enabled when you're working with an existing saved project (see [Saving Project](#)) and can be useful when capturing large amounts of data on a computer with insufficient memory.

5.10.13.3 Delay Before Recording

Specify a delay (in seconds) before recording using the *Delay before recording* spinner under the *Advanced* section of the *Scan* panel. The countdown begins as soon as you click the *Record* button. To eliminate the delay, set the value to zero.

5.10.13.4 Depth of Field

Decrease specified operating-zone (*Depth of field*) by using the *Near (mm)* and *Far (mm)* sliders under the *Advanced* section of the *Scan* panel. Here you can only decrease range within the specified boundaries.

5.10.13.5 Motion Tolerance

As the name suggests, this option allows slight movement of the object without losing the scanner's tracking. In other words, when this option is enabled, Artec Studio enables the scanners (Spider & Eva) to tolerate slight movements in the object being scanned. Motion tolerance is disabled by default, and can be enabled in the *Advanced* section of the *Scan panel*. This is particularly suitable for scanning moving objects like heads of children, objects with moving background or animals etc.

5.10.13.6 Specify Scanning Range

By default, Artec Studio provides the correct values for the minimum and maximum limits within which the cutoff planes are to be positioned. These values are different for each 3D scanner model, and they ensure that you capture good-quality 3D data. If high accuracy is a secondary concern, you can manually adjust the depth boundaries, allowing you to capture objects using an Artec L scanner or third-party 3D sensors positioned closer to or further from the object than is recommended. To do so, select the *Override default depth range* checkbox in the *Settings* dialog in the *Scan* tab, then specify new boundaries for the scanning range in millimeters (For more details about scan settings, see [Capture](#)).

Warning: Custom depth-range settings may reduce accuracy.

5.10.13.7 Hiding Scan Panel During Scanning

To widen the viewport during scanning, software automatically closes the *Scan* panel once you start recording using Artec Eva or Artec Spider scanners. The *Hide this panel during scanning* checkbox is located in the *Advanced* section and is cleared by default.

5.10.13.8 Temperature Compensation Wizard

To enable metrology precision for Eva, run a temperature compensation. It will adjust the scanner settings to the ambient temperature. In *Advanced* section, click *Start temperature compensation wizard* and wait for a process to finish.

5.11 Troubleshooting

Issue	Possible Resolution
<i>Geometry + Texture</i> radio button missing from <i>Scan</i> panel.	You were probably scanning without texture. Clear the <i>Don't record texture</i> checkbox in the <i>Advanced</i> section.
Final model contains noticeable noise.	You likely scanned the affected areas improperly, or the scanner was too far from the object. Rescan those areas.
<i>Tracking lost</i> error persists.	Make sure <i>Scan using auto-alignment</i> is enabled in the <i>Settings</i> dialog and use <i>Geometry + Texture tracking</i> .

AI PHOTOGRAMMETRY

Starting from Artec Studio 19, two new algorithms have been added to allow users to reconstruct 3D models from sets of photos and videos without a 3D scanner and a photogrammetry kit. Please be aware that projects created by this version might not be compatible with older versions of Artec Studio.

AI Photogrammetry in Artec Studio is divided into two consecutive stages:

- *Create Preview*: positions photosets in 3D space, generating a *photo scan* as the output.
- *Create Model*: creates a final 3D mesh that can be further processed and textured.

Both these algorithms are available in two types:

- *Separate Object* is intended for a single object that is fully captured within the frame and clearly separated from the background.
- *Whole Scene* is suitable for feature-rich scenes, such as aerial or drone captures, or objects like stones, statues, and architectural structures, where there is no requirement to separate the object from the background.

See also:

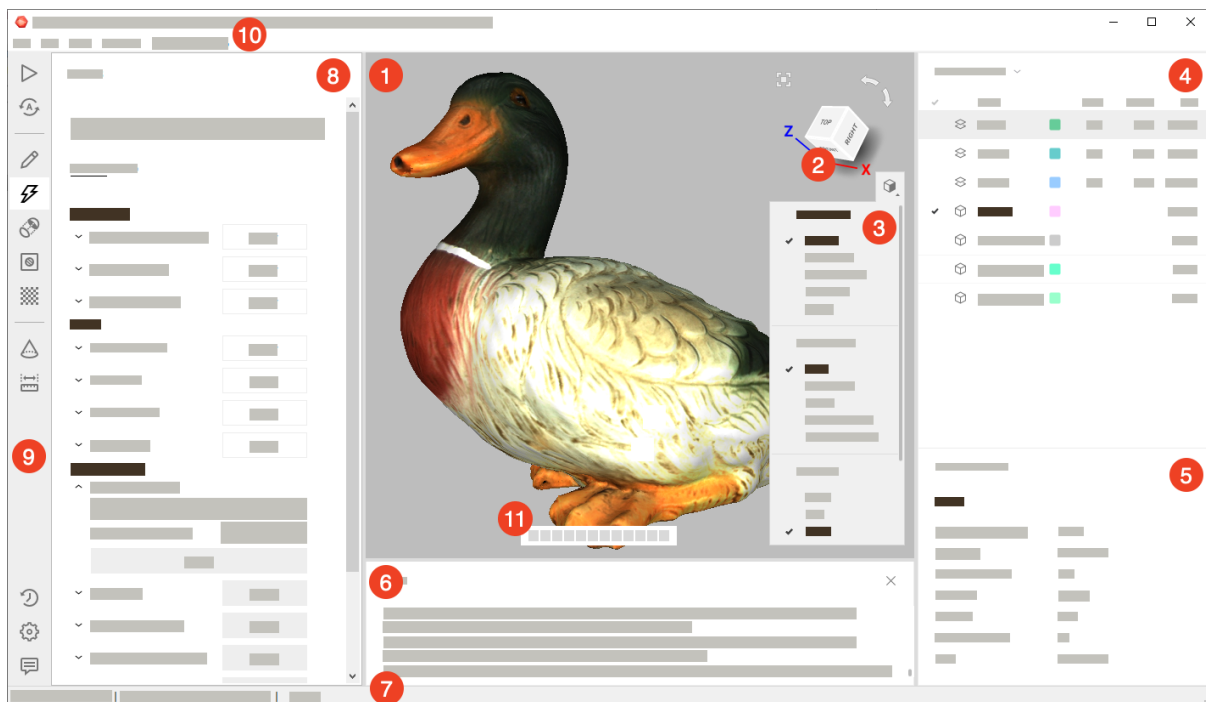
For more details on the full workflow of AI Photogrammetry, preparing objects for the algorithms, their basic and advanced settings and hardware limitations, please refer to the [Quick Start Guide](#) and the [Advanced User Manual](#).

WORKSPACE AND MORE

7.1 Artec Studio User Interface

7.1.1 Windows, Panels and Bars





When you launch Artec Studio, you will see the main application window, which allows you to perform all operations on scans and models.



The main window is divided into several sections:


Section	Intent and other information
1. <i>3D View</i>	Display all 3D data.
2. <i>Navigation cube</i>	Quickly orient objects.
3. <i>Scene settings</i>	Alter 3D-data appearance and toggle display of coordinate grid.
4. <i>Quick toolbar</i>	Quickly access to the set of tools for working with objects geometry and transformations.
5. <i>Workspace panel</i>	List and manage 3D objects as well as toggle their display and availability for tools.
6. <i>Properties panel / Features panel</i>	Displays detailed information for 3D objects. / Displays information about captured targets for scans with global registration applied.
7. <i>Log window</i>	Store records of any executed commands, specifying the time and details of each operation (error and troubleshooting messages).
8. <i>Status bar</i>	Contains information on memory availability and current usage by Artec Studio. It also has a progress indicator for any currently running task, such as algorithm execution, model and scan exporting, and so on.
9. <i>Left panel</i>	Accommodate panels for various application modes, including <i>Scan</i> , <i>Autopilot</i> , <i>Editor</i> , <i>Tools</i> , <i>Align</i> , <i>Fix holes</i> , <i>Texture</i> , <i>Construct</i> , <i>Measures</i> , <i>Settings</i> , <i>History</i> and <i>Feedback</i> .
10. <i>Left toolbar</i>	Toolbar to start the above mentioned modes.
11. <i>Menu bar</i>	Dropdown menus with various commands.

If any of the panels are hidden, go to the *Window* menu on the Menu bar, and select the panel to display it. If *Quick toolbar* is hidden or some of the tools are disabled, it means that your projects doesn't contain any supported objects.

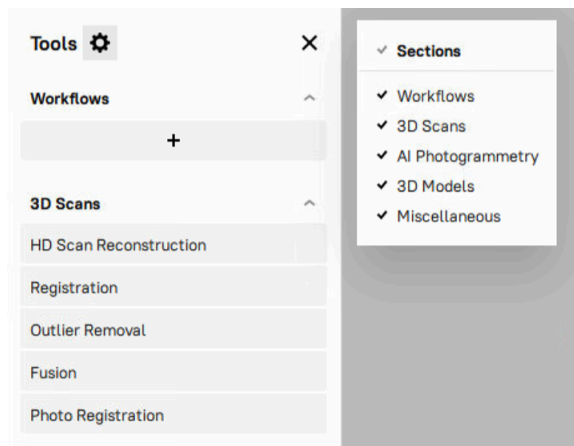
You can also quickly show or hide some of the panels/toolbars (namely, *Left toolbar*, *Workspace panel* and *Log window*) by clicking on the special bars marked with double arrows: , , , . These bars are located along one of the borders of the corresponding panel or toolbar.

You can minimize or maximize the right-side panels by clicking on the (-) or (+) icons on the upper right corners, respectively.

Note: The *Workspace*, *Features*, *Quick toolbar*, and *Properties* panels are detachable, and can be moved around and placed anywhere on the window. Simply drag-and drop, or click

on the  on the upper right corner of the panel, and drag.

The *Tools* panel in the Left panel can be customized. Click the gear icon at the top of the panel to open a popup window listing tool sections. Select or deselect tools to choose which ones appear on the *Tools* panel.



7.1.2 Primary Settings

To access the settings dialog, select *Settings...* in the *File* menu. The settings window has several tabs for various groups of application settings. To switch between the tabs, click the icon at the top of the dialog. For a detailed description of the tabs, see [Settings](#).

To change the language, select the *Miscellaneous* tab ([Figure 232](#)) and then the required language from the list and click *OK*. You will be asked to confirm the operation and restart the application. Once you agree, Artec Studio will automatically restart using the new interface language. If you choose not to restart, the changes will be applied the next time you start the application.

Important: By default, the 3D view window functions in the normal camera mode. However, you can switch to Orbit camera mode by selecting the *Orbit Camera* option in the *View* menu.
















7.2 Workspace Panel

7.2.1 Object Types

After each scanning iteration, Artec Studio saves a separate [scan](#). The list of all scans for a given project appears in the *Workspace* panel (see [Figure 84](#)). Afterwards, the algorithms, primarily [fusion](#), yield [models](#).

Artec Studio can accommodate the following types of objects in *Workspace*:

Table 4: Object types in Artec Studio.




Type	Icon	Content	Origin
Scan		Set of frames	From scanners Eva, Spider, Spider II, Leo, Micro, and Micro II
HD raw data		Set of HD frames	From Eva scanner
Point cloud scan		Point cloud	From Ray and Ray II scanners
Raw point cloud scan		Point cloud	From Artec Point scanner or imported point cloud
Sparse point cloud		Aligned photo scan from AI Photogrammetry	Created in Artec Studio
Model		Polygonal mesh	Algorithm output (fusion) or imported mesh
CAD model		CAD model	Imported
Cylinder		CAD primitive	Created in Artec Studio (see Constructing CAD Primitives)
Cone		CAD primitive	Created in Artec Studio
Plane		CAD primitive	Created in Artec Studio
Sphere		CAD primitive	Created in Artec Studio
Torus		CAD primitive	Created in Artec Studio
Freeform		CAD primitive	Created in Artec Studio
Targets		Target cloud	Imported
Group		Group of objects	Grouping of objects listed above


See also:



[Figure 86.](#)

7.2.2 Object Columns

Object data in the *Workspace* panel is arranged in several columns:

✓	Scans marked with ✓ in this column will appear in the <i>3D View</i> window and will undergo processing by all Artec Studio algorithms and tools.
<i>Icon</i>	Each type of objects has a specific icon (see Table 4). This icon is always displayed to the left of the object or group name for improved visual perception of information in the <i>Workspace</i> panel.
<i>Name</i>	When a scan is created, Artec Studio automatically assigns it a name, such as <i>Eva Scan 1</i> , <i>Eva Scan 2</i> and so on, according to the values in the <i>Scan name</i> and <i>Start with</i> fields as well as the state of the <i>Add scanner type in prefix</i> checkbox in the <i>Scan</i> panel. To rename some object, follow these instructions .
<i>Color</i>	In this column, each object has a colored square (for example, ) next to it for clarity and quick visual search. You can change the color by clicking on the corresponding square and selecting the desired color from the palette.
<i>Type</i>	The type of an object. See here for details.
<i>Error</i>	The largest registration-error value among all frames in the scan. More information .
<i>Frames</i>	The total number of frames constituting the scan.
<i>Scanner type</i>	The type of the scanner that created the object.
<i>Texture frames</i>	The number of captured texture frames. See Texturing for details.
<i>Polygons</i>	The number of polygons constituting the object.
<i>Locks</i>	Algorithms will not reposition the frames of the scans marked with  , nor will they move the scans and other objects marked with  .

Use the  button at the top left to select the columns to be displayed or to hide the panel. Change the column order by drag-and-dropping their headers.

Note: The columns marked with  and  appear automatically if you set the *Lock object* or *Lock frames* status respectively, for one or more objects using the context menu (see [Operations with Objects](#) for details on the context menu operations).

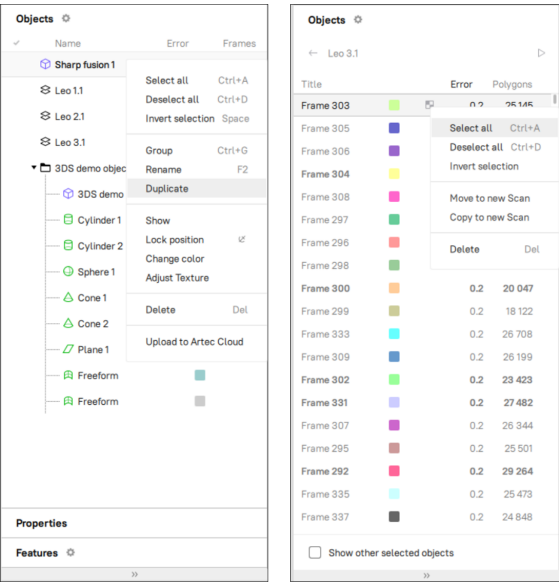


Figure 84: *Workspace* panel and respective context menus: object list on left and surface list on right.

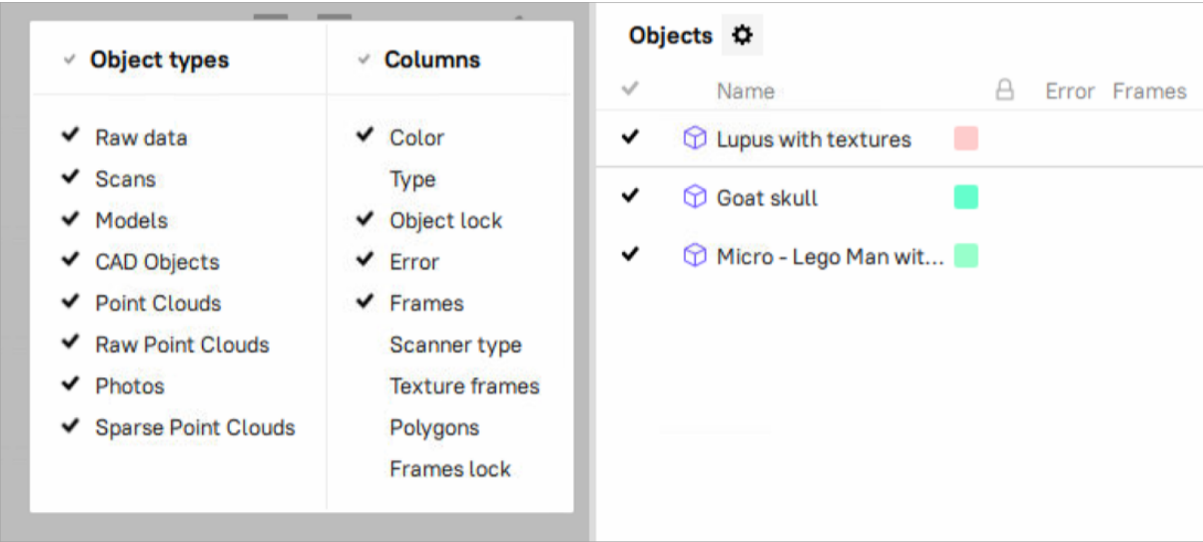
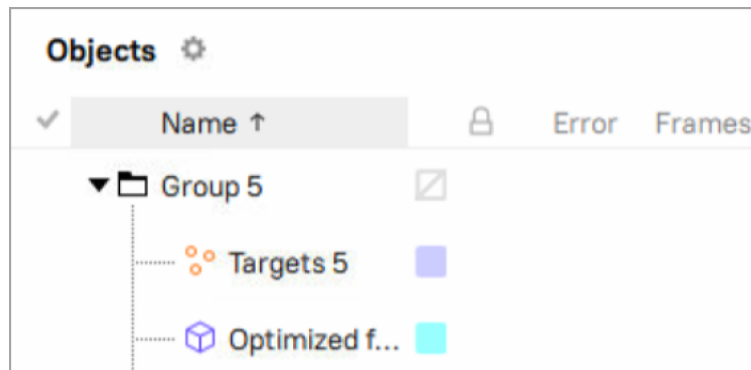


Figure 85: Selecting columns to be displayed, and filtering objects.

7.3 Operations with Objects

In the *Workspace* panel, you can perform various types of operations with objects. All types of operations are available through the context menu called by clicking **RMB** on some object.

Menu Item	Description
Objects filter	Instruct <i>Workspace</i> to display only particular types of the objects .
<i>Select all</i>	Select (highlight) all objects for further operations on them. If only one or several objects of one group are selected in <i>Workspace</i> , the first run of this command will select all group objects, the second – all <i>Workspace</i> objects.
<i>Deselect all</i>	Reset any selection
<i>Invert selection</i>	Reset the current selection and select all other objects.
<i>Group / Un-group</i>	You can group a few objects in the workspace according to some feature. Select required objects, call the context menu by clicking RMB and select <i>Group</i> . You will see that the objects are wrapped with a common header (for example, <i>Group 1</i>), which can be changed as well as the object names (see below). It is possible to create subgroups within groups. Resumed scans are also grouped automatically during scanning. Each scan imported from Leo will be included in a separate group inside the project group. See also Actions with Groups .
<i>Rename</i>	Select an object by clicking LMB on its name, hit F2 and specify a new object name in the opened dialog window. You can also rename many objects at once: select multiple objects (as described above) and then use F2 or RMB to rename them.
<i>Duplicate</i>	To make a complete duplicate of an object in the <i>Workspace</i> , right-click on the object and then select <i>Duplicate</i> . A copy of the object will be created with the name like <i>Copy of Fusion 1</i> .
<i>Show</i>	Display the selected objects in the <i>3D View</i> section. See Selecting Scans and Models for details.
<i>Hide</i>	Do not display an object in the <i>3D View</i> section (cancel the <i>Show</i> operation).
<i>Lock frames</i>	Set the Locked frames status (🔒) to a scan, which blocks the reposition of the scan frames during Global Registration . See Locking Object's Position for details.
<i>Lock object</i>	Set the Locked object status (🔒) to a and object, which blocks its position while using various other tools. See Locking Object's Position for details.
<i>Unlock</i>	Remove the Locked frames and Locked object statuses from an object.
<i>Change color</i>	Call the color palette to change the color of an object or a group. See also Actions with Groups .
<i>Copy transformations</i>	Save the transformations of a scan and its frames for their further transfer to another scan. See Transferring Transformations for details.
<i>Unregister</i>	Reset the positions of individual frames in a scan computed during its registration. See Separating Scans for a use case.
<i>Delete</i>	Delete objects from your project.
<i>Upload to Cloud</i>	Upload fusions and models to cloud directly from Artec Studio. See Exporting Projects to Artec Cloud for more information.
Any column header	Sort the objects by either of their properties. Clicks: ascending order → descending → initial.

Figure 86: Filtering objects in *Workspace*.



7.4 Actions with Groups

In the *Workspace* panel you can perform the following actions with the groups of objects using the elements of the group header row:

Table 5: Actions with groups in the *Workspace* panel.

Action	How to perform
Select/Deselect	To select or deselect all objects in a group, click the group row in the column marked with ✓.
Set/Change group color	By default, the group color is not set (□). To set or change the color of a group, click the group row in the <i>Color</i> column area and select the desired color from the palette. When the group color is set and the group is collapsed in the <i>Workspace</i> panel, then all objects in the group are painted in the group color. Otherwise, each object is painted in its own color.
Unset group color	To cancel the color setting for a group, right-click the group row in the <i>Color</i> column area.
Lock	To lock or unlock all objects or frames in a group, click the group row in the <i>Lock</i> column area (🔒 or 🔓). See Locking Object's Position for details.

7.5 Selecting Scans and Models

To view a scan or model in the *3D View* window or to [process](#) it, you need to mark it with the ✓ icon in the *Workspace* panel. To navigate scans and models, use keys ↑ and ↓ or click an arbitrary area except those in ✓,  or color column (.

Purpose	Method	Alternate Method
Highlight an object in <i>Workspace</i> to view its properties or run a command from the context menu	Left-click on the scan name	—
Toggle visibility and availability for processing (flag ✓)	Left-click in the ✓ column	<ul style="list-style-type: none"> • Use the <i>Show</i> or <i>Hide</i> context-menu commands • Select the object name using Ctrl+Alt+LMB.
Batch selection (deselection) of objects for display and processing	Click ✓ in the rows of the required objects one by one	<ul style="list-style-type: none"> • Hit Ctrl+A (Ctrl+D) to select (deselect) all objects • Click LMB while holding Ctrl (Shift) to highlight a few objects and then hit Space • Click LMB on one of the ✓ flags and while holding down LMB, move the cursor through the other flags.
Select a single object for processing and deselect others	Select the object name using Ctrl+Alt+LMB	Use Ctrl+LMB in the empty area of the ✓ column

In addition to the methods in the table above, you can use commands from the context menu by clicking RMB on the objects.

See also:

The full list of [hot keys in workspace](#).



7.5.1 Selecting Frames

Double-clicking on the scan name (or using the *View frames* command in the context menu) opens a list of all the frames in that scan (see [Figure 84](#), right).

Manually selecting specific frames will make them (and only them) appear in the *3D View* window. Alternatively, to select a particular frame directly on the *3D View* window, without the need for manually browsing through the frames list, simply click **LMB** while holding the **Alt** key.

You can select frames in a number of ways:

- Click **LMB** on the frame name to select it while clearing other selections.
- Click **LMB** while holding the **Ctrl** key to select several frames at once.
- Click **LMB** while holding the **Shift** key to select a sequence of frames in the specified range.
- Click **Ctrl+A/Ctrl+D** to select/deselect all frames.
- Click **LMB** while holding the **Alt** key to select a frame directly from the *3D View* window. This will display only the selected frame in the *3D View* window.

To start a sequential frame demonstration, use the  button at the upper right of the *Surface list*. To stop the demonstration, click .

7.5.2 Object Properties

At the bottom of the *Workspace* panel, you can see a *Properties* panel. Click on it to expand it. Then select any object to display its properties. Depending on the selected object, its properties are displayed under the *Basic* and *Advanced* tabs.

In the *Advanced* tab, you can view details of a scan like number of *Polygons* or *Size* of the scan and *Scanner ID*.

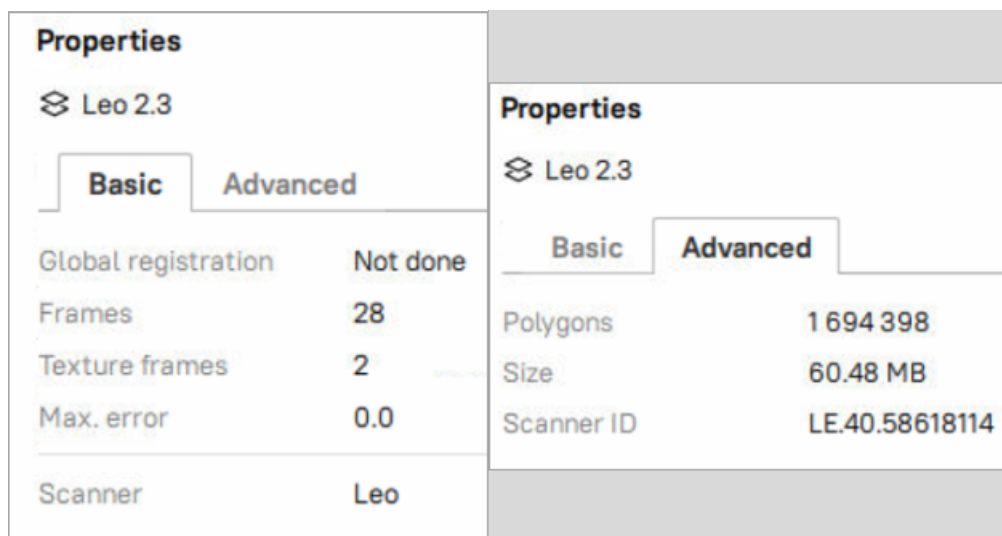


Figure 87: Basic and advanced object properties of a selected scan.

If no object is selected, the global settings of the project will be displayed in the *Properties* panel.

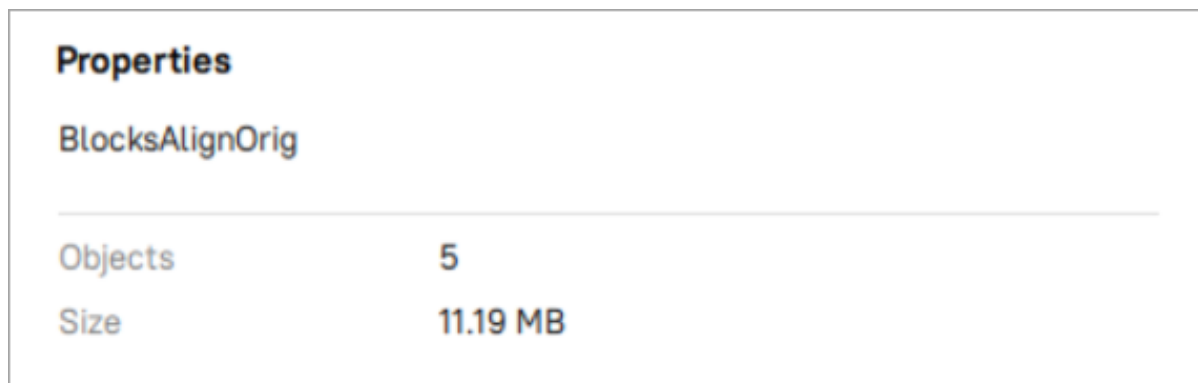


Figure 88: Project properties when no object is selected.

7.5.3 Features

By default the *Features* panel is located at the bottom of the *Workspace* panel near the *Properties* panel. Click on it to expand it. Then select one or more scans with the global registration applied and/or a reference target cloud to display the features of the captured targets.

See [Features Panel](#) for details. If no object is selected, the *Features* panel will be empty.

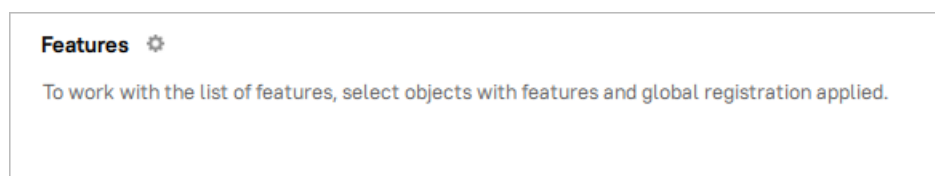


Figure 89: Features without a selected object.

7.5.4 Selecting a Point Cloud Scan

Point cloud scans contain only one surface. Click **LMB** on a point cloud scan and look at the *Properties* section:










PROPERTIES			
Ray Point Cloud			
Global registration	Not done	Sections	3
Mesh polygons	2.76 M	Size	32.80 MB
Points	2.15 M		

Figure 90: Properties of the point cloud scan.

Parameter	Description
<i>Global registration</i>	Shows whether the <i>global registration</i> procedure has been performed.
<i>Mesh polygons</i>	Since Artec Studio doesn't display all the points constituting the scan, you can only see a mesh obtained from a simplified copy of the actual point cloud.
<i>Points</i>	Total number of points in the point cloud.
<i>Sections</i>	When you scan with Ray, you may select particular regions (sections) to narrow down the actual scene. This parameter stands for the number of these regions.





7.6 Quick Toolbar

You can get access to the most frequently used tools for CAD and other objects using quick access *Quick toolbar*. The presence of tools on the *Quick toolbar* and their accessibility directly depends on the objects existing/being selected in your project.

Tool	Icon	Summary	Supported objects
Transformation		Allows to move, rotate, scale and mirror objects relative to the global coordinate-system axes. Same as <i>Editor</i> → <i>Transformation tool</i> .	All visible
Cross section		Creates a dynamically adjustable cutting plane.	Scans, Models, CAD objects, Point clouds.
Chamfer		Creates a transitional face between two adjoining object faces at a certain angle depending on set distances. Symmetrical/asymmetrical.	CAD objects.
Fillet		Creates a smooth, rounded transition between two faces of an object, based on specified distances. It generates a new face that smoothly connects the original faces and can be either symmetrical or asymmetrical.	CAD objects.
Draft		Modifies the angle of object face.	CAD objects.
Thickness		Adds thickness to object by offsetting faces inward or outward, or in both directions.	Models, CAD objects.
Move surface		Move the selected surface by a specified offset.	CAD objects.
Delete face		Delete one or more faces on CAD models.	CAD objects.
Deviation analysis		Calculates the deviation of two objects and assesses the result of the fitting and aligning geometry tools. Same as <i>Measures</i> → <i>Distance map</i> .	Models, CAD objects.

7.6.1 Cross section

To create a cross section,

1. Mark the ☒ checkboxes of desired object in the *Workspace* to which you would like to apply the *Cross section* tool on the *Quick toolbar*.
2. Click the Cross section () icon on the *Quick toolbar* to open the *Cross section* tool. The *Cross section* tool will open in a pop-up, which is draggable and can be located at any place in the 3D view window.
3. Select one of the available coordinate planes (YOZ , XOZ , XOY ). Once

the coordinate plane is selected, you will see the preview of a cross section.

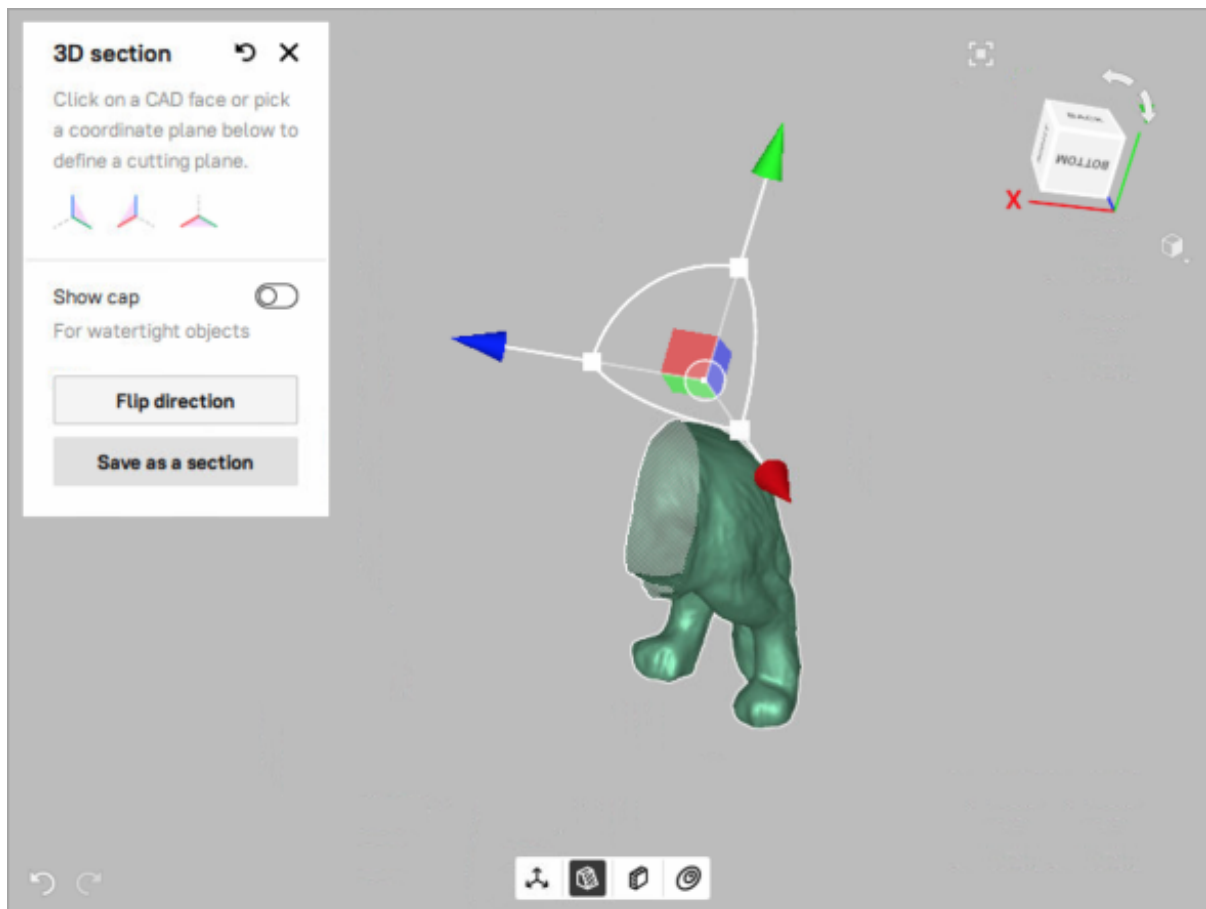


Figure 91: Cross section on YOZ coordinate plane.

Z-axis is always perpendicular to section.

To customize cross section,

- Move section along its normal (Z-axis) by clicking **LMB** on the arrow and dragging it.
- Flip the direction of cross section by clicking the *Flip direction* button

Note: Even after the cross section is generated, you can switch to another coordinate plane.

- To enhance visibility by filling section with color, toggle the *Show cap* switch on.

Keep in mind that showing caps is only available for CAD objects and models.

Apply changes by clicking on the *Save as section* button. Your saved section will appear on *Measures* panel along with other measures.

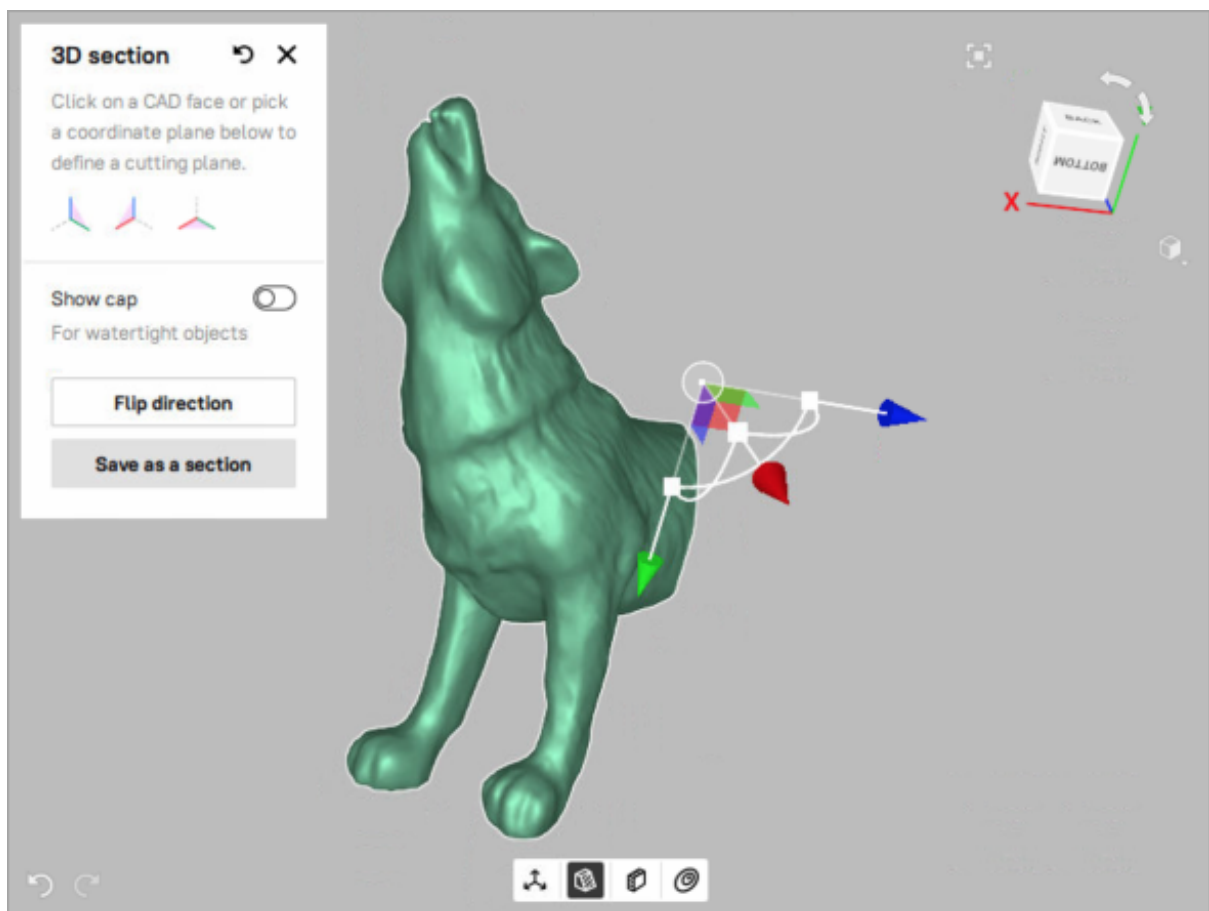


Figure 92: The flipped cross section on YOZ coordinate plane

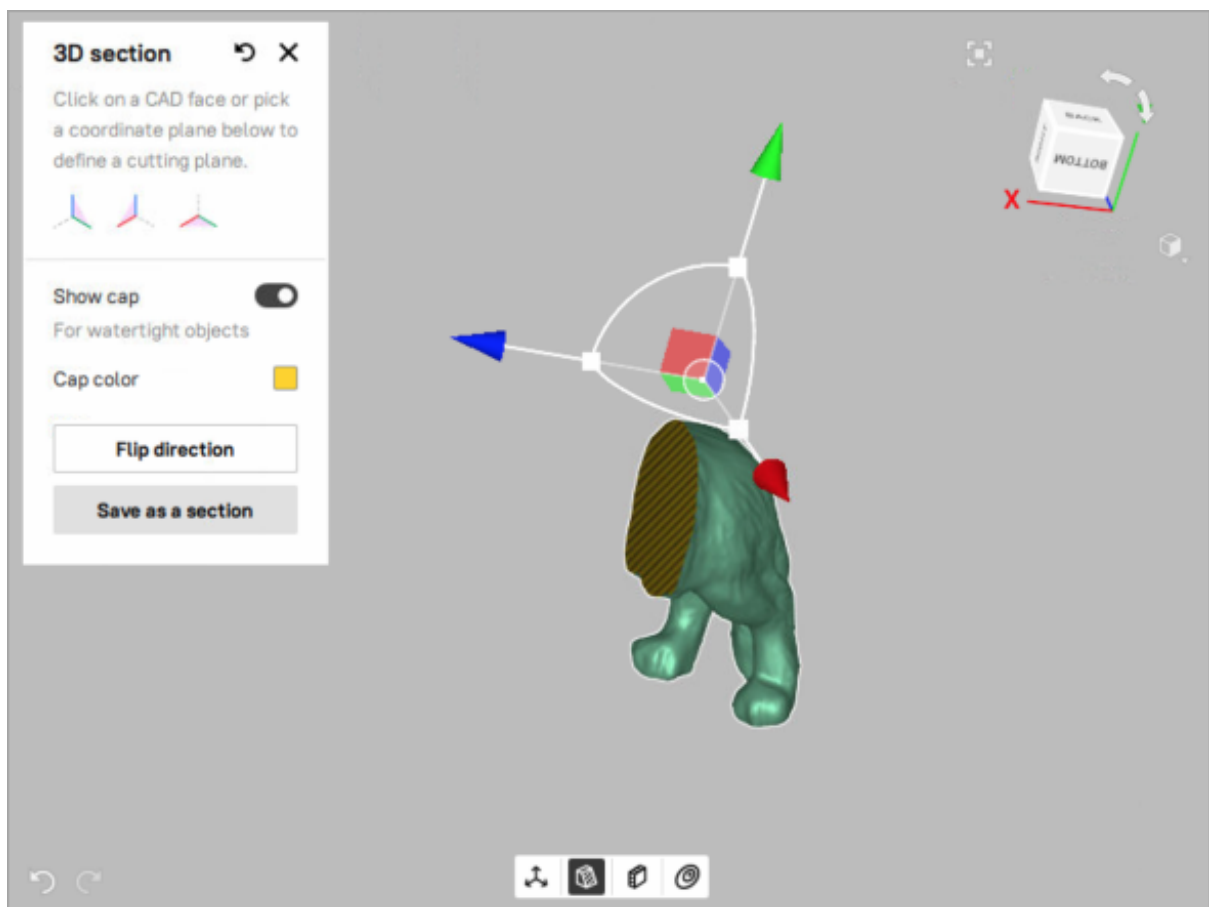



Figure 93: Cross section with colored cap.

7.6.2 Chamfer

To create a chamfer,

1. Mark the ☒ checkboxes of desired CAD object in the *Workspace* to enable *Chamfer* tool on the *Quick toolbar*.
2. Click the Chamfer () icon on the *Quick toolbar* to open the *Chamfer* tool. The *Chamfer* tool will open in a pop-up, which is draggable and can be located at any place in the 3D view window.
3. Click LMB on the desired edge of the CAD object. The hovered edge will be highlighted in yellow. Once it's selected, you will see a preview of the default chamfer.

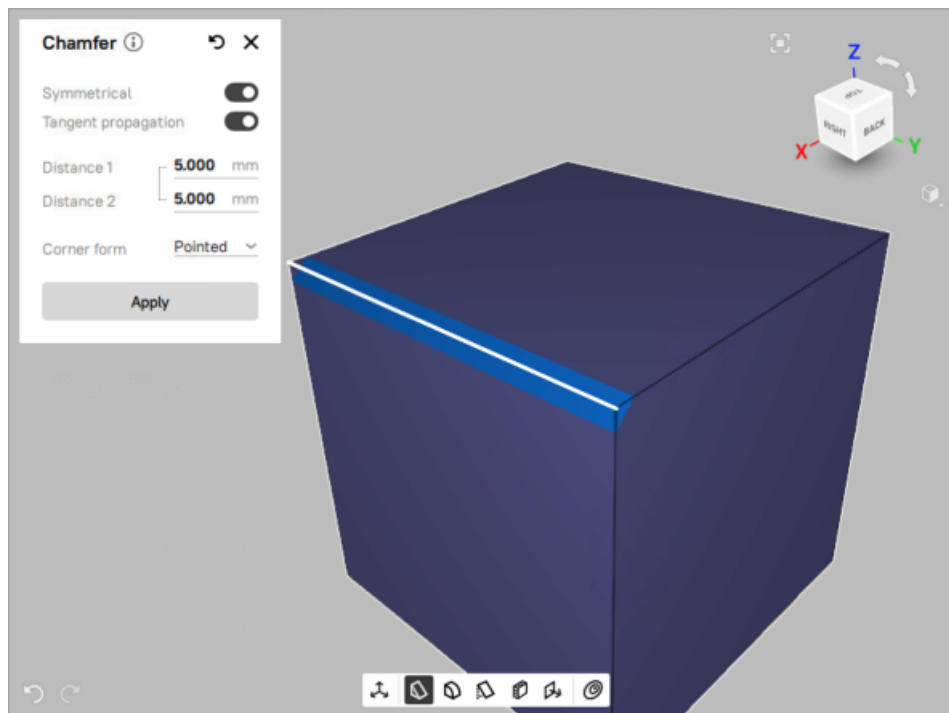


Figure 94: The default symmetrical chamfer at 45°angle.

To customize the created chamfer,

1. Set the value of distance from initial edge to the new edge on the first face to the *Distance 1* field. If the *Symmetrical* switch is toggled, the value entered in the *Distance 1* field will also be applied to the *Distance 2* field.
2. To make the created chamfer assymetrical, toogle the *Symmetrical* switch off and enter custom distances in the *Distance 1* and *Distance 2* field.
3. To adjust the shape of chamfer corner, try different values of *Corner Form* parameter
4. To spread the chamfer to the neighbouring edges that are smoothly connected, use *Tangent propagation* parameter
5. Apply changes by closing the *Chamfer* tool.

To reset your changes, click *Reset* icon (). All changes will be undone.

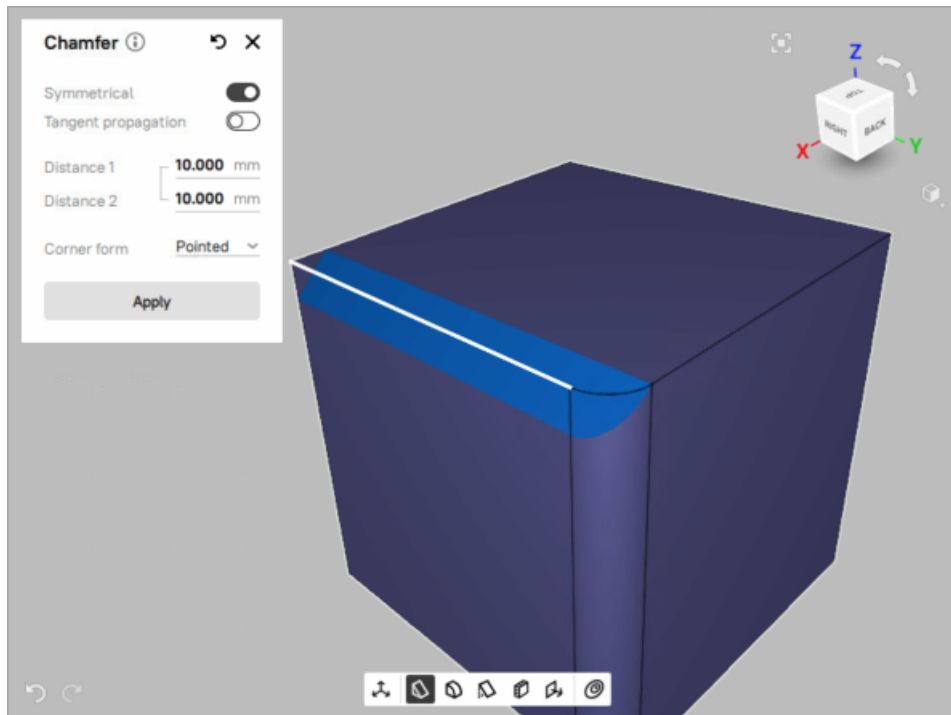


Figure 95: Chamfer with *Tangent propagation* parameter off.

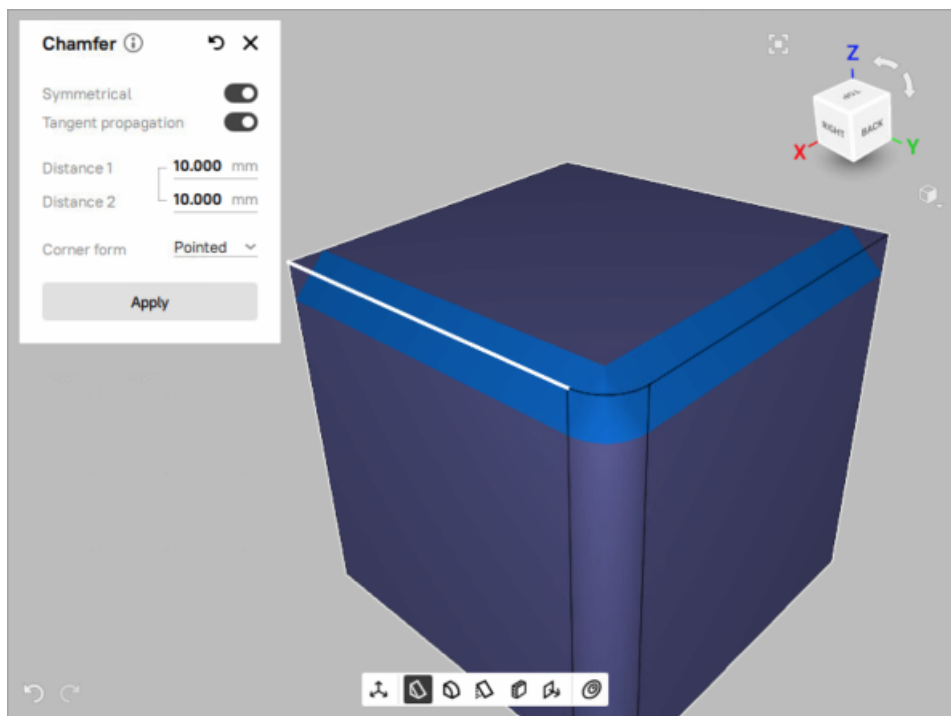




Figure 96: Chamfer with *Tangent propagation* parameter on

7.6.3 Fillet

To create a fillet,

1. Mark the ☒ checkboxes of the desired CAD object in the *Workspace* to enable the *Fillet*  tool on the *Quick toolbar*.
2. Click the Fillet () icon on the *Quick toolbar* to open the *Fillet* tool. The *Fillet* tool will open in a pop-up, which is draggable and can be located at any place in the 3D view window.
3. Click LMB on the desired edge of the CAD object. The hovered edge will be highlighted in yellow. Once it's selected, you will see a preview of the default fillet.

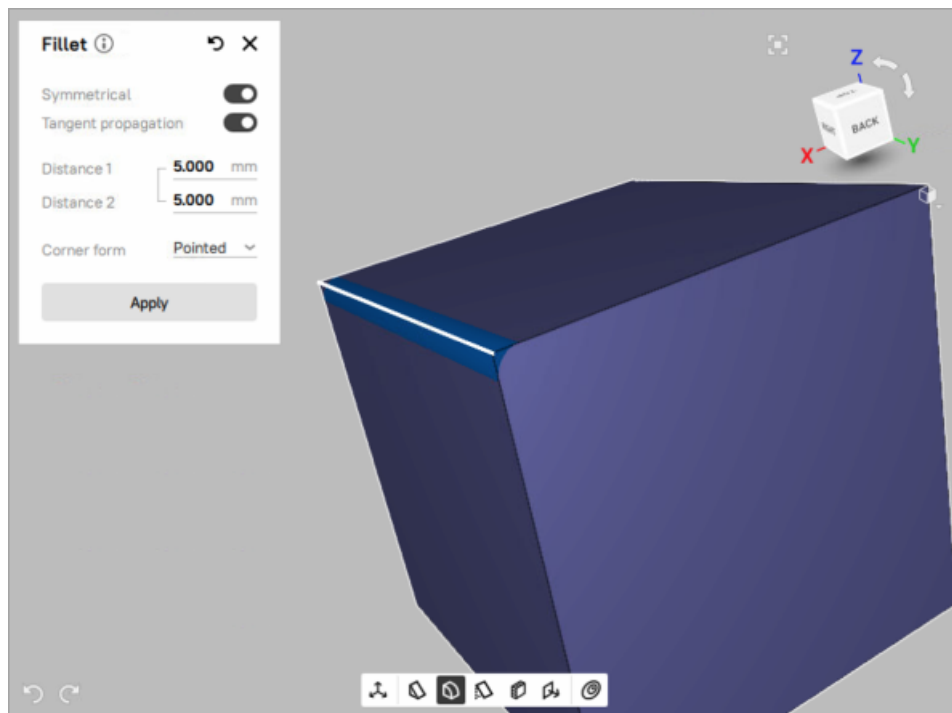


Figure 97: The default symmetrical fillet.



To customize the created fillet,

1. Set the value of distance from initial edge to the new edge on the first surface to the *Distance 1* field. If the *Symmetrical* switch is toggled, the value entered in the *Distance 1* field will also be applied to the *Distance 2* field.
2. To make the created fillet asymmetrical, toggle the *Symmetrical* switch off and enter custom distances in the *Distance 1* and *Distance 2* field.
3. To adjust the shape of fillet corner, try different values of *Corner Form* parameter.
4. To spread the fillet to the neighbouring edges that are smoothly connected, use *Tangent propagation* parameter.
5. Apply changes by closing the *Fillet* tool.

To reset your changes, click *Reset* icon (). All changes will be undone.

7.6.4 Thickness

To thicken an object,

1. Mark the ☒ checkboxes of the desired mesh or CAD object in the *Workspace* to enable the *Thickness*  tool on the *Quick toolbar*.
2. Click the Thickness () icon on the *Quick toolbar* to open the *Thickness* tool. The *Thickness* tool will open in a pop-up, which is draggable and can be located at any place in the 3D view window.
3. To adjust the thickness, set the desired value in either the Forward or the Backward field, or assign different values to both fields by turning off the Symmetrical switch.

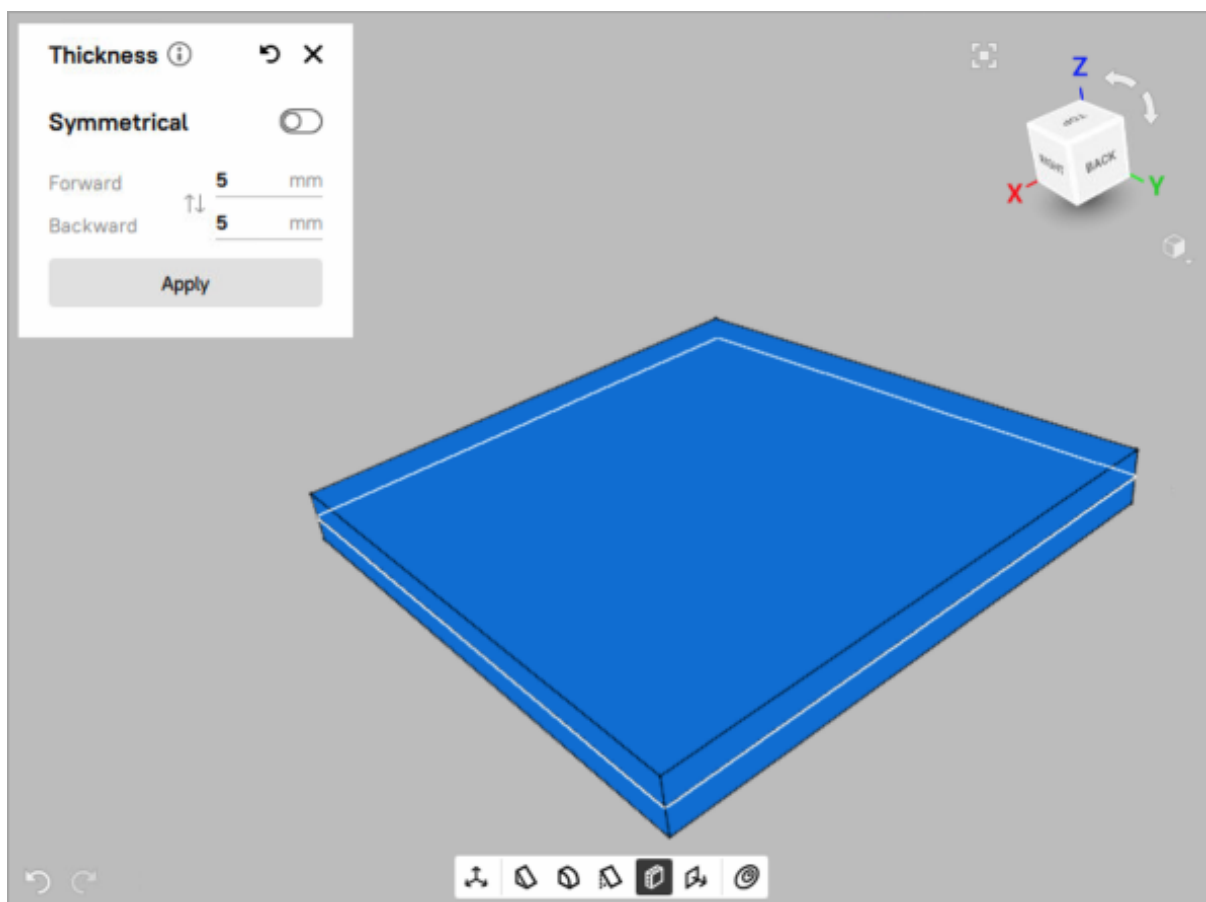


Figure 98: The *Thickness* tool with a 5mm forward and backward offset

7.6.5 Draft

To create a draft,

1. Mark the ☒ checkboxes of the desired CAD object in the *Workspace* to enable the *Draft* tool on the *Quick toolbar*.
2. Click the Draft icon on the *Quick toolbar* to open the *Draft* tool. The *Draft* tool will open in a pop-up, which is draggable and can be located at any place in the 3D view window.
3. Select one or multiple adjacent faces connected to the base for which the draft will be specified.
4. Set the draft angle in the *Angle* field.
5. Click the *Apply* button to save the created draft (see [Figure 99](#)).

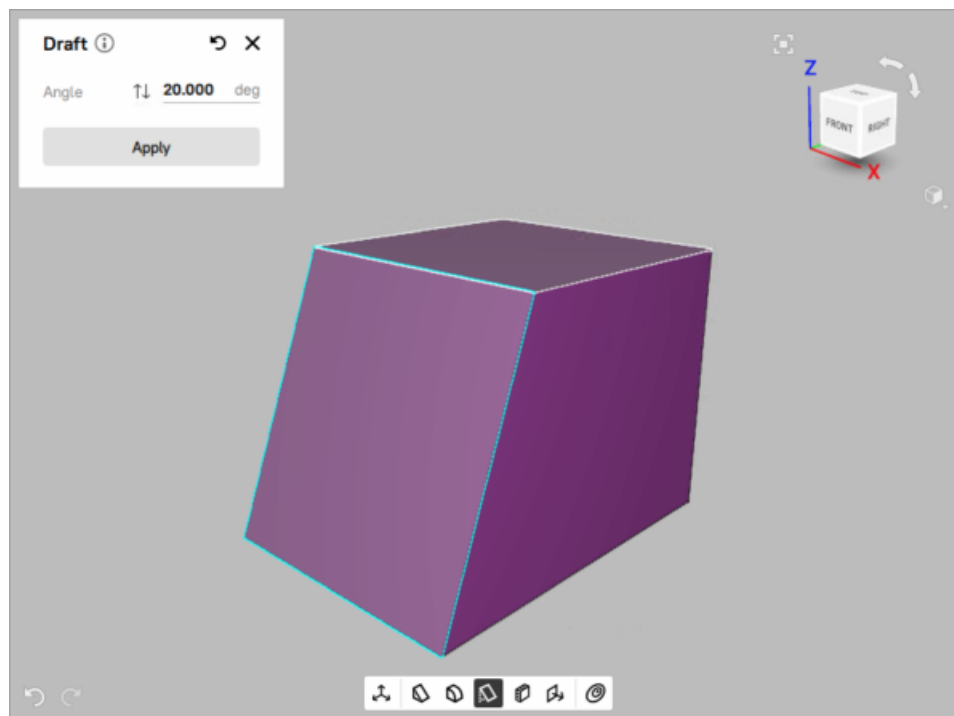





Figure 99: The created draft at 20°angle

To reverse the direction of the base surface, click the Reverse () icon in the *Draft* pop-up. The surface draft will be flipped.

7.6.6 Move surface

To move a surface of the selected CAD object,

1. Mark the ☒ checkboxes of the desired CAD object in the *Workspace* to enable the *Move surface*  tool on the *Quick toolbar*.
2. Click the *Move surface*  icon on the *Quick toolbar* to open the *Move surface* tool. The *Move surface* tool will open in a pop-up, which is draggable and can be located at any place in the 3D view window.
3. Select any face of the CAD object. Shift-click to select multiple faces.
4. Set an offset value to the *Distance* field.
5. Specify an offset axis (optional).
6. Click the *Apply* button to save changes. The face surface is moved.

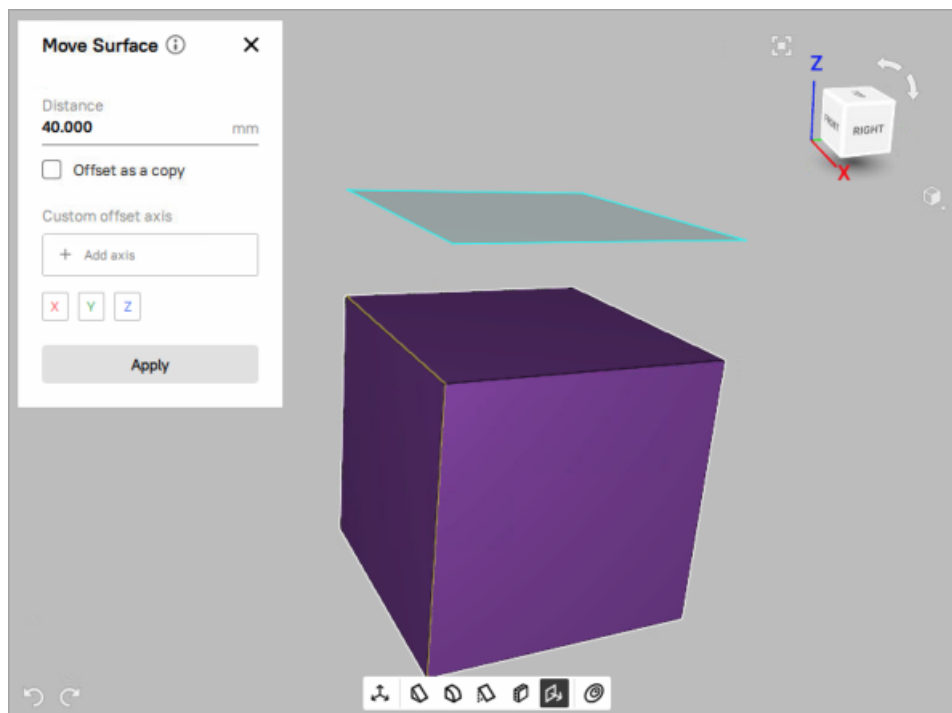




Figure 100: The *Move surface* tool with a 50mm offset - Not applied yet.

7.6.7 Delete face

To delete a face of the selected CAD object,

1. Mark the ☒ checkboxes of the desired CAD object in the *Workspace* to enable the *Delete face*  tool on the *Quick toolbar*.
2. Click the Delete face () icon on the *Quick toolbar* to open the *Delete face* tool. The *Delete face* tool will open in a pop-up, which is draggable and can be located at any place in the 3D view window.
3. Select any face of the CAD object. Shift-click to select multiple faces.
4. Choose between the *Leave hole* and *Try fixing hole* options. Depending on the selected option, the hole left in place of the deleted face will either remain as is, or Artec Studio will attempt to fix it.
5. Click the *Apply* button to save changes. The selected face is deleted.

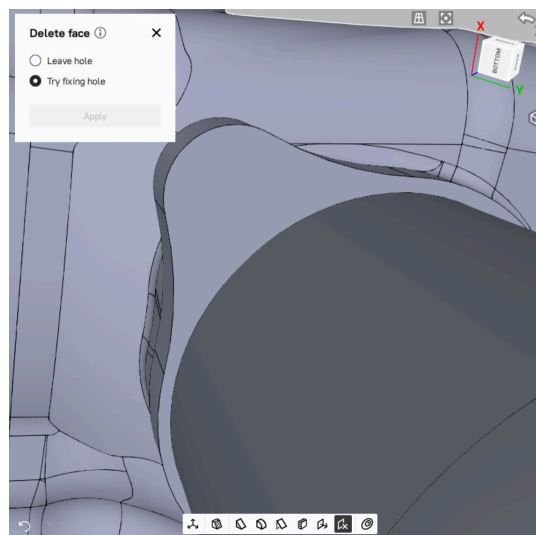


Figure 101: Deleted face with the fixed hole.

7.6.8 Deviation analysis

In Artec Studio there is a number of tools that fit the geometry of one object into another or align them:

- Fit all kinds of primitives
- Fit Freeform surfaces
- Best-fit
- Autosurface creation

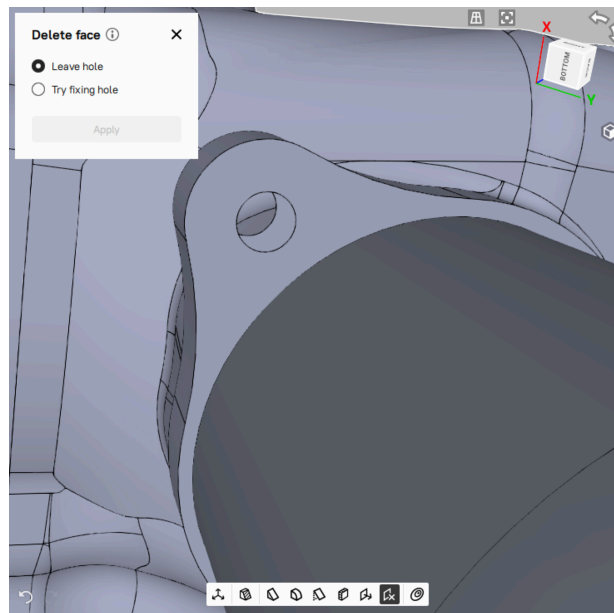





Figure 102: Deleted face with the left hole.

Deviation analysis tool calculates the distance map showing the deviation of the initial and fitted surfaces. Deviation analysis can be performed between CAD and model or two models.

To enable the tool,

1. Mark the  checkboxes of the desired CAD object and model, or two models in the *Workspace* to enable the *Deviation analysis*  tool on the *Quick toolbar*.
2. Click the Deviation analysis  icon on the *Quick toolbar* to open the *Deviation analysis* tool. The *Deviation analysis* tool will open in a pop-up, which is draggable and can be located at any place in the 3D view window.

Note: If you selected only one object, the *Deviation analysis* tool will be enabled, but you will see the text prompt to select at least two objects. If invalid objects are selected, *Deviation analysis* tool will remain disabled.

Once you've selected the valid objects for calculating the deviation, the algorithm will run automatically, the *Deviation analysis* pop-up will open.

By default, *Search distance* is 1 mm but you can also recalculate by entering a desired *Search distance* (in mm) value and click the *Recalculate* button. For more information about *Distance map* parameters, refer to the [Distance Maps](#) section.

See also:

The *Deviation analysis* tool is the same as *Measures* → *Distance map* and can also be performed in the Datum Alignment mode. See [Datum Alignment](#) for more details.

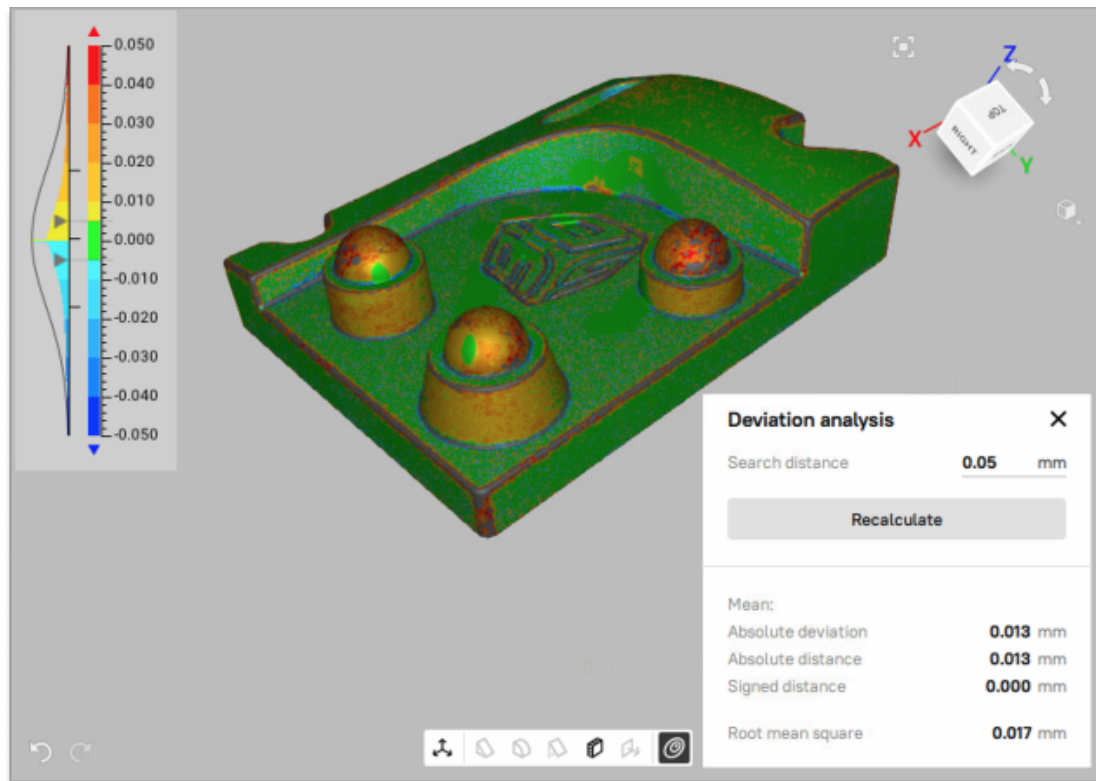


Figure 103: The *Deviation analysis* tool with calculated distance map

7.7 Memory Management: Smart RAM Usage

Working with a large data set requires a huge amount of RAM and you might often find it necessary to free up RAM without deleting any of the project data. While the previous versions of Artec Studio tackled this by making it possible for you to load or unload scans manually, the new Artec Studio 16 automatically optimizes RAM usage through smart memory management.

When you open a project, all the scans are preloaded into the RAM and displayed in the *Workspace*, which enables you to start working with them immediately. When you select one or more scans in the *Workspace*, Artec Studio will automatically load only the selected scans. If a particular algorithm or action requires any scans, the application will automatically load them into RAM too. Likewise, Artec Studio will automatically unload unnecessary scans, frames, textures or a combination thereof. This selective loading and unloading of data frees up extra RAM automatically.

Note: In addition to 3D data, the change history can also consume a large portion of memory. For information on how to control the history size as well as how to clear it, consult [Saving Project History](#).

VIEWING SCANS AND MODELS

8.1 3D Navigation

When you have finished scanning, Artec Studio displays the results in the *3D View* window.

8.1.1 Moving, Rotating and Scaling

You can control the observer's perspective in the *3D View* window by moving or rotating the observation point, or by zooming in or out. Use the mouse to control these effects.

Tip: You can also use 3D mouse to navigate 3D content (see [3D Mouse](#)).

8.1.1.1 Moving

Move the mouse pointer over the *3D View* window. Hold down the left (**LMB**) and right (**RMB**) mouse buttons simultaneously, then move the mouse to relocate the model. You can also use the middle mouse button to perform the same operation.

8.1.1.2 Rotating

To rotate around any possible axis, move the mouse pointer over the *3D View* window. While holding down **LMB**, move the mouse in the desired direction to rotate the model.

8.1.1.3 Flipping

To quickly rotate (flip) 3D data around a specific axis (or rather the axis perpendicular to the screen plane) in a specific direction, use the dedicated arc arrows (↶↷) near the navigation cube (see [Figure 107](#)) or the **O** key:

Using arrows

1. Click (**LMB**) one of the arrows (↶↷).
2. Still holding down **LMB**, move the mouse cursor in the direction of either of the arrows.

Using the **O** key

Press and hold the **O** key and drag the mouse cursor outside an imaginary ellipse that inscribes the *3D View* window.

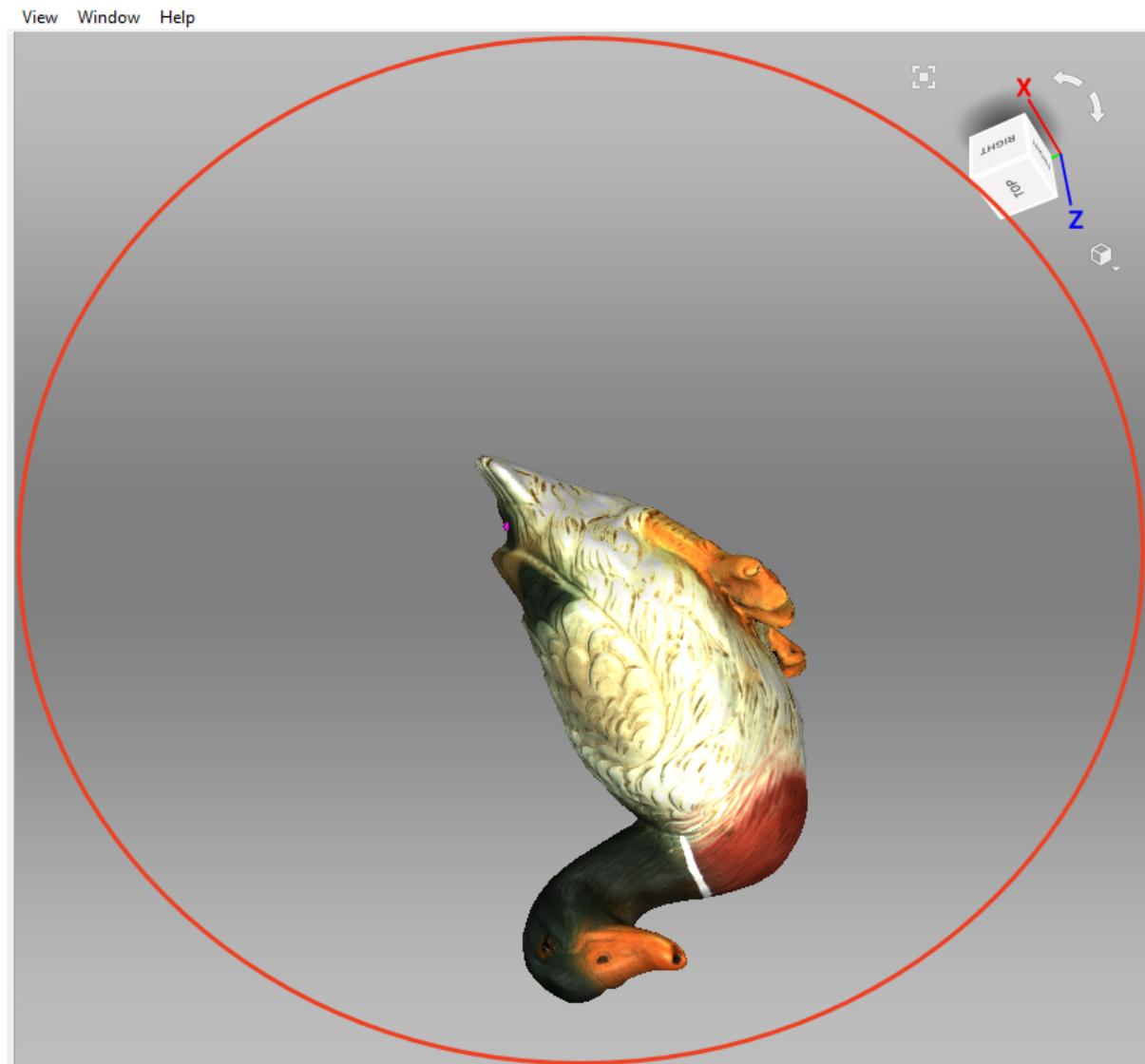


Figure 104: Imaginary ellipse inscribing the *3D View* window.

8.1.1.4 Zooming

Hold **RMB** and move the mouse. Moving left or up will zoom out, whereas moving right or down will zoom in. You can also use the mouse wheel to produce the same effect.

8.1.2 Global Coordinate System and Rotation Center

To enable or disable the global coordinate-system axes, select the *Show grid* option in the *View* menu or *Grid* in the *3D View* toolbar, or press **G**.

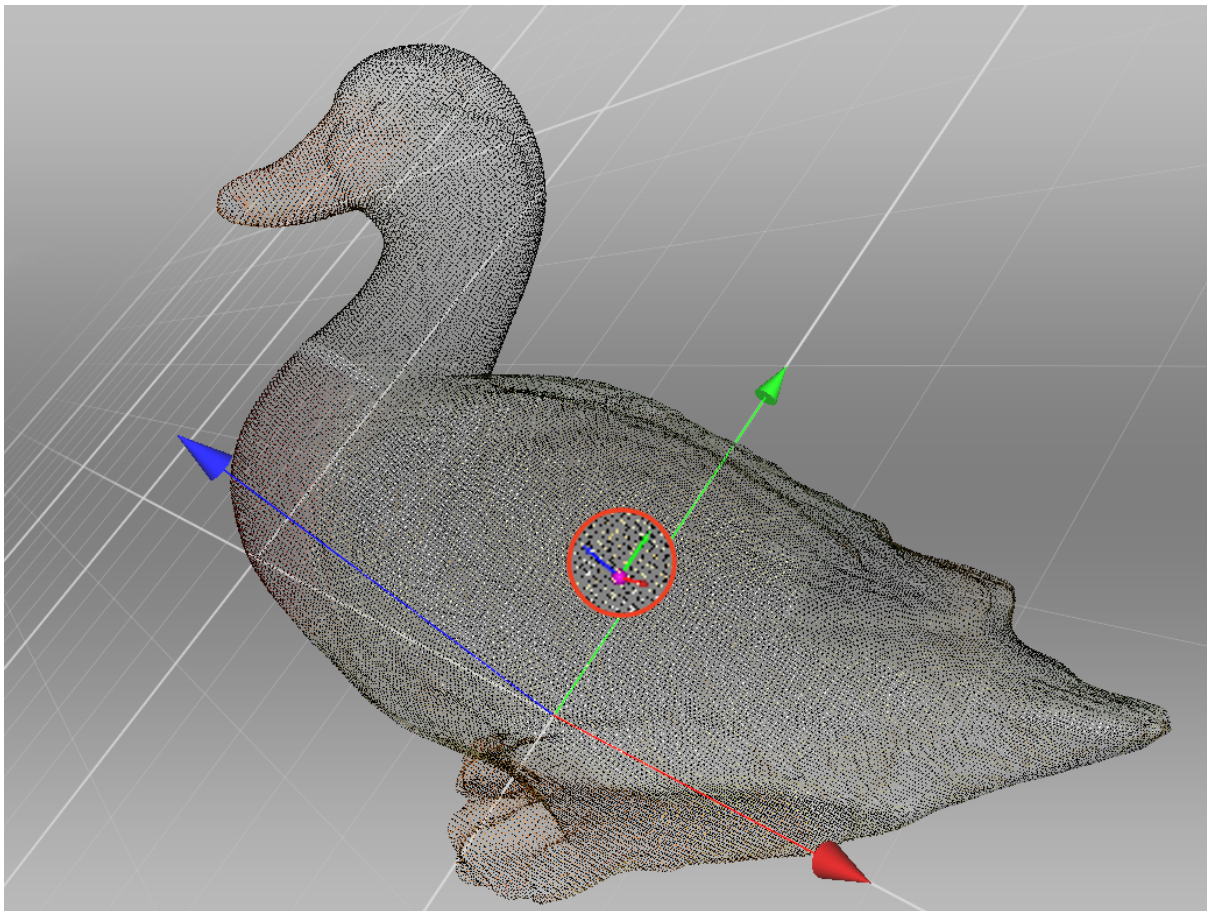


Figure 105: Custom rotation center.

When you rotate the model, the scene always turns around a certain point—the rotation center. By default, the rotation center coincides with the origin of the main axis grid. To change its location, double-click **LMB** at any point on the 3D model: the rotation center will move to this point. Setting the rotation center can be useful when you wish to view a particular object from all sides. Once it is set, rotate the view using **LMB**.

Artec Studio displays the rotation center as a small purple sphere with the three small coordinate axes (see [Figure 105](#)). If the rotation center coincides with the origin of the main axis grid, the purple sphere lacks small axes. If the rotation center hasn't been altered, it even lacks the sphere.

Application can set the rotation center to the center of mass of the object. Access the following menu command: *Edit* → *Cursor* → *Set to mass center*. To go back to the default state, select *Set to origin of axis grid*.

8.2 Choosing Projections

The *View* menu allows you to choose between perspective and orthogonal projections when displaying the model in the *3D View* window.

Perspective view is the central projection on a plane produced by direct rays that focus on one point: the projection center. This method produces a visual effect similar to human eyesight.

Orthogonal view is when the projection center resides infinitely far from the plane of projection; in this case, the projection rays are perpendicular to the observation plane. This method preserves parallel lines and is more commonly used for measurement (see [Measurement Tools](#) for details).

You can also change projection type in other ways:

- Hit `Ctrl+5` on the main keyboard
- Hit `5` on the extended numeric keypad (numpad)

8.3 Viewpoints

To quickly toggle a camera view between several predefined positions, use navigation cube, *View* menu or the keyboard combinations listed in [Table 6](#).

In comparison with the other ways, navigation cube provides more flexibility in orienting objects in the window. Apart from using labeled faces (*TOP*, *FRONT*, *LEFT*, etc.), cube allows one to orient scene to intermediate positions with the help of controls located on the edges and vertices (see [Figure 106](#)).

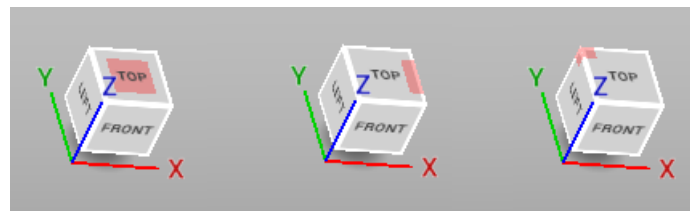


Figure 106: Navigation-cube controls (face, edge, vertex).

Table 6: Key combinations for switching viewpoints.

Viewpoint	Keyboard	Extended Numpad
Front	Ctrl + Shift + 1	1
Back	Ctrl + 1	Ctrl + 1
Right	Ctrl + Shift + 3	3
Left	Ctrl + 3	Ctrl + 3
Top	Ctrl + Shift + 7	7
Bottom	Ctrl + 7	Ctrl + 7

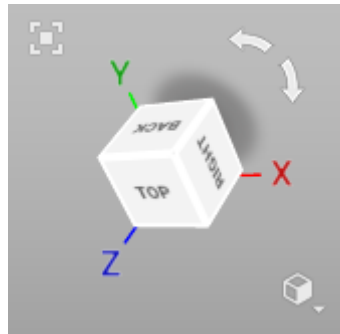



Figure 107: Navigation cube and arc arrows.


The *Home* command of the *View* menu or **H** keystroke restores the view to its original position.

The *Fit to view* menu option,  button or **F** keystroke automatically fits the object to the *3D View* window.

For point-clouds, you can have a look at scan from the Ray perspective. Open the right-click menu for this scan and select the *Go to scanner viewpoint* command to this end.

8.4 Displaying 3D Data

The toolbar on the right of the *3D View* window features controls for data-display modes.

If minimized, it can be opened by clicking button  in the *3D View* window (see [Figure 107](#)). All the commands for viewing and switching between modes are also available in the *View* menu.

8.4.1 Rendering and Shading Modes

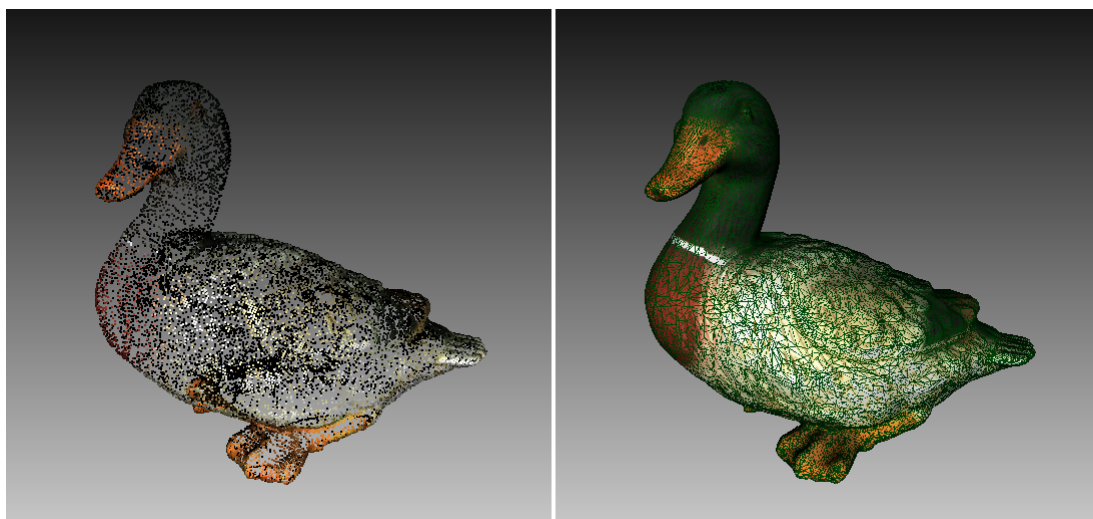


Figure 108: Examples of model using different rendering modes.
Point model on left and wire over solid on right.

Both the *View* menu and the *3D View* toolbar allow you to choose one of the following 3D rendering options for scanned frames:

Render solid the most common way to render with a solid fill on all faces using your selected shading method

Render wireframe display polygonal-mesh edges without applying a solid fill to the faces

Render points display polygonal-mesh vertices

Render wireframe over solid apply a solid fill to the faces and use a different color to display edges. This method enables you to visually assess the quality of the polygonal model (see [Mesh Simplification \(Tools, Mesh Optimization\)](#) for details).

Render points and solid automatically display scans in point view, but display models in solid-fill view. This mode eliminates the need to switch to another mode in order to find the best rendering approach for each surface type. It is enabled by default for the Artec Spider scanner.

For some examples of the various model-rendering modes, see [Figure 108](#).

To choose a shading method for the solid fill, use the *View* menu:

Smooth shading the color value for each point in a triangular face is calculated using color interpolation at the vertices

Flat shading all the points on a triangular face are assigned the same color

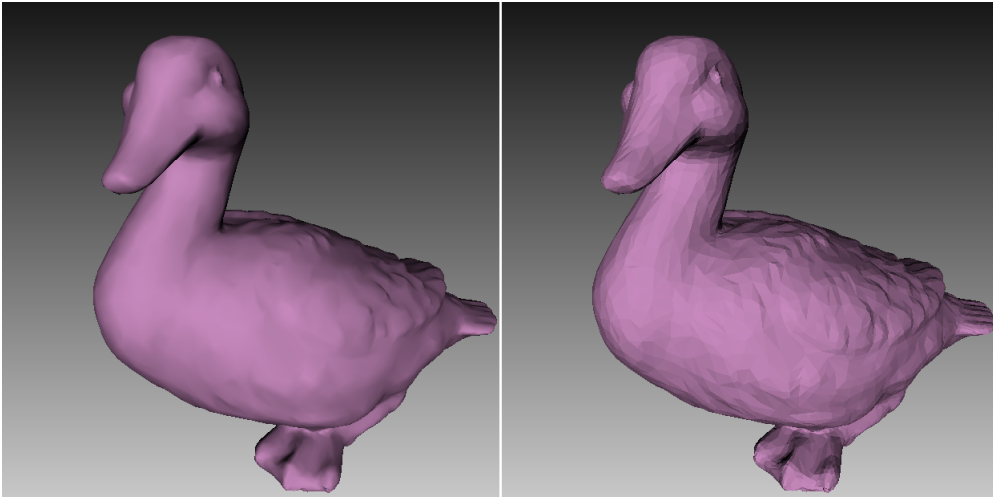

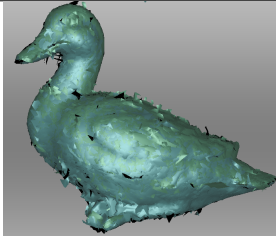
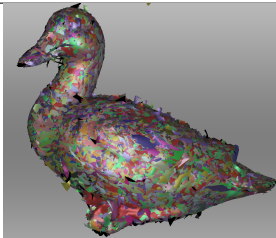
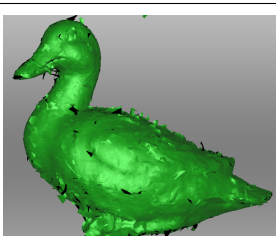



Figure 109: Smooth versus flat shading (respectively).

8.4.2 Color and Texture

The *Color* subgroup in the *View* menu or *Color mode* section in the toolbar list the methods for assigning colors to the surfaces in the *3D View* window:

<i>Texture</i>	displays textured data; otherwise, the software uses the scan's default color			Ctrl+Alt+1
<i>Scan color</i>	displays the default color of the scan; the figure depicts two scans			Ctrl+Alt+2
<i>Surface color</i>	displays each frame in a scan using a different color			Ctrl+Alt+3
<i>Max error</i>	colors the frames from Eva and Spider in accordance with their <i>registration quality</i> from green to red via yellow and orange; red indicates unacceptable values and registration errors			Ctrl+Alt+4
<i>X-ray</i>	beneficial for noisy data since it highlights only areas with high point density; it features a slider for adjusting its intensity			Ctrl+Alt+5

8.4.3 Lighting

The *Show* option under the *Lighting* subgroup in the *Scene settings* section or *Lighting* option in the *View* menu toggles the lighting in the *3D View* window. This option may be useful when you must turn the lighting off to see only the outline of the model or to assess texture quality.

Additionally, the *Directional* option under the *Lighting* subgroup in the *Scene settings* enables you to adjust the *Height* and *Azimuth* of the light source in the 3D scene. To do so, make sure the lighting is ON on the 3D View window, click on the *Directional* option, and adjust the sliders as desired.

[Figure 110](#) is an example of a model rendered with different Azimuth values.

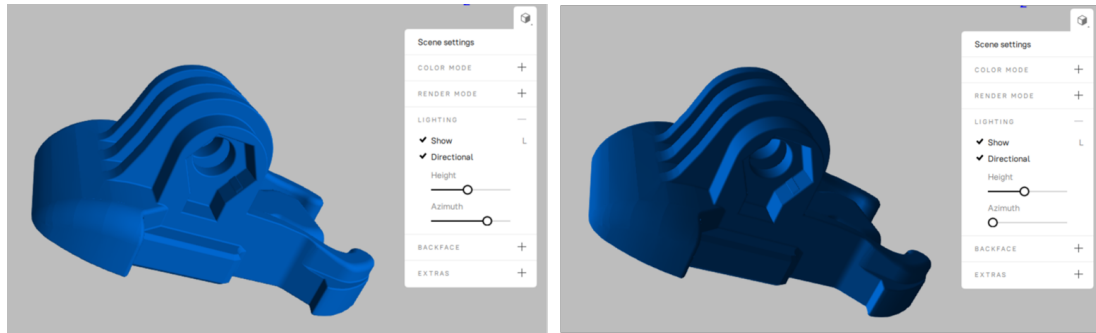


Figure 110: Adjust the light source in the 3D View window.

8.4.4 Backface Rendering

Artec Studio offers four methods for rendering a frame's backface:

Show assigns the backface the same color as the model. This display mode is useful when you want to correct geometric problems in a model by working with it from the inside.

Cull the backface is not displayed. This mode produces a very clear view when combined with the *X-ray* mode (see [Color and Texture](#) for details).

Black renders the backface in black. In this mode, it is easiest to distinguish between the front and back sides of the scanned surfaces.

Transparent renders the semi-transparent backface using a color that is slightly different from the front side of the corresponding surface. This mode allows you to view both sides of the scanned surfaces at the same time: those at which the scanner was aimed, and their backs. This is convenient for viewing scans of closed environments such as a room scan taken from the inside.

You can choose the mode from the *View* menu or from the toolbar in *3D View* window. See [Figure 111](#) for examples that illustrate the different modes of backface rendering.

The *Transparent* mode is the default one.

8.4.5 Rendering Object Outlines

To highlight the outlines of the object displayed in the *3D View* window, hover the mouse cursor over its name in the *Workspace* panel. This can be useful, for example, to distinguish between several scans of the same object when they are rendered in the *3D View* window simultaneously. The outlines are highlighted even through surfaces.

You can enable and disable the outlines highlighting on the *UI* tab of the *Settings* dialog.

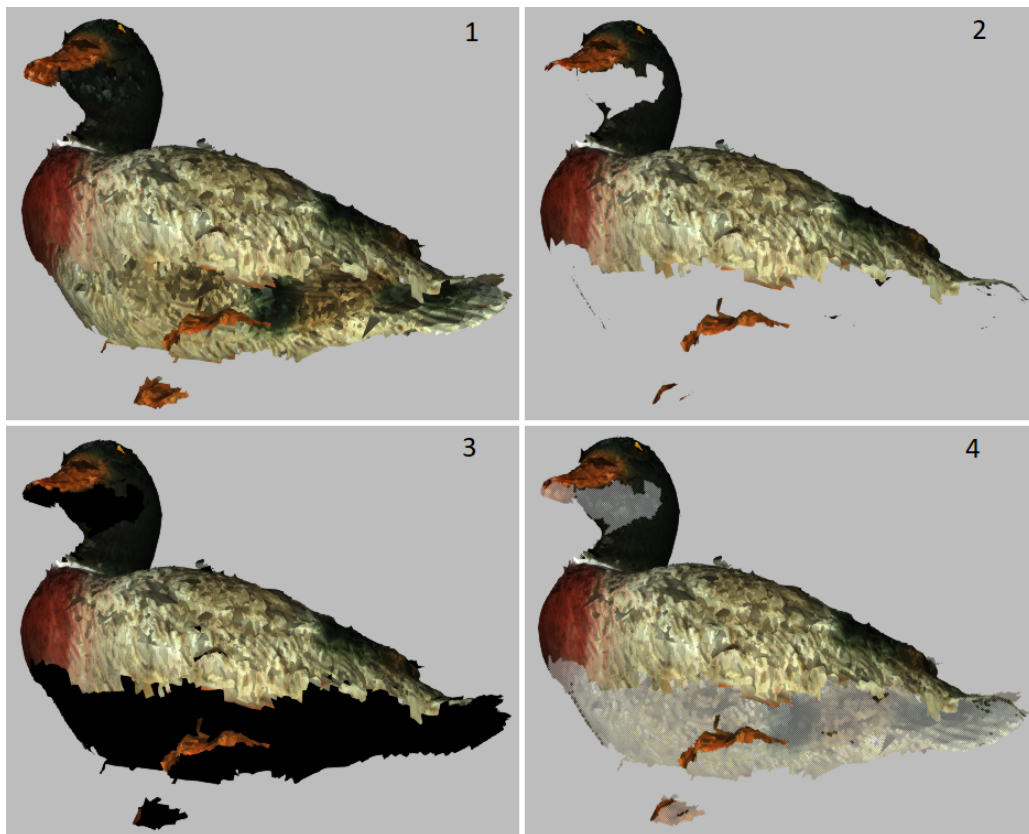


Figure 111: Examples of different modes of backface rendering:
1—*Show*, 2—*Cull*, 3—*Black*, 4—*Transparent*.

8.4.6 Representation of Normals and Boundaries

The *Show normals* option in the *View* menu enables or disables rendering of normals for each vertex. By default, the normals point away from the model surface and toward the 3D scanner. You can change this direction using the *Invert normals* command. You can also switch between modes for displaying normals by hitting the **N** key with the *3D View* window active.

When working with edges, the *Show boundary* feature in the *View* menu allows you to enable and disable highlighting of the model's edges. To toggle this feature, hit the **B** key with the *3D View* window active.

8.4.7 Rendering and Texturing Untextured Polygons

Textured models may have some untextured areas (for instance, the green area in the middle of [Table 7](#)). The *Render polygons without texture* option in the *View* menu allows you to toggle rendering of such areas.

If the texture of the imported model is smaller than the model itself, Artec Studio can wrap it to fill the untextured areas (see [Table 7](#)). The wrapping effect is similar to floor tiling or a repeating wallpaper pattern—that is, the texture repeats periodically. To activate this option, enable the *Wrap texture coordinates* option in the *View* menu.

Table 7: Rendering and texturing untextured polygons.

Options Enabled	Result
None	
<i>Render polygons without texture</i>	
<i>Wrap texture coordinates</i>	

8.4.8 Displaying Boundaries of Texture Atlas

Textures applied to 3D models are obviously two-dimensional. You may, however, want to see the boundaries of each texture patch on the actual 3D surface. Artec Studio can display a texture-atlas file, such as the the middle image in [Figure 176](#), with its boundaries highlighted (see [Figure 112](#)). Identifying the way in which the boundaries lie on the surface may, for example, help you determine whether you must simplify the model to get better texture application.

To enable boundary display, access the *View* menu and select *Show texture boundaries* or hit the `Shift+B` keys with the *3D View* window active. To disable this feature, make sure this menu command is unchecked.



Figure 112: 3D model with texture-atlas boundaries.

Technically, this command also works for textures produced by triangle methods, but it provides no usable information.

8.4.9 Specifics of displaying the textures of Leo scans

Leo allows you to obtain scans with a scanning depth of 2 m or even more. However, texture frames with a scan depth greater than 1.5 m (distance between the scanner and the scanned surface) may distort the actual colors of the scanned objects. For this reason, Artec Studio excludes the use of such texture frames for rendering the texture of final models. To warn you about such texture frames, Artec Studio displays them blackish on the scans in the *3D View* window.

8.5 Saving Screenshots

You can capture surfaces displayed in the *3D View* window and save them in a graphics file. Unlike the conventional system `Print Screen` command, this option saves only the contents of the *3D View* window and uses the specified background color (see [Background for screenshots](#) transparent, black or white). Screenshots taken while you are using the measurement tools will also contain your measurements and notes (see [Measurement Tools](#) and [Notes \(Annotations\)](#) for details).

Tip: When saving screenshots in *X-ray* mode, avoid using transparent background.

To capture a screenshot, follow this procedure:

1. Select the *Save screenshot...* option in the *View* menu, or hit `Shift+Ctrl+S`.
2. In the dialog, specify the destination folder and file name, then click the *Save* button. Artec Studio will save the file in `PNG` format.

Note: If you save a screenshot using an existing file name, Artec Studio will overwrite that file. Be sure to specify a unique name.

PROJECTS, SCANS, AND MODELS

A project encompasses all 3D data obtained by scanning and postprocessing that can be saved to disk and accessed for later use. In addition, it contains [command history](#) and [measurement](#) results. For each project, a corresponding folder contains all project data and an A3D project file.

Note: Please note that, the project data is stored as .sst files for versions 16 and above, and may not be accessible.

Artec Studio can display project statistics. It includes information on number of scans, surfaces (frames), polygons, vertices and UV coordinates. To access this data, call a right-click menu for any *Workspace* object and select *Project info*. If you want to collate data on the selected scans with the total numbers for the project, first mark the required scans using with the ✓ flag.

9.1 Creating Project

To start a new project, select the *File* → *New project* menu option. It is a best practice to [save this project](#) to a specific folder before you start scanning. If you start scanning with the *Save scans directly to disk* option enabled or import scans from Ray/Ray II, a temporary project is created in the Windows temporary folder or another directory if you specified one in [Settings](#).

9.2 Saving Project

Starting from version 16, Artec Studio automatically saves projects, and changes made to projects instantaneously. A newly created and yet manually unsaved project is automatically saved and stored in the default Temporary folder (see [Temporary Folder](#)). You can manually save the project in a preferred location using the *File* → *Save project as...* menu option or access it from the temporary folder as necessary.

9.2.1 Restoring Project

While working, if Artec Studio crashes due to unexpected reasons, then the next time you open the application, it will prompt you to restore the project. It is specifically applicable for projects that were not been manually saved (or in other words, that were still in the default temporary folder).

9.3 Opening Project and Scans

To open an existing project, use the *File* → *Open project* menu option or hit `Ctrl+O`.

Note: Artec Studio versions 16 and above do not support SPROJ files. Projects created with earlier versions in the SPROJ file format, must be converted to the A3D format to be compatible.

By default, when you open a project, the application will restore it to the state in which it was last saved.

Note: When Artec Studio opens a project, it will determine the amount of available memory. If the scan you are trying to load requires more memory than is available in your system, the application will process it as an “unloaded” scan.

9.3.1 Opening SPROJ file

In order to open an SPROJ file in Artec Studio (versions 16 and above), you will need to convert them to the A3D file format. On selecting an SPROJ file to open, Artec Studio will automatically prompt project conversion. Artec Studio will convert the selected project to A3D format and save it separately at the file location you specify. You will not lose your SPROJ project. The converted A3D project will, however, not contain the project's command history.

9.3.2 Opening Project from Leo

You can obtain projects from Leo via direct connection to the scanner or using an SD card installed in the device.

9.3.2.1 Connecting to Leo

1. Ensure that your Leo scanner and your computer are connected to the same network, and you authenticated using the same credentials
2. Click *File* → *Import* → *Leo project (connect to scanner)*
3. Wait for the application to show your Leo scanner. If no device is displayed or you are using a direct connection, follow the steps indented below:
 - a. Click *Connect by IP*
 - b. Specify IP address that you may find in Leo network settings
 - c. Click *Add*
4. Select the required scanner and click *Connect*
5. Then using either LMB or ↑ and ↓ select the project that you want to load ([Figure 114](#))

Note: You can import more than one project from Artec Leo at the same time, into a single Artec Studio project. To select multiple projects, use the shift key.

1. If the selected project contains HD raw data, you can import it by checking *Import raw data*.
2. To start HD reconstruction immediately after the import, perform the following actions:
 - a. Check *Launch HD reconstruction*.
 - b. Select the desired *Point density*, ranging from *Normal* to *Extreme* by adjusting the eponymous slider.

The *Point density* determines the number of polygons per frame that is used for reconstructing the scanned surfaces from the raw data. With 1× the number of polygons is of the same order as for the SD resolution and 64× corresponds to ~5 million polygons per frame. Increasing the *Point density* results in higher degree of resolution, coverage, and detail, but requires more memory and time for the HD reconstruction.

Important: If Artec Studio evaluates your computer's resources as insufficient for the selected *Point density*, then the warning is displayed that the HD reconstruction can take up to several hours on your computer. For information on resources requirements, see the *Using HD mode* section in [System Requirements](#).

3. Click *Import*.

If you have enabled the HD reconstruction, it will start immediately after the data uploading finishes.

Wait for scans to appear in the *Workspace* panel.

The imported projects and scans will be automatically grouped—the group with the project name will be divided into subgroups of scans (see [here](#) about grouping). The imported HD scans will have an “HD” mark in their names, for example: *Leo HD Scan 1*.

If the scans contain information on [supporting surface](#) and the [corresponding option](#) is enabled in *Settings*, Artec Studio will also launch base removal.

Note: You can import HD projects from Artec Leo multiple times with different values of *Point density*.

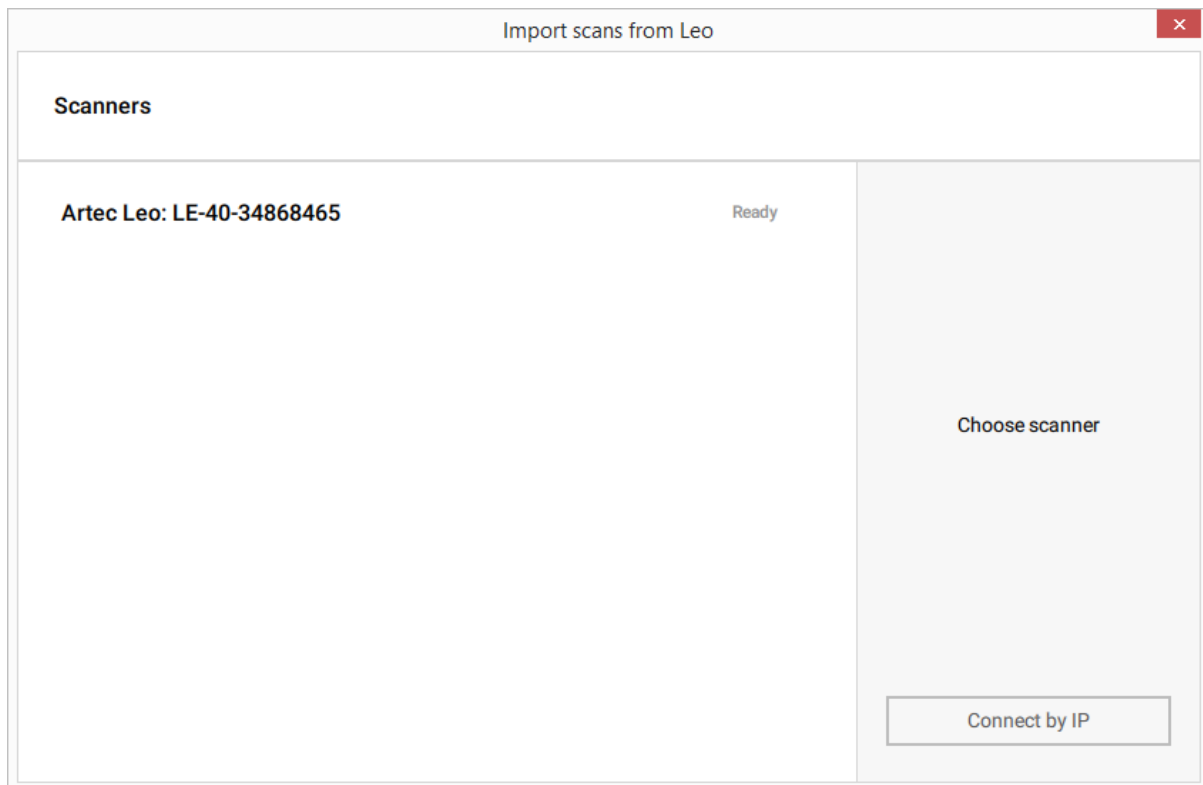


Figure 113: Scanner list and the *Connect by IP* button.

9.3.2.2 Using SD Card

If you want to open Leo scans without having to connect to the device, use the following method:

1. On Leo, first copy a project to SD card.
2. Then insert the card into the computer with installed Artec Studio.
3. Click *File* → *Import* → *Leo project*
4. Browse for the required project folder
5. Select the folder containing Leo project and click *Select folder*. Import will start.

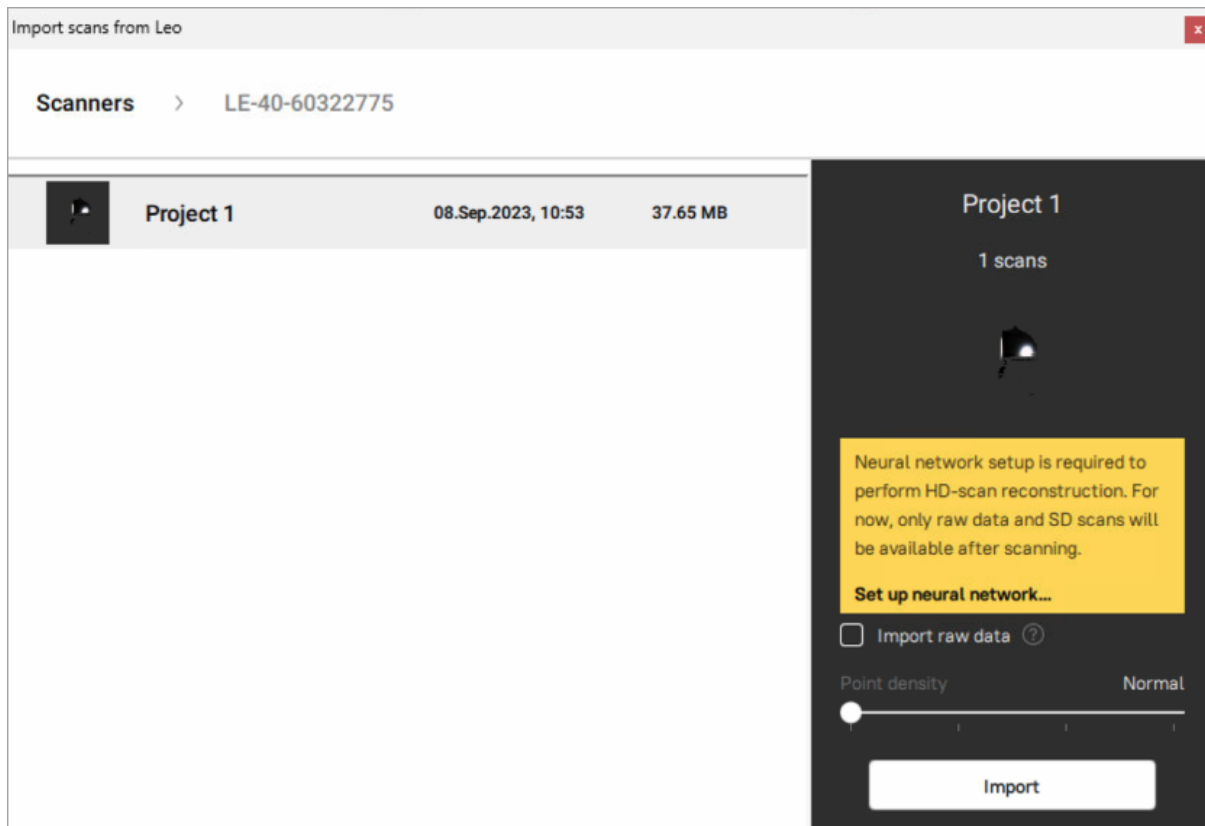


Figure 114: Dialog for selecting Leo projects to import.

Note: HD data from Artec Leo can be exported to an SD card with the .leo format.

9.4 Importing Models and Scans

Importing is another way to load data into Artec Studio in place of capturing or opening a project. You can import scan files created in earlier versions of the software, individual frames, point cloud data, as well as CAD models in the following formats:

SCAN	Artec 3D scan format
PLY	Stanford polygon file format
STL	Stereolithography file format
VRML	VRML file; actual extension is *.wrl
OBJ	Wavefront OBJ file format
PTX	Disney per-face texture mapping format
C3D	Artec Ray original point cloud
BTX	Artec Ray/Ray II point cloud
STEP, STP	(CAD format) Standard for the Exchange of Product model data
IGES, IGS	(CAD format) Initial Graphics Exchange Specification
X_T	(CAD format) Parasolid XT data format
SAT	(CAD format) Standard ACIS text format
E57	Point cloud format
RCP	Point cloud format
USD	Universal Scene Description (*.usda in text and *.usdc in binary format; *.usda/usdc via usdz zipped in an archive, also in binary or text format)

9.4.1 Importing Scans or Meshes

To import a file, use the *File* → *Import* → *Scans, meshes or point clouds* menu option or hit **Ctrl+I**. Next, select a file for importing. You can also drag and drop a file into the main Artec Studio window, or just double click on it.

Note: The import process runs in the background, so you can continue working with the scans you've already loaded. The progress indicator for the import operation will appear at the bottom of the main application window. To abort the operation, click *Cancel* in the bottom-right corner.

Artec Studio will import frame files as individual single-frame scans. After importing each scan, the application calculates the *key frames* for any scan that contains more than one surface. Also, the application will check the surfaces for defects when the appropriate setting is enabled (see *Surface-Consistency Detection During Import*). If it finds defects, it will show a dialog with a list of defective surfaces once the import operation is complete. You can then choose which ones should be corrected.

Note: When importing point clouds from an external source in e57 format, you will need to choose how Artec Studio interprets the data, especially if the file contains multiple segments.

1. *Import separately.* Choose this option if you want Artec Studio to treat each part of the imported file as an individual point cloud. This is useful if the file contains

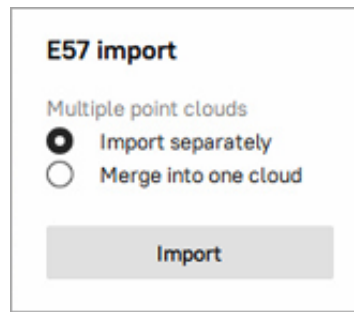


Figure 115: Dialog for importing point clouds in e57 format.

multiple distinct segments (such as separate hemispheres). After import, each segment will appear as a separate object in the *Workspace*, allowing for independent processing.

2. *Merge into one cloud.* Select this option if the data represents a single point cloud but has been divided into multiple parts. Artec Studio will merge these segments into a single point cloud object in the *Workspace*, processing it as one unified cloud.

9.4.2 Importing Ray II scans

To import Ray II scans, use the *File* → *Import* → *Ray II scans* menu option. Next, select a Ray II project (*.artec) file. You can also drag and drop a file into the main Artec Studio window.

Now, mark the checkboxes of the desired scans to import, and then click *Import* button.

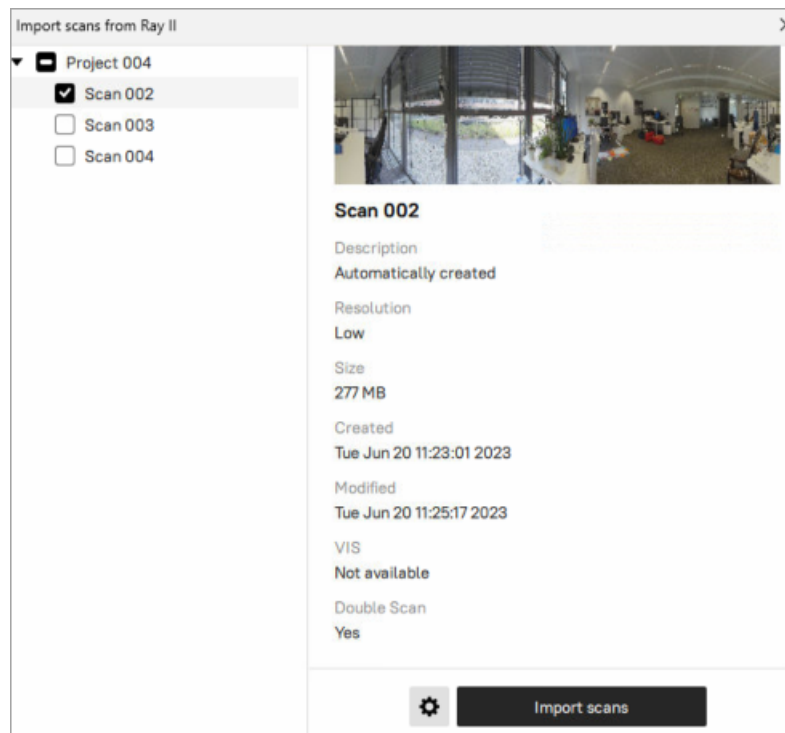
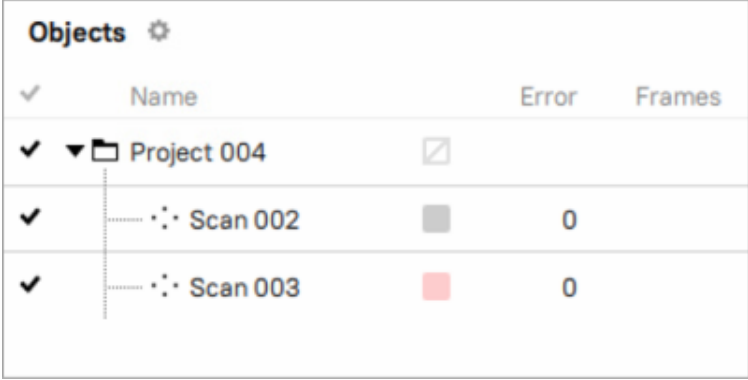


Figure 116: Dialog for importing Ray II scans from the selected project (*.artec).

Note: Wait until all selected scans are imported. Imported scans will appear in the *Workspace* panel.



The screenshot shows the 'Objects' panel with a table of imported scans. The table has columns for a selection checkbox, Name, a small icon, Error, and Frames.

✓	Name		Error	Frames
✓	▼ Project 004	☑		
✓	••• Scan 002	■	0	
✓	••• Scan 003	■	0	

Figure 117: Imported Ray II scans in the *Workspace* panel.

Spheres and checkerboard targets can be searched during import and later with the *Target Detection* tool in the *Tools* panel. Disabling the *Sphere targets* option of the import dialog will make the import faster.

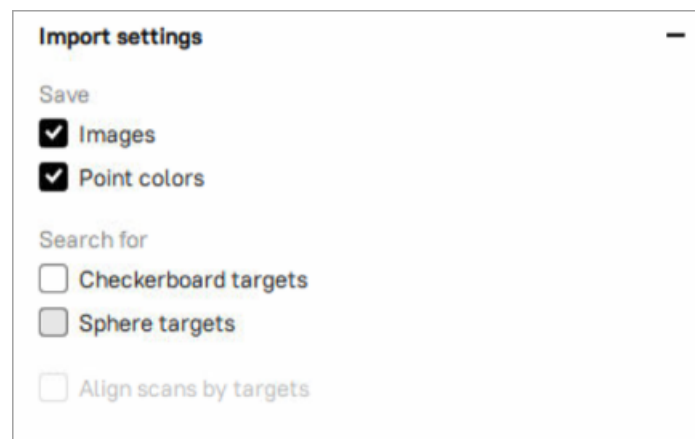


Figure 118: Import options

To detect spheres for further *Global registration* and *Alignment*:

- Mark the ✓ checkboxes of desired scan in the *Workspace*.
- Navigate to the *Tools* panel → *Target Detection*.
- Click the ⚙ icon.
- If searching for spheres, select the *Sphere targets* option and specify the spheres' diameters by entering the value in the *Diameter* field.
- If also searching for checkerboard targets, select the *Checkerboard targets* option.
- Click the *Run* button to apply *Target detection algorithm*.

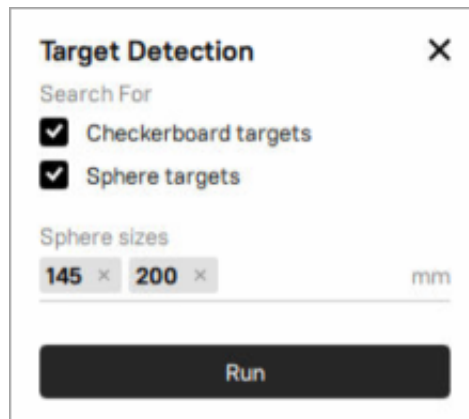


Figure 119: Target detection pop-up

9.4.3 Importing CAD models

You can import CAD models created in different CAD programs and saved to the following formats: STEP, STP, IGES, IGS, X_T, SAT.

To import a file, use the *File* → *Import* → *CAD models* menu option. Next, select a file for importing. You can also drag and drop a file into the main Artec Studio window, or just double click on it.

9.5 Exporting Models, Scans, and Point Clouds

When you want to store data for future processing, the best approach is to save the project as an A3D file or to export the data to the SCAN format. Any Artec Studio version can open the latter format. If you plan to use the data in other applications, however, you should save scans and individual frames in another format.

You may also need to perform one of the following tasks:

Export one or more scans	<i>File</i> → <i>Export</i> → <i>Scans</i> or use the <i>Export</i> option in the context menu	Doing so will save all frames to folders with names that match the corresponding scan names. An exception is the SCAN format; in this case, Artec Studio not only stores the frame-by-frame scan structure, but it does so in a single file.
Export a single surface	<i>File</i> → <i>Export</i> → <i>Meshes</i> or use the <i>Export</i> option in the context menu	It works for models. If you, however, marked several scans, models or frames using the ✓ button, Artec Studio will suggest merging them.
Export one or more point clouds	<i>File</i> → <i>Export</i> → <i>Point clouds</i>	It supports point cloud scans from both Ray/Ray II and external sources.

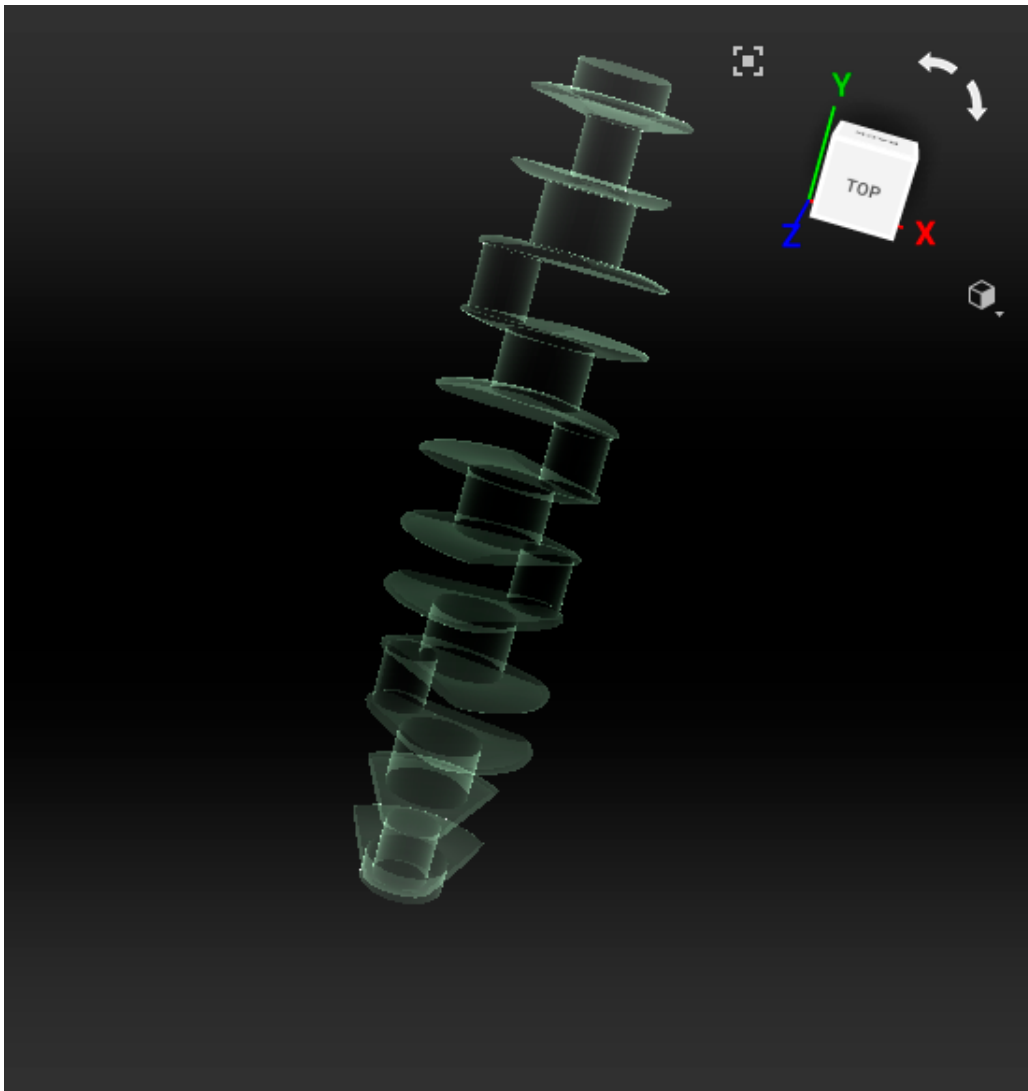



Figure 120: Imported CAD model.

9.5.1 Exporting Scans

To export scans:

1. Mark any scans you want to export using the  button.
2. Right-click and select the *Export* → *Scans* option, or select the *File* → *Export* → *Scans* command.
3. Click the ... button to open and specify the destination folder.
4. Select *Scan export format* using the eponymous dropdown list.
5. If the selected format supports textures, also specify the texture format.
6. Select the *Apply transformation* checkbox, or leave it cleared (for more information, consult [Understanding How Artec Studio Applies Transformations](#)).
7. Click *OK*.

ply	Stanford polygon file format
stl	Stereolithography file format
obj	Wavefront OBJ file format
wrl	VRML file; actual extension is *.wrl
x	Direct X file format
scan	Artec 3D scan format
obc	OBC point-cloud file

Note: The export process for models and scans runs in the background, so the application will allow you to continue working with the scans. The progress indicator for the export operation will appear at the bottom of the main application window. To abort the operation, click *Cancel* in the bottom-right corner.

9.5.1.1 Understanding How Artec Studio Applies Transformations

Artec Studio offers two options for exporting surfaces:


1. Store surfaces using the scanner coordinates and create *XF* text files that contain the coordinates calculated during registration. To use this approach, clear the *Apply transformations* checkbox.
2. Store surfaces that are relocated to the positions calculated during registration. In this case, *XF* files contain no relevant data. To use this approach, select the *Apply transformations* checkbox.

9.5.2 Exporting Meshes (Models)

9.5.2.1 Exporting Meshes to File

You can export a single model (mesh) or multiple models at a time. Models can be merged before export or exported separately.

To export a mesh or multiple meshes:

1. Mark one or more models using  or select frames in the scan by clicking on them while holding the `Ctrl` key.
2. Right-click and select the *Export* → *Meshes* option, or go to the *File* → *Export* → *Meshes* command. A dialog window will appear ([Figure 121](#)).

Tip: `Ctrl+Shift+E` hot key does the same.

3. Click ... and specify the destination folder.
4. Use one of the following options for file names:
 - Leave the field blank to use the names of the corresponding models from the *Workspace* panel.
 - Enter a custom export name. If you're exporting multiple meshes, this name will be used as a base. For example, if you enter 'Model', the exported files will be named *Model1*, *Model2*, and so on.
5. Select the appropriate mesh format from the *Model export format* dropdown list¹ (see the description of available formats below).
6. If the model has texture and the selected mesh format supports it, choose an appropriate texture export format from the corresponding dropdown list (see [Storing and Exporting Color Information](#) for details).
7. To merge the models into a single mesh before exporting, select the *Merge models* checkbox. Otherwise, each model selected in the *Workspace* panel will be exported to a separate file.
8. To move the models to origin before exporting, select the *Move to origin* checkbox.
9. Click *OK*.

¹ If you type an extension in the file name field, application will use it rather than the selected mesh file format.

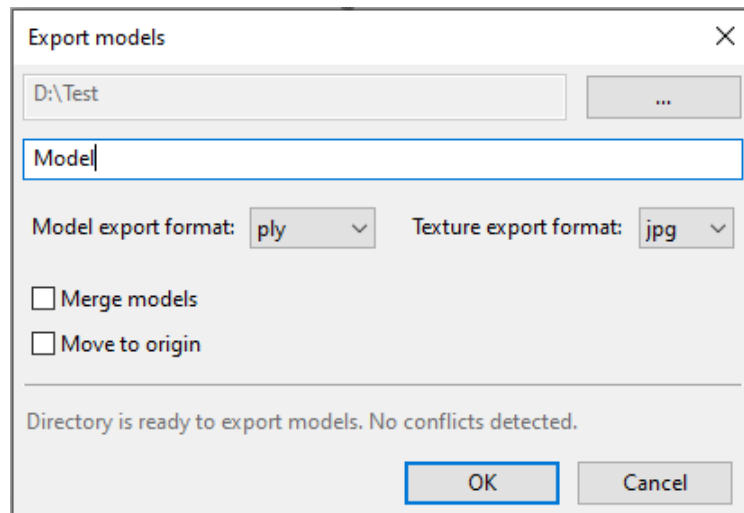


Figure 121: Dialog for exporting meshes.

PLY	Stanford polygon file format (standard and with the support for vertex color)
STL	Stereolithography file format
VRML	VRML file (1.0 and 2.0); actual extension is *.wrl
OBJ	Wavefront OBJ file format
ASC	Point cloud 3D format
AOP	American Academy of Orthotists and Prosthetists file format
PTX	Walt Disney Ptex: mesh with per-face texture mapping
X	Direct X file format (binary or text)
Custom Text File Format	Custom Text file format
E57	ASTM E57 3D file format (with the support for vertex color)
USD	Universal Scene Description (*.usda in text and *.usdc in binary format; *.usda/usdc via usdz zipped in an archive, also in binary or text format)

See also:

[Model Placement](#)


9.5.2.2 Uploading Meshes to Artec Cloud

- To upload a fusion that is currently open on Artec Studio, select the fusion, go to *File* → *Export* → *Fusion to Artec Cloud*. Alternatively, right-click on the fusion in the *Workspace* panel, and select the *Upload to Cloud* option from the drop-down menu.

9.5.3 Exporting CAD objects

You can export CAD primitives created in Artec Studio to the following formats: STEP, IGES, X_T.

To export CAD primitives:

1. Mark one or more CAD object using flag  or *Workspace* menu commands.
2. Select the *File* → *Export* → *CAD objects* command.
3. Specify the destination folder, enter the file name, and select the appropriate format from the dropdown list.
4. Click *Save*.

9.5.4 Exporting Point Clouds

You can export point cloud scans obtained from Ray and imported from Ray II to either of the following formats (respective units are given in the third column):

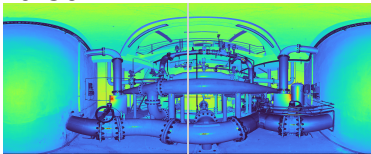
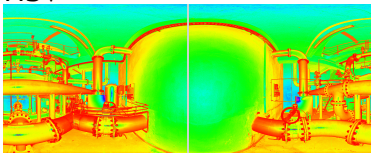
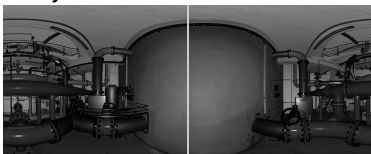
E57	Artec Ray/Ray II and external point clouds	Meter
RCP	Artec Ray/Ray II and external point clouds	Meter
PTX	Leica PTX Important! Don't confuse it with Disney Ptex .	Meter
Custom Text File Format	Custom Text file format, raw point clouds from Artec Point	Specified in settings
BTX	Artec Ray/Ray II point cloud; various versions (v2, v3, v5, v6).	Micron

1. Mark one or more point cloud scans using ✓ flag in *Workspace*. Ensure that you have selected a point cloud scan by double-clicking its name: the panel must show point cloud properties.
2. Select *File* → *Export* → *Point clouds*.
3. Specify the destination folder and required format and click *Save*.
4. Depending on the selected format, adjust the export settings (See [Export Settings for Point Clouds](#)).

9.5.4.1 Export Settings for Point Clouds

Note: When exporting to PTX, ensure the *Export point clouds to PTX with merged sections* in the *General* tab of *Settings* is selected. This option merges all sections (selections made during scan with Ray scanner) so that third-party software products can open the exported file.

Setting	Description	Supported Formats
Minimum range	Sets the minimum distance from the scanner. Points closer than this value are not exported.	RCP, Leica PTX, Custom Text File Format
Maximum range	Sets the maximum distance from the scanner. Points farther than this value are not exported.	RCP, Leica PTX, Custom Text File Format
Minimum intensity	Sets the minimum intensity (reflection) value. Points with lower intensity are not exported.	RCP, Leica PTX, Custom Text File Format
Maximum intensity	Sets the maximum intensity (reflection) value. Points with higher intensity are not exported.	RCP, Leica PTX, Custom Text File Format

Setting	Description	Supported Formats
Color by intensity	Applies color to points based on intensity values. Useful for point clouds without color, allowing clear visualization using three color schemes: Turbo, HSV, and Gray.	E57, RCP, Leica PTX, Custom Text File Format, BTX
Colormap	<p>Defines the color scheme for intensity-based coloring. Available options:</p> <ul style="list-style-type: none"> Turbo  HSV  Gray  	E57, RCP, Leica PTX, Custom Text File Format, BTX
Noise filter	<p>Defines the color scheme for intensity-based coloring. Available options:</p> <ul style="list-style-type: none"> Minimal: Preserves maximum points Medium: Filters out isolated points not part of a surface or object Aggressive: Keeps only points that clearly belong to a surface or object 	RCP
Decimation	When enabled, keeps only one point per specified cubic volume (in mm). Lower values increase point density and file size.	RCP
Keep intensity	Keeps points with intensity data.	BTX
Keep color	Keeps points with color data.	BTX

Setting	Description	Supported Formats
Compatibility with Design X	Makes exported point clouds compatible with the Geomagic Design X software.	BTX

9.5.5 Exporting Projects to Artec Cloud

Artec Cloud is an easy-to-use collaborative platform that makes your 3D scan data available to you and your team, anywhere.

The Artec Cloud interface is now integrated into Artec Studio. You can view, download and upload projects and fusions in Artec Cloud, directly via Artec Studio. This enables you to quickly share your projects, without any external devices or without the need to open Cloud in a browser. It is possible to upload projects stored in your PC, upload newly acquired meshes, generate sharable links and automatically create Artec Cloud accounts, that are free to use.

To open and view projects in your Artec Cloud account, open *Home* panel → *Artec Cloud*. Each project contains its status info on the preview image. To upload a new project from your PC, navigate to the *Recent* tab in the *Home* panel, click on the upload (📁) icon of the desired project, and then click on the *Upload* button. If you're a first time user of Artec Cloud, the window prompts you to create a free account.

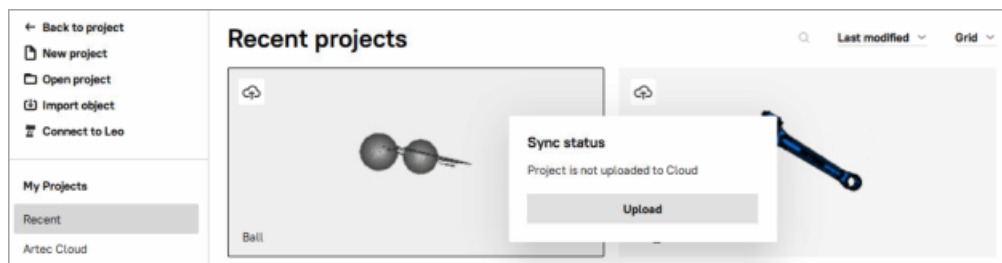


Figure 122: Upload a project from Artec Studio to Artec Cloud

Once uploading completes, the project preview image will have the uploaded (☁️) icon. To sync the shared project between Artec Studio and Artec Cloud, you have three following states:

- *Project updated locally* - click on the synchronize (🔄) icon to upload local updates of the project to Artec Cloud. You can review changes by clicking the *Review changes* button. *Review changes* modal will display the list of changes made with this project in Artec Studio.

To upload changes to Artec Cloud, click the *Upload to Cloud* button.

- *Project updated in Artec Cloud* - click the cloud icon (☁️), and then click the *Check*

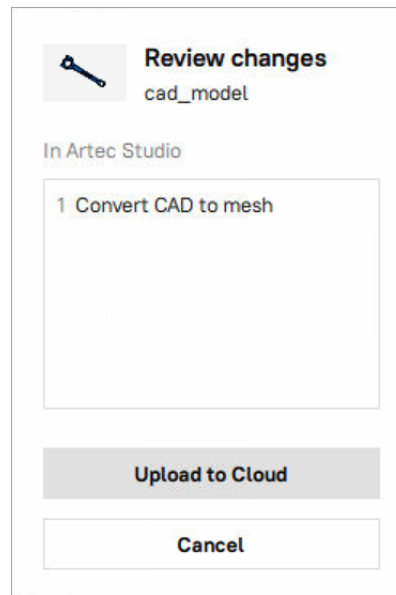



Figure 123: Review changes before uploading them to Artec Cloud

updates button. Once checking updates completes, you can review updates by clicking the sync icon () , and then clicking *Review changes* button.

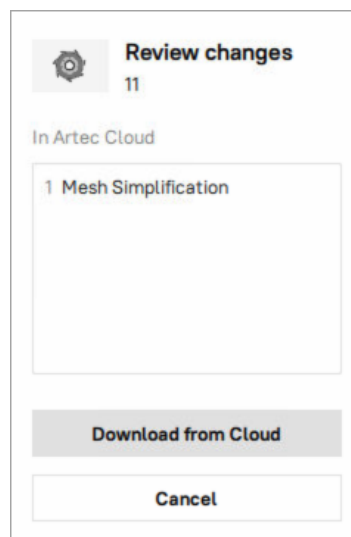



Figure 124: Review changes before downloading from Artec Cloud

To download changes from Artec Cloud, click the *Download from Cloud* button.

- *Project updated both locally and in Artec Cloud* - click the sync icon with a dot () . Sync popup will show you how many changes have been made in Artec Studio and Artec Cloud. Click the *Review changes* button to see the difference.

Here you have the following options to resolve conflict:

- *Get changes from Cloud* - All changes made in Artec Studio and not uploaded to Artec Cloud will be overwritten by those from Artec Cloud.

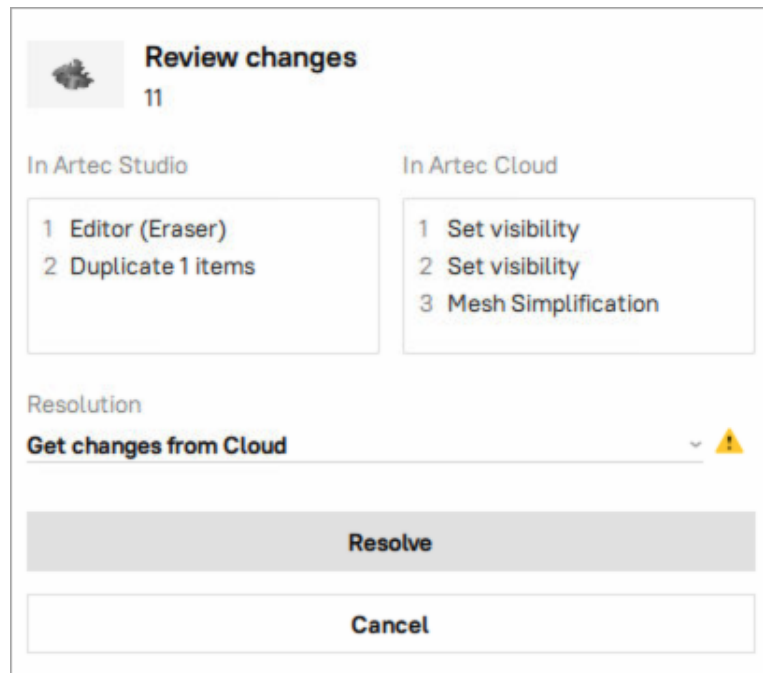


Figure 125: Review changes made either in Artec Studio and Artec Cloud

- *Upload changes to Cloud* - All changes made in Artec Cloud and not downloaded from there will be overwritten by those from Artec Studio and uploaded to Artec Cloud.
- *Split changes into two projects* - A copy of the conflict project will be created and displayed in the *Recent projects* tab, the original project will get all changes from Artec Cloud. From now on, these are two separate projects.

Alternatively, you can click the *Resolve conflict* button on the Sync popup instead of reviewing changes in detail. There, you can select the same options for resolving conflict described above.

9.5.6 Special Aspects of Scan Placement

In most cases, when exporting a scan to a common 3D graphics format (for example, XF), you should select the *Apply transformations* checkbox. This ensures that third-party applications display the surfaces the same way as Artec Studio does: that is, with the origin at the center of mass. If, for some reason, you need to store a scan in the scanner's coordinate system—in other words, with the surfaces positioned at a distance from the origin corresponding to the scanner's operating range—clear the *Apply transformations* checkbox.

Technically, Artec Studio saves scans in the scanner's coordinate system, but it displays them in a user-friendly manner by placing the origin at the center of mass. The actual positions of surfaces calculated during registration are stored in text (XF) files. Therefore, when importing files using Artec Studio, it makes no difference whether the checkbox was cleared when Artec Studio exported them. It does make a difference, however, for third-party applications that cannot read XF files simultaneously with 3D geometry.

9.5.7 Storing and Exporting Color Information

You can transfer color information for 3D surfaces in three ways. The most common is through a texture using a separate bitmap file (see [Applying Texture](#)). Another option is to save color information in each vertex of a mesh. The third is to assign a small textured fragment to each polygon. The two latter methods produce no texture files.

Colors stored in a vertex are blended throughout the polygon. As a result, you should avoid oversimplifying the exported mesh; otherwise, colors blended over a large face may fail to render true texture information.

Table 9: Formats that support color-information transfer.

Texture stored as a bitmap	PLY, VRML (*.wrl), OBJ, X, USD
Model file contains separate texture for each face	PTX
Formats that support vertex color	plyVC, Custom Text File Format, E57

When exporting texture as a bitmap image, you can select one of the following formats: PNG, BMP or JPG. PNG format provides the best quality for a given file size thanks to its lossless image compression. JPG is the most compact format.

9.5.8 Exporting Target Coordinates

If you scan while in the *Targets* tracking mode [using only Artec scanners](#), you can save an OBC file containing the target coordinates. Once you finish scanning, run *Global registration*, then do the following:

1. Use the ✓ button to mark any scans that you captured without having uploaded an OBC file.
2. Select the *File* → *Export* → *Scans* command.
3. Click the ... button to open and specify the destination folder.
4. Select *obc* from the *Scan export format* dropdown list.
5. Click *OK*. The `targets.obc` file will appear in the folder you specified.

For more information on the OBC file structure, consult the [FAQ](#).

9.5.9 Exporting to Third-Party Software

9.5.9.1 Exporting to Leios

Artec Studio enables you to export files to *Leios* by accessing the *File* menu if the *Leios* software is already installed on your computer.

1. Select a model in the *Workspace* panel
2. Open *File* → *Export to Leios*
3. Then, in *Leios*, select millimeters as the length unit for the imported files.

9.5.9.2 Exporting to Geomagic Design X

Polygonal models created in Artec Studio are insufficient for most design needs. Geomagic Design X (formerly Rapidform XOR) is purpose built to create manufacturing-ready CAD model's directly from meshes.

To export a model,

1. Make sure Geomagic Design X is installed on your computer
2. In the *Workspace* panel, mark one model using the ✓ flag
3. Select the *Export to Design X* command from the *File* menu
4. Wait for the model in OBJ format to open in the reverse-engineering system.

9.5.9.3 Exporting to SolidWorks

Artec Studio allows you to export models, CAD primitives and cross-sections to SolidWorks. You can export CAD primitives, cross-sections and models directly to SolidWorks without any third-party plug-ins. It is also possible to export one or multiple objects into a single file in SolidWorks.

To export objects,

1. Make sure SolidWorks is installed on your computer
2. In the *Workspace* panel, mark one or more objects using the ✓ flag
3. Right-click and select the *Export to Solidworks* option from the context menu
4. Alternatively, use the *Export to SolidWorks* command in the *File* menu
5. Wait for the selected objects to open in the CAD system as one single file
6. In order to export each object as a separate instance, export them one by one

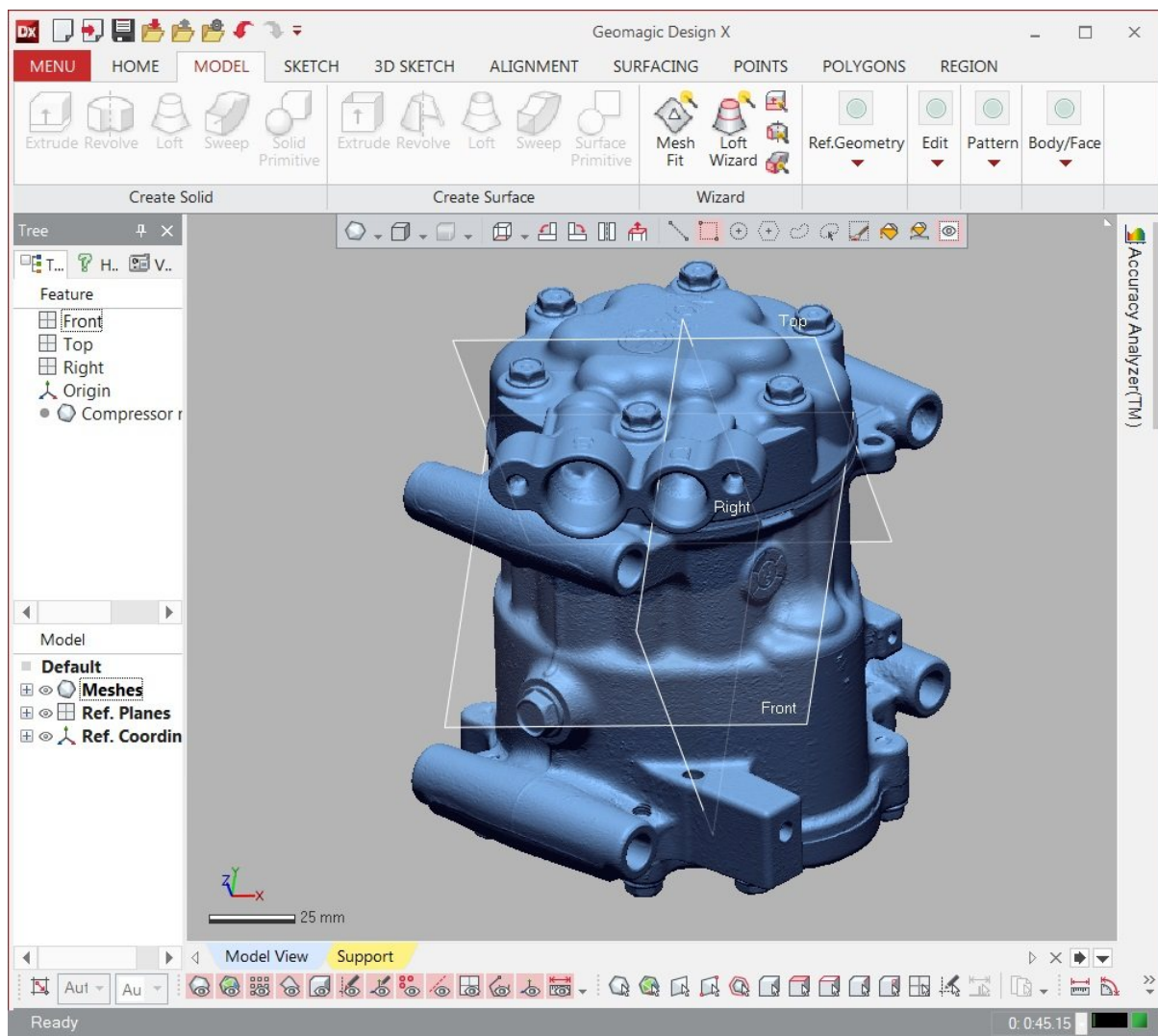


Figure 126: Model exported to *Geomagic Design X*


9.5.9.4 Exporting to Control X

Control X is a 3D quality control and dimensional inspection software with which you can capture and process the data from 3D scanners to measure and inspect quality. With Artec Studio 17, you can export models and target clouds to Control X, or directly inspect them and generate inspection results.

To inspect a model or target cloud in Control X,

1. Make sure Control X is installed on your computer
2. In the *Workspace* panel, right-click on the model or target cloud that you want to inspect
3. Select the *Inspect in Control X* option from the dropdown menu
4. Wait for it to directly open in Control X and generate the inspection report

9.6 Saving Project History

Artec Studio stores all data changes, and you can later undo any unnecessary changes. You can see the saved changes and their use of memory in the *History* panel. To open the panel, click the  button at the bottom left or hit `Ctrl+H`

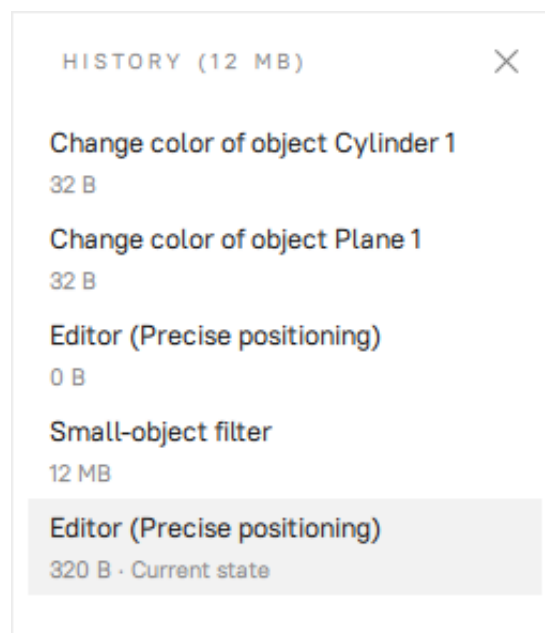




Figure 127: The History panel.

Click on the desired operations in the list to undo or redo them. Operations can be undone (redone) only sequentially, i.e. you cannot skip any of them selectively.

To quickly undo or redo the changes stored in the project history, you can also use the following options:

- Undo:
 - Hit `Ctrl+Z` or
 - Click  in the lower-left corner of the main window
- Redo:
 - Hit `Ctrl+Y` or
 - Click  in the lower-left corner of the main window

When you save a project, Artec Studio stores 3D data together with the history of changes. You cannot limit the maximum length of command history. The *Clear command history* button clears the command history, and thus frees up RAM, and makes the undo operation for the most recent changes unavailable. Additionally, in the *Clear History* window, you can choose to *Keep the last'n' actions*, and clear the rest. Simply specify the number of actions you would like to keep, and confirm. To clear the history, you can use the *Edit → Clear history* menu option in the main window or hit `Ctrl+Alt+H`.

DATA PROCESSING

Once you have captured an object from all desired angles and created a sufficient number of scans, you can then build a 3D model. This chapter offers a detailed description of the process.

See also:

[*3D Scanning at a Glance.*](#)

- [*Reconstructing HD scans from saved raw HD data*](#)
- [*Revising Scans*](#) and [*Editing Scans*](#)
- [*Alignment*](#)
- [*Global Registration*](#)
- [*Creating Models \(Fusion\)*](#)
- [*Editing Models*](#)
- [*Texturing*](#)

10.1 Maximum Error and Registration Quality

Error is the parameter that reflects frame registration quality. For scans, it shows the maximum value among all the frames. The larger the value, the less accurate the alignment. Artec Studio displays noteworthy values only for scans that have passed *Fine registration*, *Align* and *Global registration*.

Table 10: Maximum error values for the scanner types.

	Good results	Acceptable	Unacceptable
Spider/Spider II	0.0–0.1	0.2–0.3	0.4–...
Eva	0–0.3	0.4–0.9	1.0–...
Micro/Micro II	0.0	0.1	0.2–...
Leo	0.0–0.5	0.6–1.3	1.4–...
Ray/Ray II	0.1–0.9	1.0–2.9	3.0–...

Table 11: Other possible errors.

Error	Recommendations
<i>Warning!</i>	Check the frame list
<i>Failed</i>	Indicates unregistered frames in <i>Show all frames</i> mode

10.2 Reconstructing HD scans from saved raw HD data

If your scanner supports the HD mode (such as Artec Eva) and you used it to capture raw HD data without reconstructing HD scans (see [Enabling HD Mode](#) for details), then before you start building a 3D model, you may want to get HD scans from this data.

To launch the reconstruction of HD scans from your saved raw HD data, follow these steps:

1. In the *Workspace* panel, select one or more raw data scans ([Figure 128](#), right).

Note: Raw data scans are not rendered in the *3D View* window.

2. Open *Tools* → *HD Scan Reconstruction* ([Figure 128](#), left).
3. Select the desired values for the *HD frames frequency* and *Point density* parameters. For their description and setup recommendations, see [Launching reconstruction after scanning](#).
4. Click *Run*.

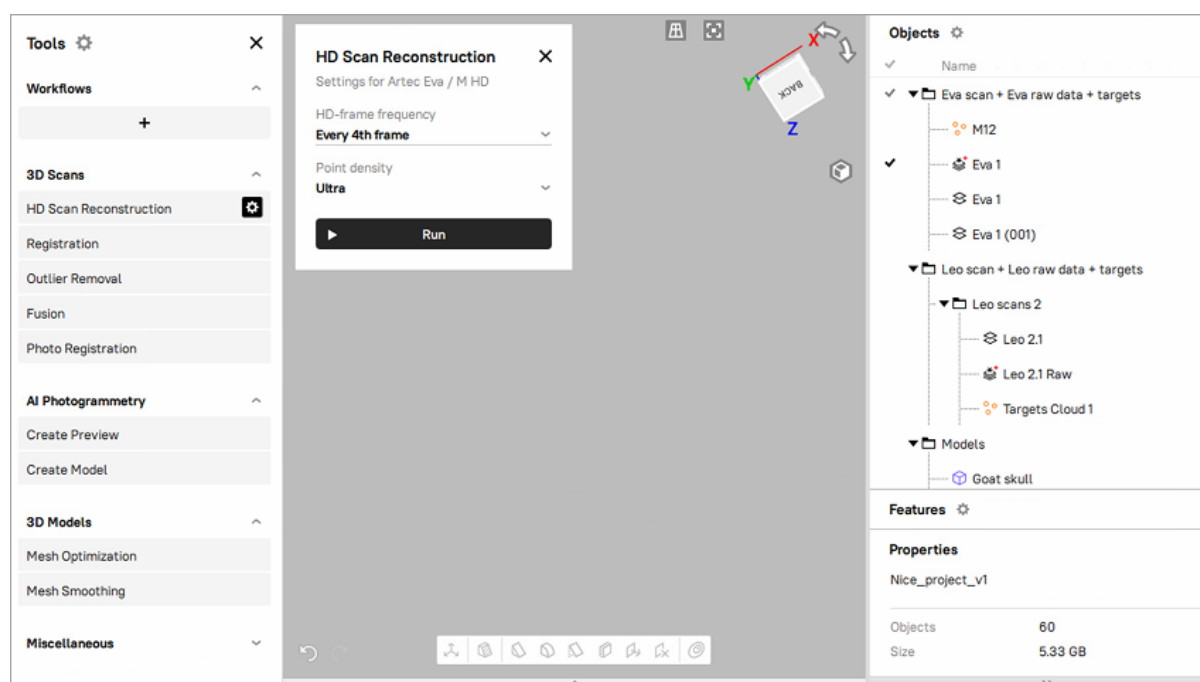


Figure 128: Launching HD scan reconstruction from saved raw HD data. The *HD Scan Reconstruction data* section in the *Tools* panel on the left, a raw data scan selected in the *Workspace* panel on the right.

Important: The HD reconstruction is a time-consuming and resource-intensive operation. On slow computers, it can take up to several hours. If Artec Studio evaluates your computer's resources as insufficient for the selected values of *Point density* and *HD Frames frequency*, then the corresponding warning will be displayed. For information on resources requirements, see the *Using HD mode* section in [System Requirements](#).

The HD reconstruction will start, and the corresponding progress bar will be displayed on the *Status bar*.

When the processing is complete, HD scans will appear in the *Workspace* panel. Their names will be marked with the letters “HD”, for example: *Eva HD Scan 1*.

10.3 Revising Scans

As you begin building a 3D model, you may want to start by preprocessing your scans: separate misaligned areas (if any) into separate scans and cut out unwanted objects from the scene.

You may encounter the following problems:

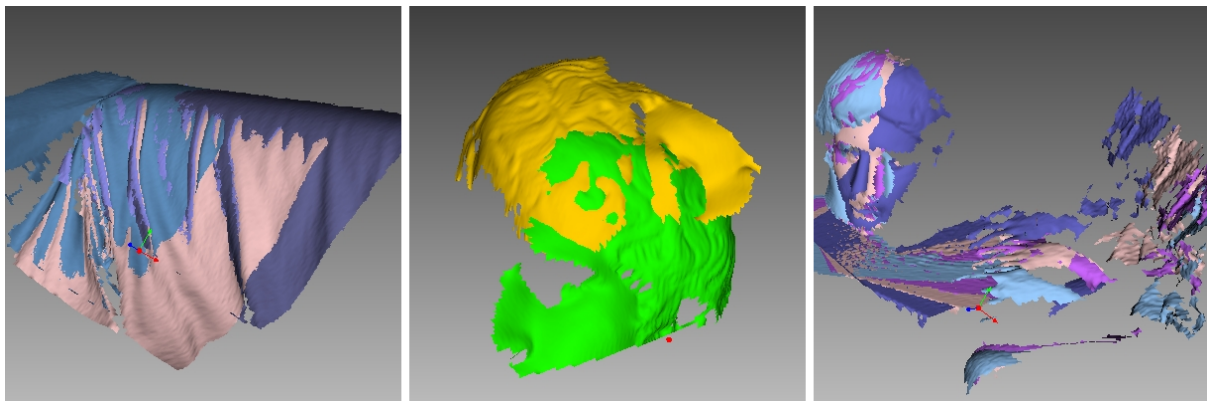


Figure 129: Possible scan errors.

Bad geometry on the left, scan misalignment in the middle and hands captured in frames on the right.

- Misaligned frames (see [Figure 129](#), left)—may occur because of small size, an insufficient number of geometrical features on the object or an insufficient number of polygons in a frame.
- Misaligned parts (see [Figure 129](#), middle)—occurs when the real-time alignment algorithm incorrectly determines the position of the new frame relative to previous ones.
- Unwanted objects in the frame (see [Figure 129](#), right).

A visual inspection of the frames can be very helpful in determining problematic areas. To perform a visual inspection, select the scan and view all the frames that it contains by holding ↑ or ↓ on the keyboard. This technique can easily detect misaligned frames.

When viewing scans, application generally shows only [key frames](#) and textured frames. To display all the frames, select the *Show all frames* option in the *Scene settings*.

See also:

[Misalignment Detection](#).

10.3.1 Separating Scans

During the fine-alignment process, frames in certain scans may be misaligned. Sometimes it's possible to divide the problematic scan into several scans, where each part is registered fairly well. In this case, divide the scan. To move some of the frames into a new scan, use the following procedure:

1. Select in the *Surface List* panel the frames you want to move (see [Selecting Frames](#)).
2. Click RMB and select *Move to new scan* ([Figure 84](#), right).

You can also fix alignment errors in another way: reset the current frame-transformation values and repeat the registration, making any appropriate changes to the settings. Select the desired scan in the *Workspace* panel, click on it using RMB and select *Unregister* from the dropdown menu. Doing so will reset the computed positions of individual frames in the scan. A dialog will then appear, prompting you to confirm the operation. To compute new positions, run the *Rough serial registration* and then *Fine registration* algorithms (see [Fine Registration](#)).

10.4 Alignment and Registration at a Glance

Registration and alignment tools perform similar tasks, however, they differ. Use the table below to get an insight into the details.

Table 12: Understanding registration and alignment modes.

Type	Purpose	Details
<i>Fine registration</i>	Adjusting frames' positions	Treat scans in batch separately. Starts once you leave <i>Scan</i> panel.
<i>Align</i>	Assembling scans	See also Alignment
<i>Global registration</i>	Optimizing frames within scans	Launch it for a pre-aligned batch of scans or for a single scan
<i>Rough serial registration</i>	Preliminary registration performed during scanning	No need to start it manually
<i>Photo registration</i>	Applying texture to models with registered photographs	See also Texturing

10.5 Editing Scans

To edit scans, open *Editor* from the side panel and select the *Eraser* tool. You can also use [Positioning tool](#) or [Transformation tool](#) to orient the scanned data.

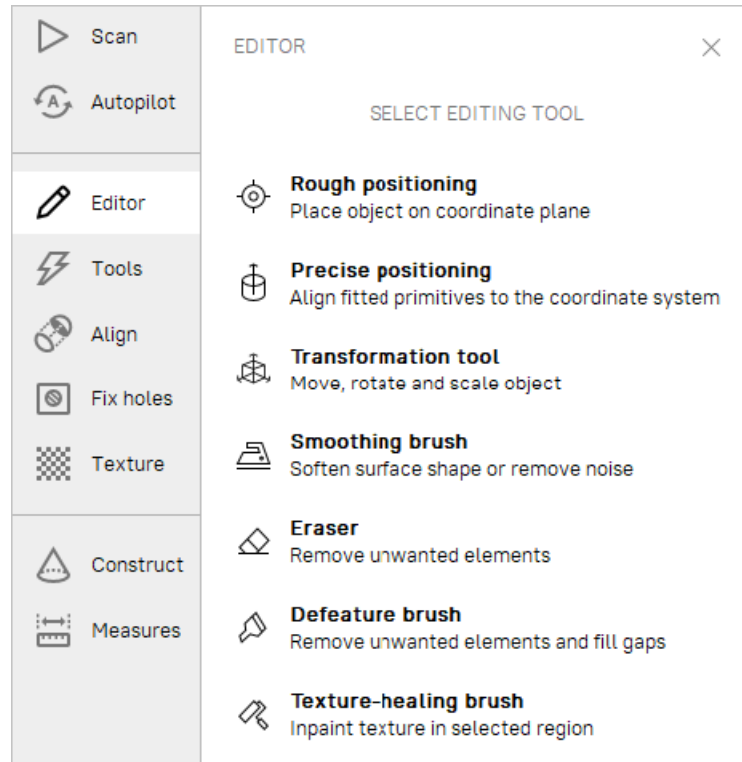


Figure 130: *Editor* panel.

10.5.1 Eliminating 3D Noise (Outlier Removal)

During the scanning process, so-called outliers may appear in the scene. Outliers are small surfaces unconnected to the main surfaces. They require removal because they may spoil the model or produce unwanted fragments. Artec Studio provides two ways to remove outliers: erase them before fusion (preventive approach) or after fusion (“furthering” approach). We advise using the former approach because it decreases the possibility of improper fusion by preventing noisy features from attaching to the main surface.

This outlier-removal approach is based on a statistical algorithm that calculates for every surface point the mean distances between that point and a certain number of neighboring points, as well as the standard deviation of these distances. All points whose mean distances are greater than an interval defined by the global-distances mean and standard deviation are then classified as outliers and removed from the scene.

For better results, we recommend running global registration before starting the algorithm. If you begin *Outlier removal* before doing so, a dialog will appear prompting you to perform global registration.

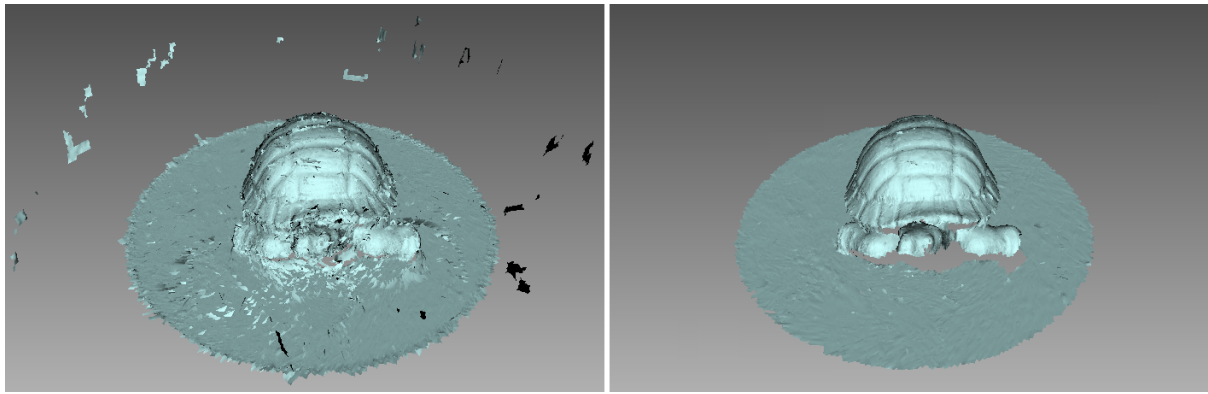



Figure 131: *Outlier removal*: before and after.


In most cases, none of the parameters accessible through the  button requires adjustment. But if necessary, you can change the values of these parameters:


- *3D-noise level* is a standard-deviation multiplier. We recommend choosing the value for this parameter according to the following guidelines:
 - 2 for noisier surfaces
 - 3 for less noisy surfaces
- *3D resolution, mm* should be set equal to the resolution of the *Fusion* process that you expect to run later.

Click *Run* to initiate *Outlier removal*.


10.5.2 Erasing Portions of Scans (Eraser)

Nearly always, the scanning process will capture unwanted elements, such as walls, the operator's hands, surfaces on which the object is located and other extraneous objects. This unwanted data can hinder postprocessing. To avoid this problem, we recommend eliminating these objects before processing. Eraser offers several options to quickly and easily remove unwanted elements from the scene (see [Selection Types](#)).

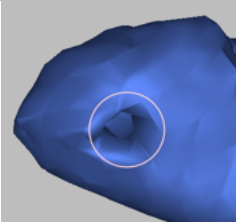
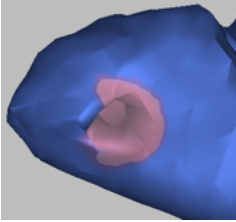
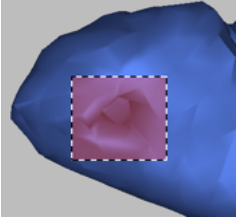
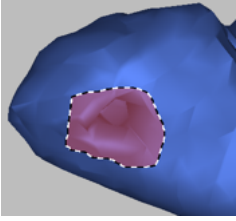
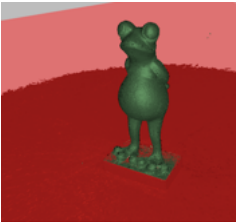
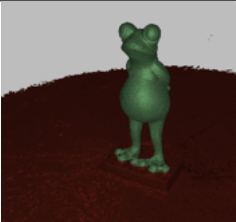
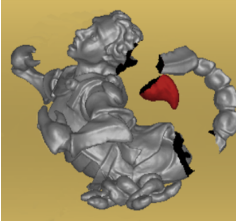
1. Open the *Editor* panel using the side toolbar.
2. Open the *Eraser* tool by clicking  or by hitting **E**.
3. Select one or more scans in the *Workspace* panel.
4. In the *Editor* panel, choose the required [selection type](#).
5. Consult the [instructions](#) for a specific mode and select regions on the scans that you want to erase. To clear all selections, click *Deselect*.
6. Click *Erase* to eliminate the area highlighted in red or to apply cutting plane (*Cutoff-plane* or *Base* selections).

To undo changes, click  in the 3D window or hit **Ctrl+Z**. Each click of the *Erase* button generates a command history entry. To undo several operations, use the dropdown menu

of button  and select the lowest entry.

Note: From Artec Studio version 18 onwards, you can also set an Eraser lock to one or more objects in the workspace. The *Eraser* tool will not affect any object in the Locked object  status.

10.5.2.1 Selection Types

Type	Illustration	Usage
<i>2D</i>		Hold down <code>Ctrl</code> and use <code>Scroll wheel</code> to adjust the tool size. Paint with <code>Ctrl+LMB</code> to create a selection.
<i>3D</i>		See above.
<i>Rectangular</i>		Use <code>Ctrl+LMB</code> to select a rectangular region.
<i>Lasso</i>		Use <code>Ctrl+LMB</code> to freely outline an irregular region. You can release <code>LMB</code> (not <code>Ctrl</code>) and then continue clicking on desired points to select a desired shape.
<i>Cutoff-plane</i>		Create selection as in <i>2D</i> mode. Once you have released the mouse button, a plane will appear. If necessary, adjust the plane level by using <code>Scroll wheel</code> while holding down <code>Ctrl+Shift</code> or orient the plane freely in 3D space. To this end, hit <code>Alt</code> to display the <i>designed control</i> . Then still holding the key, drag the required control ring. Note that it doesn't work with raw point clouds from Artec Point.
<i>Base</i>		Select a flat area as in <i>2D</i> mode. The tool will automatically fit the base plane and select everything below it. Note that it doesn't work with raw point clouds from Artec Point.
<i>Object</i>		Select any separate part of the mesh. This option enables you to easily remove any unwanted object, as whole, from the model.

If the *Select through* checkbox is selected, all surfaces throughout the scan are affected. If not, the brush only works on the visible surface.

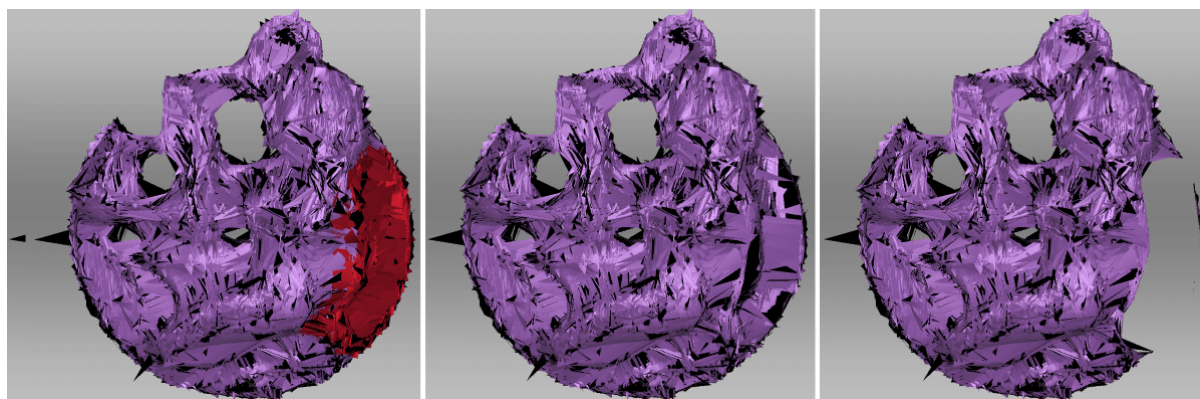


Figure 132: *Select through* in 2D selection: disabled in the middle, enabled on the right.

Use the following general procedure to erase unwanted elements. With the *Eraser* tool, you can also edit target clouds by selecting the desired target using one of the available selection types (*2D*, *3D*, *Rectangular*, or *Lasso*). Follow the general procedure to complete the editing of target clouds.

See also:

[Hot keys in Editor](#).

10.5.2.2 More Actions With Selections

Apart from erasure, you can perform the following action with the selected regions:

- **Clear selection** to create a new one. Click *Deselect* or reselect the region manually while holding down `Ctrl+Alt`.
- **Invert selection** (clear the highlighted region and select the rest). It might be useful when working with large scans. Click *Inverse* or hit `I`.
- **Temporarily hide selection** if it obstructs the region you want to erase. Click *Hide* to this end. To display hidden polygons, click *Show*. Then select the region you want to erase.

10.5.2.3 Erasing Supporting Surface

Artec Studio offers two selection modes that differ from conventional brushes in the way how you select the area for erasure. First, you indicate the flat surface (table, floor or base) on which the object is resting. Then, application either determines the base plane and select the area underneath it (*Base selection*, [Figure 133](#)), or creates a cutting plane (*Cutoff-plane selection*) that divides the scan into two parts: the first will remain and the second will be erased (see [Figure 134](#)). You can orient this plane in any way you need.

Tip: Consider using the [Enable automatic base removal](#) option when scanning since it deletes the flat surface automatically after you close the *Scan* panel.

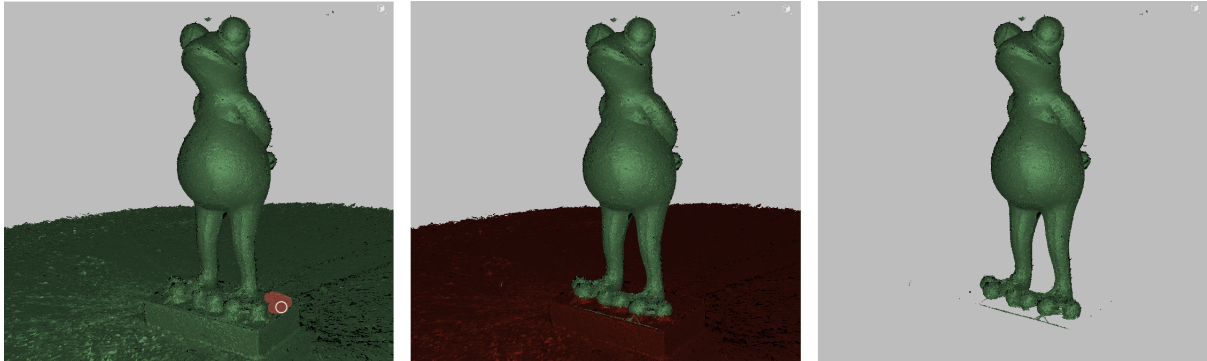


Figure 133: *Base selection* in action: indicating a flat region → defined base → removed base.

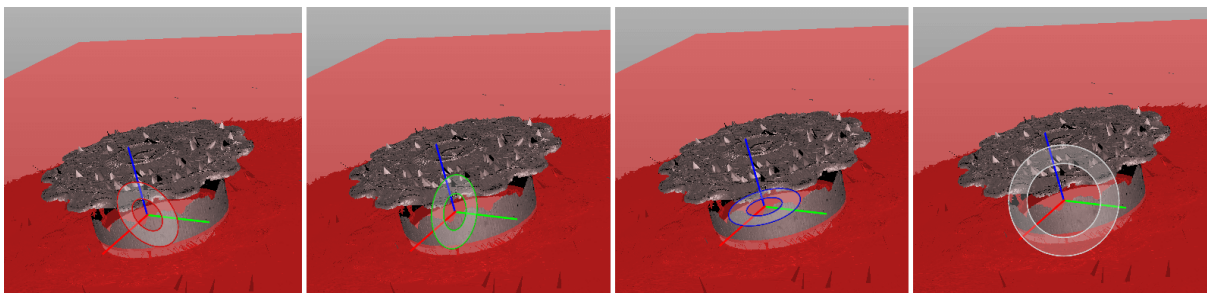


Figure 134: Various controls for orienting cutoff plane: around axes (X, Y and Z) and view direction.

10.6 Fine Registration

Fine registration is an algorithm designed to precisely align captured frames.

In a number of cases you can start the Fine registration algorithm manually open *Tools* → *Registration* and select the *Fine* type of registration. The algorithm affects all scans marked with the ✓ icon in the *Workspace* panel (see [Selecting Scans and Models](#) for more information on scan selection), but it processes them separately.

<i>Features</i>	<i>Geometry and texture or Geometry</i>	The type of algorithm that will perform scan registration. The former is preferable as it takes both geometry and texture into account. If your scan entirely lacks texture, we recommend using <i>Geometry</i> option.
<i>Subsampling</i>	0.01–1	The option makes the input geometry data less dense to speed up the processing. Use lower values for objects with poor geometry. Designed for scans with HD reconstruction, this option can speed up processing in <i>Geometry and texture</i> mode.

10.7 Scan Decimation

Sometimes it is necessary to retain only a portion of frames in point clouds that are difficult to process. Manually selecting these frames can be tedious. Therefore, *Similarity tolerance* provides a more intelligent approach to frame reduction compared to simply lowering the frame rate. This parameter removes frames that do not contribute new information. Higher values result in the removal of more frames. Values above 5.0 may remove too many frames and are not recommended.

When the *Decimate texture frames* parameter is enabled, texture frames will also be considered for removal.

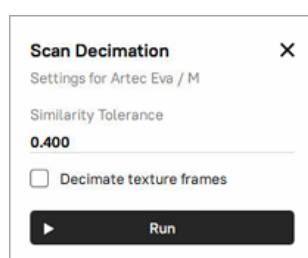



Figure 135: Scan decimation tool.


10.8 Alignment



Although Artec Studio features continuous scanning, there may be some cases where the application lack sufficient information about the relative positions of multiple scans. To assemble all scans into a single whole, you must convert the data to a single coordinate system—that is, you must perform alignment using the *Align* tool.

Hint: First refer to [Auto-Alignment](#).





10.8.1 Selecting Objects for Alignment

In the *Workspace* panel, use the  flag to mark all scans or *groups* that you intend to work with. Once you click *Align* in the side panel, the marked scans and groups will appear in the left panel already selected in the same order as they appear in the *Workspace* panel.

Note: *Workspace* *group*  of scans is treated as a single entity. To release objects constituting the group, use the *Ungroup* item from the dropdown menu.

During the *Align* operation, Artec Studio divides the selected scans or groups into two *collections*: registered (aligned) and unregistered (unaligned). The first collection initially contains only one scan (the first one in the list) or group, which are highlighted in blue. Collection name appears in bold and uses the same color icon ( or ). *Auto-Alignment*, however, may produce several collections of aligned scans.

The user's task is to align all scans to those that are already registered and to "assemble a model". In general, the procedure includes the following steps:

1. Select a required *Type* from the dropdown menu in the *Align* panel.
2. Select one scan or group () from the unregistered collection in the *Align* panel. The name of unregistered scan appears in a regular typeface. When selected, the unregistered scan is marked by the gray icon , whereas the group is marked by icon . You can select several scans using either of the following methods:
 - Press and hold down the `Ctrl` key, and then click each scan or group that you want to select
 - Click the first item, press and hold down the `Shift` key, and then click the last item.
3. If necessary, specify point pairs (for two scans) or sets of points (for more than two scans)
4. Click the desired alignment-command button (*Auto-Alignment* is the most recommended one). The command affects all scans selected in the *Align* panel plus the first one (.

Note: If other objects, except for scans, belong to a group, you can also position them simultaneously with the scans. Select the *Apply to all objects in parent groups* checkbox to this end.

Since each alignment type varies in its effects, see the details in the corresponding subsections for more information. Note that you can use either one method or a series of methods: drag alignment, best fit alignment with and without points, auto-alignment, datum alignment etc.

10.8.1.1 Changing Object Status

If you have already aligned several scans, you should move them to the registered collection. Select them in the *Align* panel using LMB. Next, click RMB on the name of any scan and select the *Mark as registered* option from the dropdown menu, or just double-click its name in the list. At this point, Artec Studio will treat registered scans as one, so you cannot move them independently.

If you accidentally mark a scan as aligned, remove it from the registered collection by selecting the *Mark as unregistered* item from the dropdown menu, or just double-click it.

10.8.1.2 Navigation in 3D View

Objects selected in the *Align* panel will appear in the *3D View* window. Navigation in Align mode is similar to navigation in the *3D View* window.

Rotate	Hold LMB and move mouse
Zoom in/out	Scroll the Mouse wheel, or hold RMB and move mouse
Move freely	Hold LMB and RMB simultaneously, or hold the middle button, and move mouse

10.8.1.3 Managing Collections and Scans

You can perform the following actions on the scans from the list in the *Align* panel (right-click on the item to open the context menu):

- *Mark as registered*. Only available for single unregistered scans or *groups* (● → ●)
- *Mark as unregistered*. Use this command to discard the alignment state of a particular scan (unavailable for ● scans)
- *Select collection* highlights the respective *collection* (●, ●, ● and so on)
- *Mark collection as registered* converts all scans from the collection into the basic registered collection (● → ●)

10.8.2 Drag Alignment

Drag alignment is the fastest alignment method, but also the least accurate. This method allows you to align scans by manually dragging them in the *3D View* window.

Owing to the low accuracy of this approach, however, you can optionally use it for preliminary alignment before running more-accurate alignment types.

1. Select the scan you want to align, keeping in mind the recommendation in [Selecting Objects for Alignment](#). Artec Studio allows you to select multiple scans, but note that it will align them with the registered scans as a single unit.

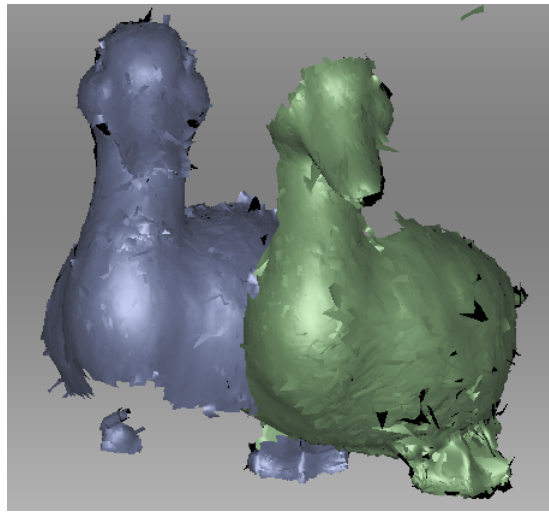


Figure 136: Dragging a scan

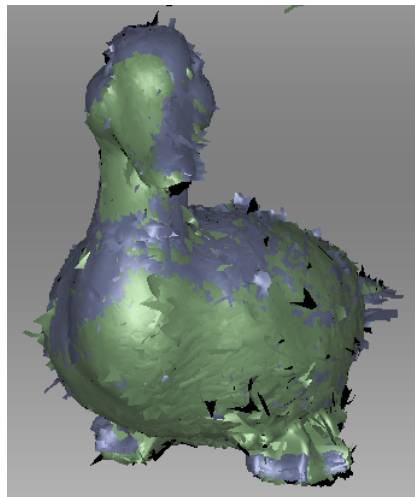






Figure 137: “Drag” alignment result

2. Holding down the `Shift` key and one mouse button, move and rotate the scan you're aligning (a green one ) close to the registered scan (a blue one ). Here is a list of allowed movements and corresponding buttons:
 - `Shift+LMB` to rotate
 - `Shift+LMB+RMB` to move
 - `Shift+RMB` or `Shift+Scroll` to move only unregistered scan along the view direction
3. To confirm the alignment, release the mouse button(s) and the `Shift` key, then click *Apply*. Note carefully that any scans you are registering won't automatically move to the registered set  (see [Figure 137](#)). You can do so manually as the [Changing Object Status](#) describes.
4. If you have several scans to align, repeat these steps for each one individually.

10.8.3 Auto-Alignment



Best Fit alignment is a universal alignment type suitable for aligning most scans. However, Auto-alignment is the easiest approach. The advantages of the latter type include the ability to align several scans at once and avoid the need to specify points; the only disadvantage is minimum requirements for the size of the overlapping areas in the scans you're aligning.

To perform auto-alignment, follow these steps:

1. Mark the necessary scans/objects for alignment.
2. If several objects are already marked in the *Workspace* panel, then all of them are automatically selected upon opening the *Align* panel. You can then clear unnecessary selections using the `Ctrl` key.
3. Select the *Best fit* type in the *Align* panel.
4. In the *Points* option, switch ON the *Auto* toggle, and click on *Align*.
5. Ideally, Artec Studio aligns all the scans and marks them using the  icon. It may, however, mark scans as registered even though the 3D surfaces failed to join properly.

Important: Artec Studio version 18 onwards, Auto-alignment can be used to align a Mesh to CAD model.

Auto-alignment may produce the following results:

- Aligned scans, marked with the  icon (basic [collection](#) of registered scans)
- Unregistered scans, marked with the  icon

- One collection (●) or several collections (●, ●) of registered scans. Scans forming this collection failed to align with the basic registered collection (●), although they succeeded in aligning with each other.


Note: Auto-alignment may be unsuccessful if the scans have a small overlapping area.

We recommend resolving issues with unregistered scans or registered collections by aligning them manually as [Best Fit Alignment with Points](#) describes. Other methods may also help.

10.8.4 Best Fit Alignment without Points

You can perform Best Fit (rigid) alignment either with or without markers (point sets). If scans are close to each other in distance (e.g., after “drag” alignment) or have a large overlapping area or rich texture, you can skip the task of point specification when aligning them.

Perform the following steps:

1. Make sure the *Best fit* type is selected.
2. Select the scans you want to align, as the beginning of [Alignment](#) describes.
3. Set the *Points* value to *Auto* by toggling the corresponding switch.
4. If aligning point clouds from Artec Ray or Artec Ray II, enable the *Advanced* switch to adjust the advanced settings that determine how alignment points will be calculated:
 - *Distance from scanner, mm* is a radius around the scanner viewpoint from where the algorithm will take points. Alter it when you need to ignore the background 3D noise.
 - *Feature voxel, mm* is a volume measure to cull extra points from the algorithm input. The more the value, the more the points will be culled and the faster the algorithm. Increase it sparingly since it affects the algorithm accuracy.
 - *Maximum height difference, mm* determines the height difference value of scans, which helps decrease registration algorithm processing time. If the scans are taken at different heights, please input a value of 0.
5. Click *Align*. The result should be as [Figure 140](#) depicts. If you are dissatisfied with this result, click  and follow the recommendations in [Best Fit Alignment with Points](#).
6. Select another scan from the list of unregistered scans and repeat the above procedure.
7. Click *Align* once again

Points Auto ☒

Alignment points will be calculated automatically based on specified parameters

Advanced Settings ☒

Distance from scanner
25000.000 mm

Feature voxel
50.000 mm

Maximum height difference
0.000 mm

Figure 138: Advanced settings for point clouds alignment without points.

10.8.5 Texture Alignment

If the object was scanned with texture, the texture-alignment feature may ease the alignment process. It uses texture-image characteristics of scanned objects and greatly decreases the possibility of incorrect alignment. This feature also helps to align objects with few or no geometrical features, such as round or flat objects with no corners. If an object has rich, nonrepetitive geometry, however, we recommend disabling texture alignment to reduce the algorithm's running time. Also keep in mind that texture alignment will be useless if the object texture is monochrome.

To enable texture alignment, select the *Enable texture alignment* checkbox at the bottom of the *Align* panel before you click on *Align*.

Note: Texture alignment is a resource-intensive algorithm that slows down the alignment process. We recommend using it only in cases where the object's geometrical features are insufficient.

10.8.6 Specifying Point Sets (Markers) and Editing their Positions

Before considering how to align scans using points, it is helpful to learn about point-pair specifications. The alignment algorithm uses pairs of point, or point sets in *Complex* alignment type (*Complex Alignment*), to detect scan areas that should be brought close together.

To do point alignment, create several point pairs. To create one pair, mark one point on the aligned scan and then mark another one on the unaligned scan. Ensure that in each case the points for a given pair match a corresponding point on the surface of a real object. However, high matching accuracy is unnecessary, since Artec Studio only uses the pairs to gain a rough approximation before performing precise registration. In the *Complex* type, you can create a set of points (instead of just a pair), i.e. you can simultaneously specify more than two points in one or several unregistered scans and only one in the registered scan. All these points are connected by polylines and form a set.

When specifying points in the *Best Fit* and *Nonrigid* types, the application automatically creates pairs. Having specified one pair, you can immediately create the next one. In the *Complex* type you must confirm set creation by hitting `Space` or by clicking *New set* from the left panel, because the set may comprise multiple points (see [Figure 139](#) and [Figure 144](#)).

You can toggle between the point pairs (sets) by hitting `Space` and `Backspace`, or by clicking `RMB` in the *3D View* window and selecting the relevant options from the menu. You can also relocate points in the pair (set). Hover the mouse cursor over the point until the pair (set) is highlighted in white, then drag the point to the proper position using `LMB`, or select the pair (set) and specify a new position using `LMB`. To confirm your actions and deselect the pair (set), hit `Space`. You can also remove either a pair (set) or one of its individual points: click on the point using `RMB` and choose the appropriate command from the menu. Alternatively, you can use `Del` to remove the selected pair (set).

10.8.7 Best Fit Alignment with Points

We recommend using the *Best fit* type for scans located at a significant distance from each other or when aligning polygon models with CAD models.

To use this approach, follow these steps:

1. Make sure the *Best fit* type is selected.
2. Select the object you want to align, as the beginning of [Alignment](#) describes.
3. Enable the *Advanced* switch to adjust the following advanced settings:
 - *Feature search radius, mm* is the search radius for features used in geometry-based alignment. This setting applies only if *Auto* option for *Points* is turned off.
 - *Max points* is the maximum number of scan or fusion points considered during geometry-based alignment.

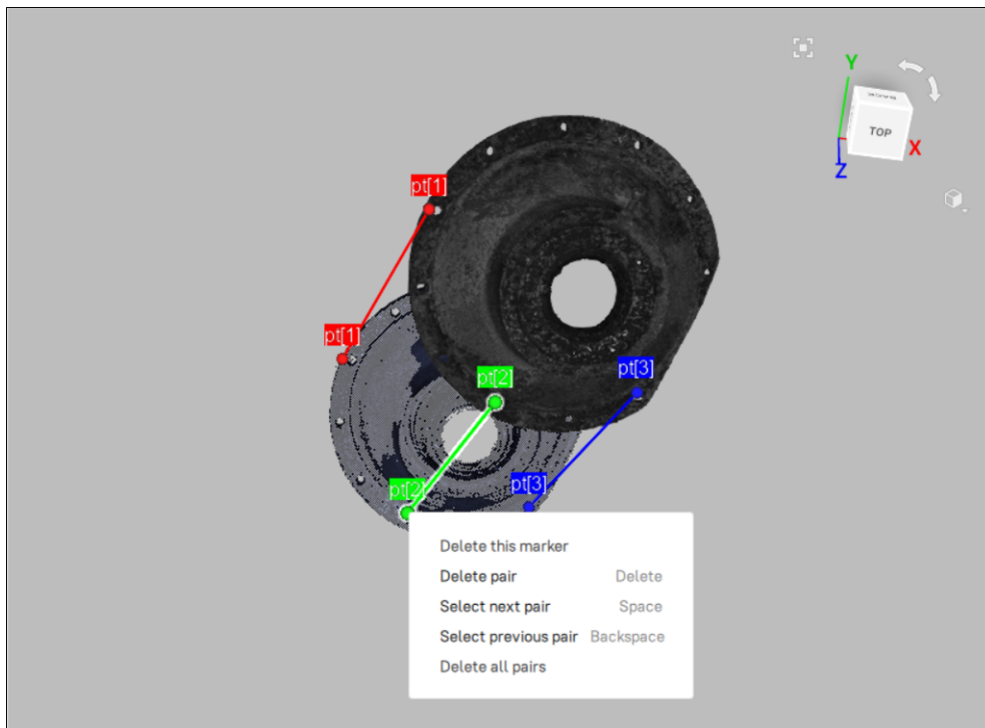


Figure 139: Creation of point pair.

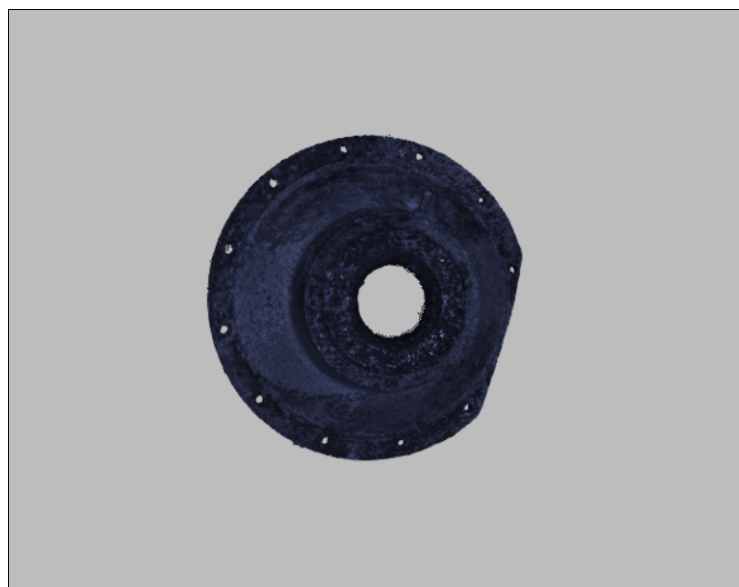


Figure 140: Alignment result.

4. Specify several point pairs ([Figure 139](#)), keeping in mind the recommendations from [Specifying Point Sets \(Markers\) and Editing their Positions](#).
5. Click *Align markers*. This alignment type takes into account only the coordinates of specified points and tries to reduce the distance between the markers for each pair.
6. Carry out Steps 5–7 of the [procedure](#) in [Best Fit Alignment without Points](#).

Note: If point clouds from Artec Point are selected for best fit alignment, the *Targets* switch will be toggled on by default. This means that targets will be used as alignment points.

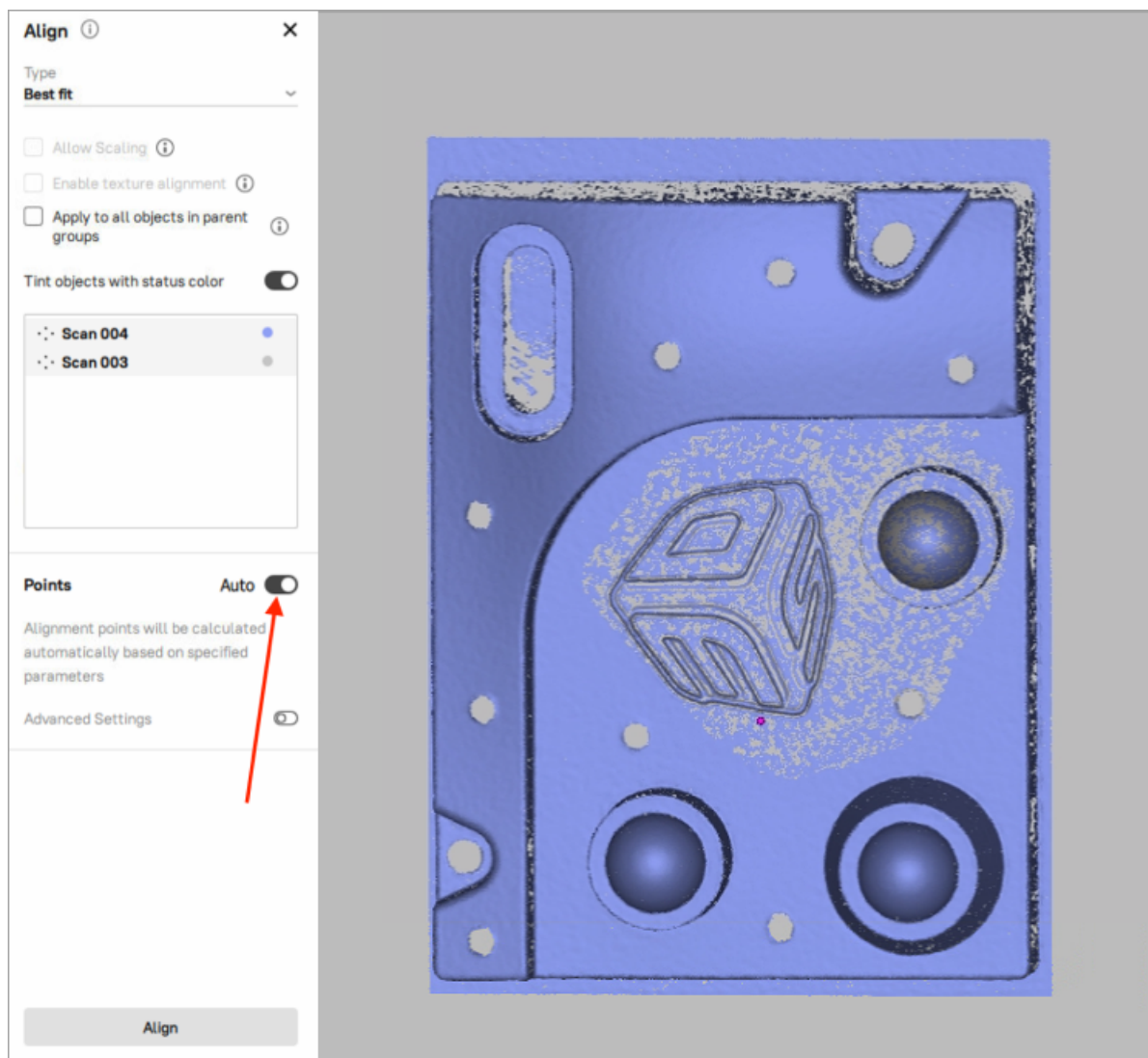


Figure 141: Alignment of Artec Point point clouds using targets.

10.8.7.1 Allow Scaling Option

While using the Best Fit alignment mode, Artec Studio allows you to align objects of different sizes without the need manually scale them. To do so, select the point pairs first, which will enable the *Allow Scaling* option, then simply enable this checkbox.

Note: You can check the scale factor in your log messages after alignment.

10.8.8 Nonrigid Alignment

While Best Fit (rigid) alignment can only perform such transformations as translation and rotation, the nonrigid algorithm can deform 3D data. This algorithm is intended to process so-called nonrigid objects: objects whose shapes have changed during the scan (e.g., models of animals or humans—see [Figure 142](#), left). Keep in mind that the surface Artec Studio produces as a result of the deformation may differ from the surface of the actual object.



Figure 142: Two models after Best Fit (left) and nonrigid alignment (right).

Note: Nonrigid alignment works on models only. Thus, before you run it, prepare models by fusing the source scans. It is also necessary to first align models in Best Fit mode (see [Best Fit Alignment without Points](#), [Auto-Alignment](#) or [Best Fit Alignment with Points](#)).

To run the nonrigid alignment, follow these steps:

1. Make sure the *Nonrigid* type is selected.
2. Select the models you want to align, as the beginning of [Alignment](#) describes.
3. If the models differ significantly from each other, we suggest that you specify several point pairs, keeping in mind the recommendations in [Specifying Point Sets \(Markers\) and Editing their Positions](#).
4. Where necessary, adjust the deformation degree using the flexibility slider. The greater the flexibility value (i.e., the more “flexible” the deformation), the longer the computation will take.

Warning: Avoid extreme *Flexibility* values. Applying very large values may result in major surface distortions and may slow down the algorithm. Extremely low values, on the other hand, barely deform surface and often fail to produce the expected nonrigid-alignment results.

5. Click *Align...* The algorithm will align models by deforming one of the model (see [Figure 142](#), right). If you are dissatisfied with the alignment results, click ↺ and specify additional point pairs, or reposition the current pairs.
6. Select another model from the unregistered set and repeat the steps above.
7. Click *Apply* to confirm your alignment results or *Cancel* to reject them.

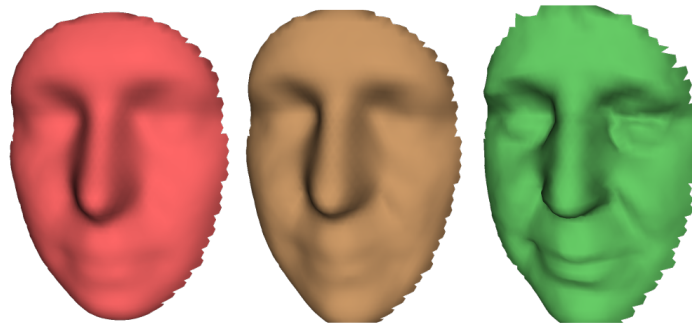


Figure 143: *Flexibility* slider in action: original model (left), nonrigidly aligned model with low *Flexibility* value (middle) and with high value (right).

Note: This version of Artec Studio does not support texture mapping on nonrigidly aligned models.

10.8.9 Complex Alignment

Complex alignment allows you to align not only scan to scan, but surface to surface within a given scan. Relative to other types, this one supports multipoint-set definition—that is, you can link more than two points. It's useful for aligning scans obtained during circular movements of the 3D scanner in cases where fine or global registration fails to align them. To run the *Complex* alignment, perform the following steps:

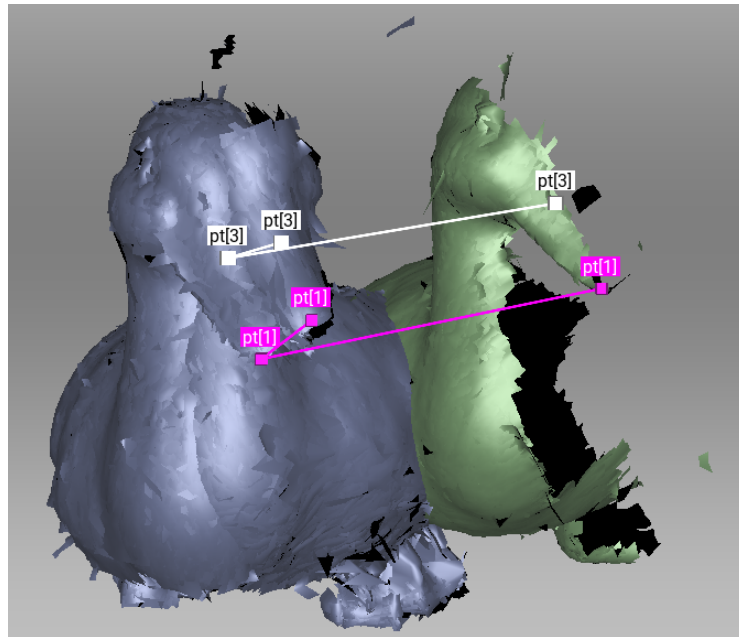


Figure 144: Before alignment: two point-set added.

1. Make sure the *Complex* type is selected.
2. Select the scans you want to align, as the beginning of [Alignment](#) describes. This alignment type allows you to work even with just one registered (●) scan.
3. Specify one or more point sets on the scan surface (see [Figure 144](#)), keeping in mind the recommendations in [Specifying Point Sets \(Markers\) and Editing their Positions](#).
4. Click *Align...* to run the alignment with your specified restrictions ([Figure 145](#) shows example results). If you are dissatisfied with the alignment results, click ↺ and specify additional point sets, or reposition the current sets. To redo an operation that you have undone, click ↻.
5. Click *Apply* to confirm your alignment results or *Cancel* to reject them.

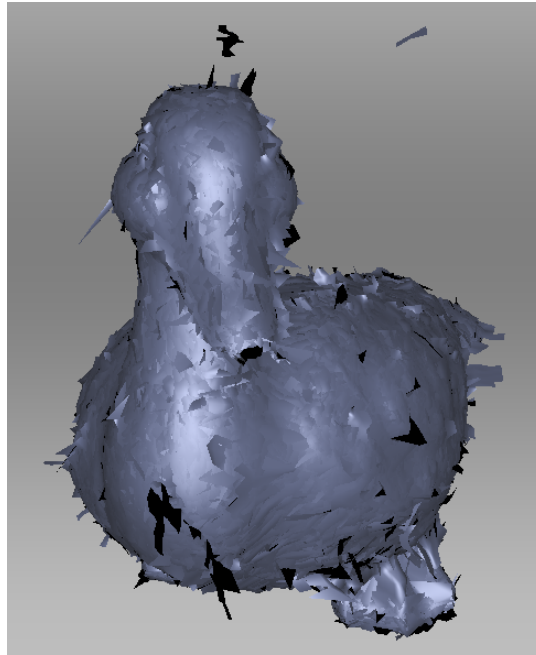


Figure 145: Alignment result.

10.8.10 Datum Alignment

Some quality control tasks for a CAD model require very precise positioning of the CAD model relative to the original mesh. For this purpose, the Datum Alignment type was implemented in Artec Studio 17. This type allows you to view and evaluate the linear and angular deviations between the shapes of the CAD model and the mesh.

To use the Datum Alignment type, you need to specify a set of key geometric features called datums. Datums can be described as the reference points, vectors, or planes that help to designate the location and orientation of the model or its part. When you define a particular geometric feature as a datum, specific constraints dependent on the datum type are applied to the model, restricting the degrees of freedom controlled by that feature type.

Up to three datums can be specified as it is always enough to constrain all degrees of freedom. At present the following types of geometric features can be selected as datums:

- Cylinder,
- Cone,
- Sphere,
- Plane.

The type of datums and the order in which they are selected are important, as the degrees of freedom of the primary datum (datum A) will be applied first, with negligible or no deviation. Then, the remaining degrees of freedom will be constrained by the secondary datum (datum B) so that models will be aligned as precisely as the first constraint allows. Finally, the tertiary datum (datum C) will be considered, subject to the limitations imposed by the previous datums.

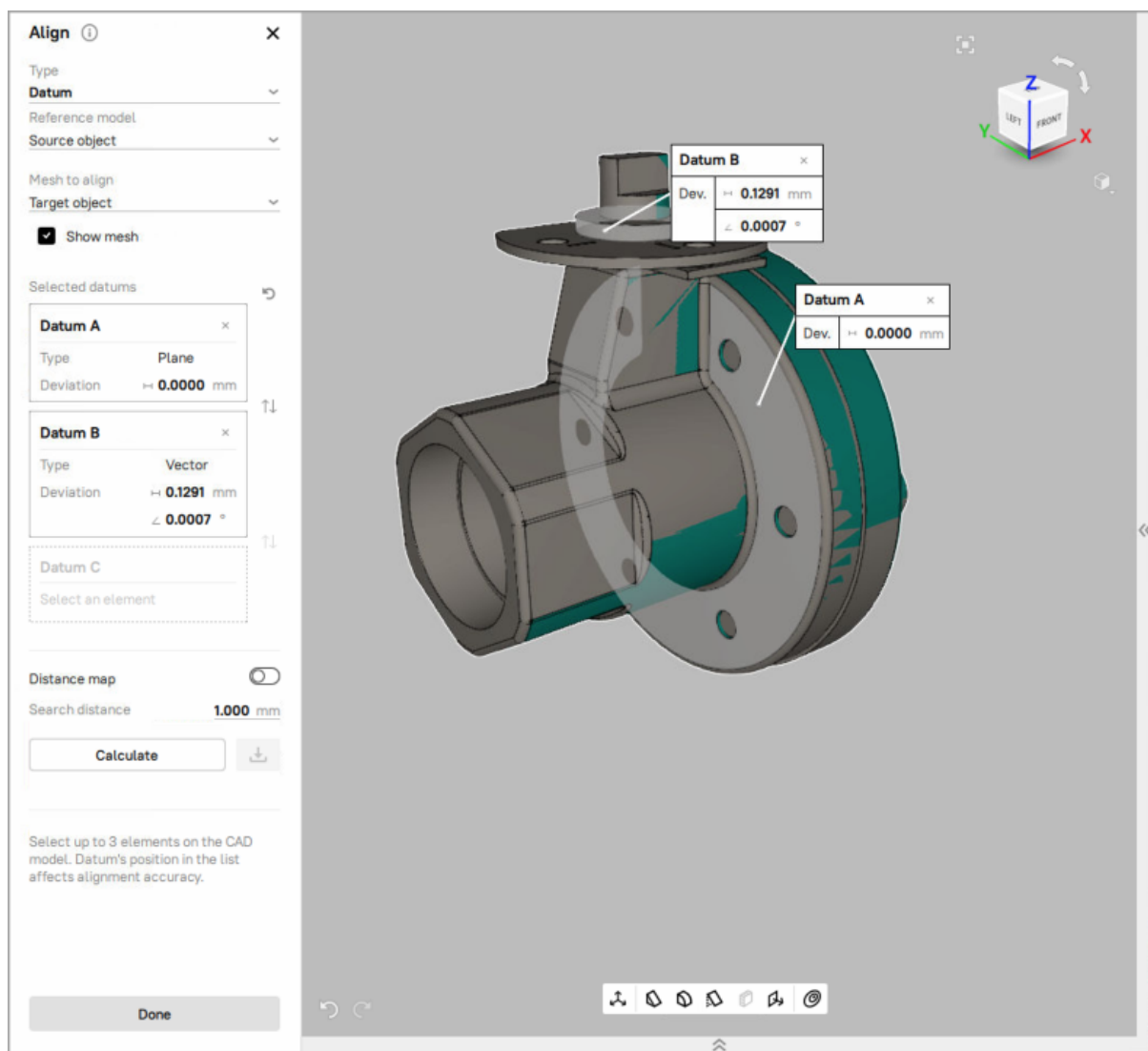


Figure 146: Example of datums specified

Note: Datum alignment is a fine alignment type, so it requires a pre-alignment to be performed first. If selected objects haven't been aligned beforehand, a yellow warning will appear on the Datum Alignment tab along with a button that opens the *Best fit* alignment tab (see Figure 147).

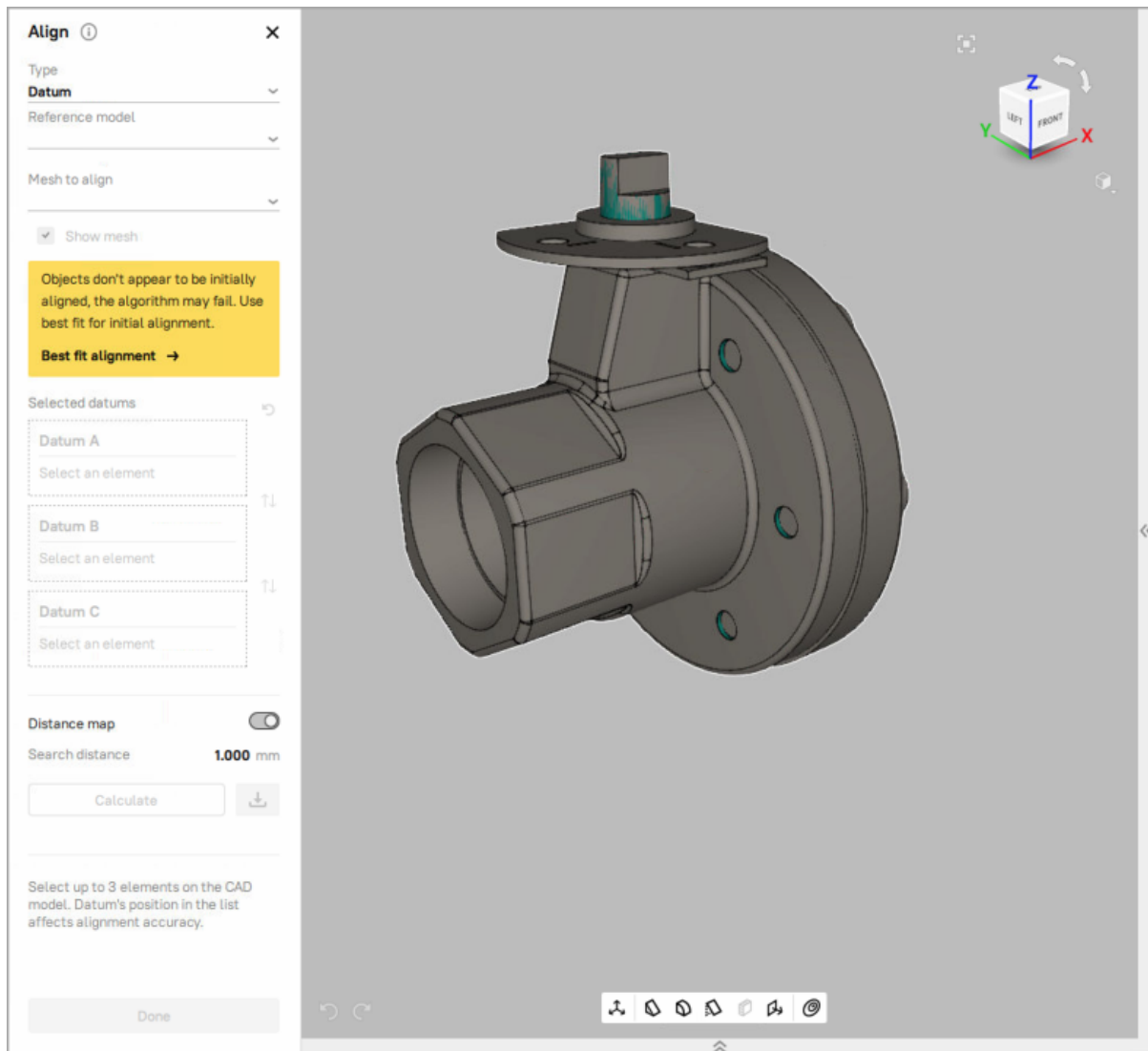


Figure 147: The disabled Datum Alignment for non-aligned objects

To perform datum alignment, follow these steps:


1. Select a CAD model and a mesh to be aligned in the *Workspace* panel.
2. Open the *Align* panel. By default, it will open on the *Best fit* tab.
3. Prepare the selected CAD model and mesh for alignment using one of the Best Fit alignment methods: *Best Fit Alignment without Points*, *Best Fit Alignment with Points* or *Drag Alignment*. Then, click *Align*.
4. After the models are pre-aligned, switch from the *Best fit* tab to the *Datum* tab.
5. Wait until the models are prepared for further work.

Note: Artec Studio may require additional time to synchronize the models.

6. Specify the *Reference model* and the *Mesh to align*. You can hide the mesh from the *3D View* window by deselecting the *Show mesh* option.

7. Click the desired element of the CAD model to select it as the first datum.

The selected element will be labeled as Datum A (or Datum B, etc.). Depending on the type of element selected, a linear (⊥) and/or angular (∠) deviation pop-up will be displayed (see [Figure 146](#)).

- To move the deviation pop-up, drag it to the proper position using **LMB**.
- To deselect a datum, click the x button to the right of its name in the *Align* panel or in the deviation pop-up.
- To clear all datums, click the  button in the *Align* panel.


8. Repeat step 6 to specify other datums if required.

Note: It is not necessary to specify three datums each time. In some cases, to constrain the system completely, only two datums are required (for example, two non-parallel cylinders). For some quality inspection scenarios, even one datum may be enough.

9. To complete the work with datum alignment, click *Done*.

In the Datum Alignment type, you can also calculate a distance map to visually estimate the deviation.

To calculate the distance map:

1. Enable the *Distance map* switch in the *Align* panel.
2. Specify the *Search distance* value (in mm) and then click *Calculate*. Once the process is complete, the distance map will appear in the *3D View* window.
3. To save the distance map for further work, click . It will be available in the *Measures* tab under the name *Distance map 1* (*Distance map 2*, etc).

See also:

[Distance Maps](#)

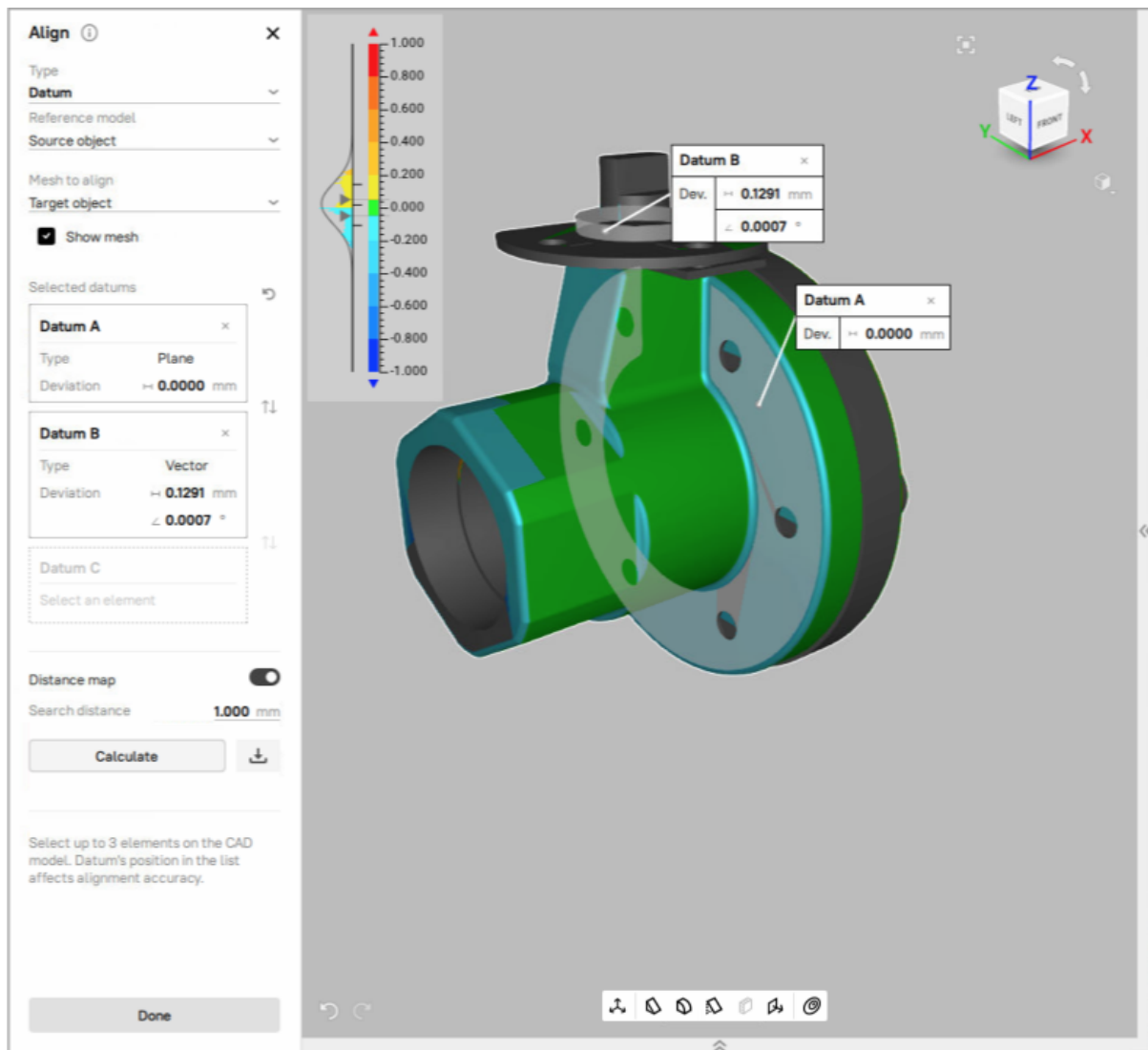


Figure 148: Example of a distance map calculated in the Datum Alignment type

10.9 Global Registration

Once you have aligned all your scans, proceed to the next stage: global registration. The global-registration algorithm converts all one-frame surfaces to a single coordinate system using information on the mutual position of each surface pair. To do so, it selects a set of special geometry points on each frame, followed by a search for pair matches between points on different frames. To perform correctly, the algorithm requires an initial approximation, which a user ensures in the course of the *Align* operation.

Note: Global registration is a resource-intensive operation. Processing of large data sets may take a long time and require a large amount of RAM.

Before launching the global-registration algorithm, you can fix the position of some of the scans and/or their frames if necessary (for detail, see [Locking Object's Position](#)).

To launch the algorithm,

1. Select all aligned scans in the *Workspace* panel.
2. Open *Tools* → *Registration*.
3. Make sure *Global* is selected as the registration type in *Registration* pop-up.
4. Check the *Preset* field on the *Tools* panel. It must display the actual scanner that was used to obtain the selected scans.
5. Click *Run*.



10.9.1 Global-Registration Parameters

<i>Features</i>	<i>Geometry and texture, Geometry, or Reference cloud</i>	The type of algorithm that will perform scan registration. If an object has rich texture and poor geometry, consider using the <i>Geometry and texture</i> option. For objects with rich geometry, you can choose <i>Geometry</i> mode to increase the registration speed. For registration of targets on a scanned object with those from a reference cloud, use <i>Reference cloud</i> mode.
<i>Registration mode</i>	<i>Collective, Separate, or Separate then Collective</i>	This enables registration of selected scans <i>separately</i> (one by one), altogether <i>collectively</i> , or both <i>separately then collectively</i> . Does not work with the <i>Artec Ray</i> and <i>Artec Ray II</i> .
<i>Key frame ratio</i>	0–0.6	Determines how many surfaces are treated as key frames. Decreasing this parameter when processing a feature-rich object may speed up registration. Increase it if only the previous attempts to register scans failed. Technically, values higher than 0.7, including 1, are possible, but they may significantly slow down the algorithm.
<i>Focus on geometry</i>	On/Off	Enable it for objects with rich geometry and poor texture. With this setting enabled, the registration will still take texture into account, but geometrical consistency will be given a higher priority. It is only available for <i>Geometry and Texture</i> mode.
<i>Search features within, mm</i>	3–5 mm (Spider); 5 mm (Eva/Leo) and 50 mm in <i>Geometry and texture</i> mode	To align frames, the algorithm needs information on how far away the identical features are distributed on the adjacent frames. Lower this search radius for objects with many repetitive features and increase for large objects to ensure the algorithm robustness. Increase this parameter sparingly since large values may cause erroneous registration and hinder calculation. Adjust it if Fine Registration completes with inappropriate values of maximum errors .
<i>Smart subsampling</i>	On/Off	Enable it to allow Artec Studio to automatically adjust the input geometry data as required, to speed up the processing. Designed for scans with HD reconstruction, enabling this option can speed up processing in <i>Geometry and texture</i> mode.

10.9.2 Locking Object's Position

When you perform operations that change the relative position of objects or individual frames (such as [Global Registration](#)), it may be necessary sometimes to lock the repositioning of some of these objects or frames. Consider, for example, the case where you work with several scans made in the [Target-Assisted Scanning](#) mode. The initial relative position of such scans in space should be preserved.

Artec Studio supports two types of locking mechanism:


- *Lock frames* () - locks the repositioning of scan frames relative to each other during the global registration but allows you to move the scan itself. This mechanism applies only to scans containing frames, that is, obtained using handheld scanners such as Artec Eva, Spider, Leo, Micro, or Micro II.
- *Lock object* () - locks the repositioning of the object relative to the global coordinate system. This mechanism applies to scans and any other objects.


Note: *Lock frames* is the same mechanism that was called *Lock* in Artec Studio 15 and earlier.

The *Lock object* status affects not only the results of global registration but also the operations of *Positioning*, *Transformation* and *Eraser* tools (see [Preparing Models To Export](#) for details). When using these tools, any reposition or change to objects with the *Lock object* status is blocked.

You can lock or unlock a specific object in the *Workspace* panel:

- using the context menu of this object, or
- by clicking the object row in the *Lock* column area

To lock or unlock all objects in the *Workspace* panel, click the header of the *Lock* column ().

To lock or unlock all objects in a group, click the group row in the *Lock* column area ().

Note: When you change the lock status of several objects at once, the result of the mouse click will depend on the types of objects that are displayed in the *Workspace* panel or included into the group and on the current lock status of these objects.

10.9.3 Global Registration for Point Cloud Scans

Global registration with the *Artec Ray* and *Artec Ray II* presets only runs on several point cloud scans. Artec Studio offers four modes:

- *Geometry Ray*. The prerequisite step for this mode is alignment. The scans must have sufficient initial approximations and may not have targets.
- *Targets* considers only targets (spheres and checkerboard targets)
- *Targets and geometry*. Global registration first runs on the basis of targets, then on geometric features.
- *Reference cloud*. Global registration of targets on a scanned object with those from a reference cloud.

10.9.4 Possible Global-Registration Errors

- After the global-registration algorithm finishes, the frames are in disarray (see [Figure 149](#), left) or the frame positions are unchanged. This error occurs because the application is configured for a different scanner type than the one that captured the data. Change the device type in the application settings (see [Algorithm Settings](#)).
- The algorithm has completed successfully, but a gap exists between two or more scans (see [Figure 149](#), right). Select just these scans in the *Workspace* panel and run the global-registration algorithm. If the scans have drawn closer to each other but have failed to align after the algorithm finishes, increase the number of iterations and rerun the algorithm. Repeat this process until you achieve full alignment, then run global registration once again for all data. If you are unable to align several problematic scans, try aligning just two of them, then gradually increase the number of scans until all of them are aligned.

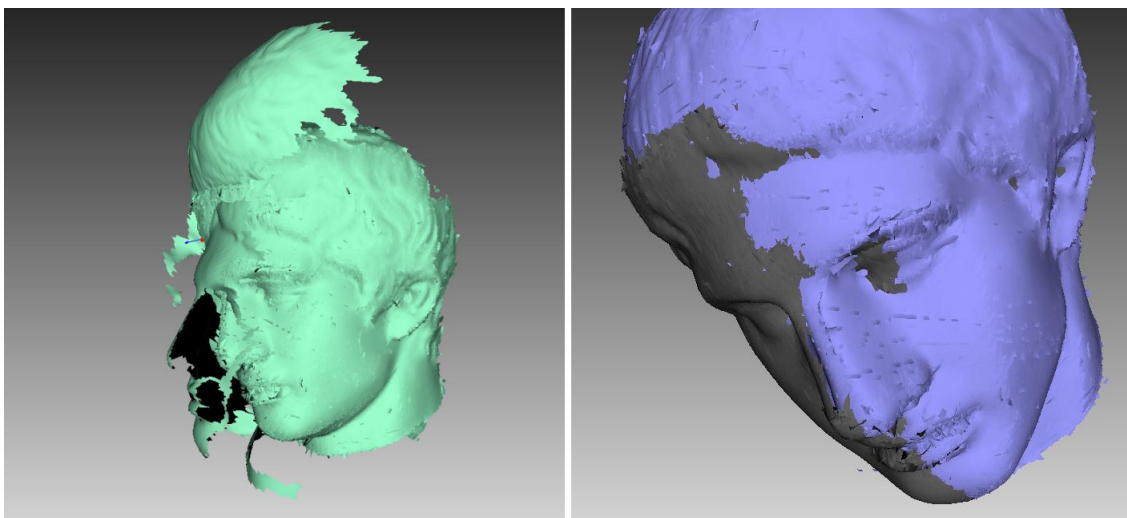


Figure 149: Global-registration errors: wrong settings on left and gap between scans on right.

10.10 Transferring Transformations

Sometimes it can be useful to transfer transformations from one scan to another (see [Use Cases for Transformations Transferring](#)). The transfer of transformations means that all transformations of scan frames resulting from the application of different Artec Studio tools are sequentially repeated for all frames of another scan. The transformations of the source scan as a whole are copied to the destination scan as well, including the global registration status.

Note: In general, you can transfer transformations from one scan to **any other** scan. However, of practical interest are only the cases when the source and destination scans are copies of each other.

To transfer the transformations from one scan to another, perform the following actions:

1. In the Workspace panel, right-click the source scan and choose *Copy Transformation* from the context menu (see [Figure 150](#), left). The transformations of the source scan and its frames will be saved.
2. Select one or several destination scans.
3. Right-click the selected scan(s) and from the context menu choose *Paste from <source scan name>* (see [Figure 150](#), right).

All saved transformations will be sequentially applied to the selected scans and their frames. After the transfer is finished, the information about the saved transformations will be erased.

You can use the corresponding buttons of the main window to undo and redo the transfer of transformations (see [Saving Project History](#)).

10.10.1 Use Cases for Transformations Transferring

Use case 1: Saving time when processing HD scans

Global registration of HD scans is a very time-consuming operation: several times longer than it takes for SD scans. To save time, you can utilize the following scheme:

1. Make a copy of an HD scan.
2. Treating the scan copy as an SD scan, perform all the required transformations including the global registration.
3. Transfer the transformations from the copy to the original HD scan.

Use case 2. Saving time when working with backup copies of scans

Global registration takes longer than any other scan and frames transformation. Therefore, replacing the *Global registration* with the transformations transfer may save time.

Consider the following scenario:

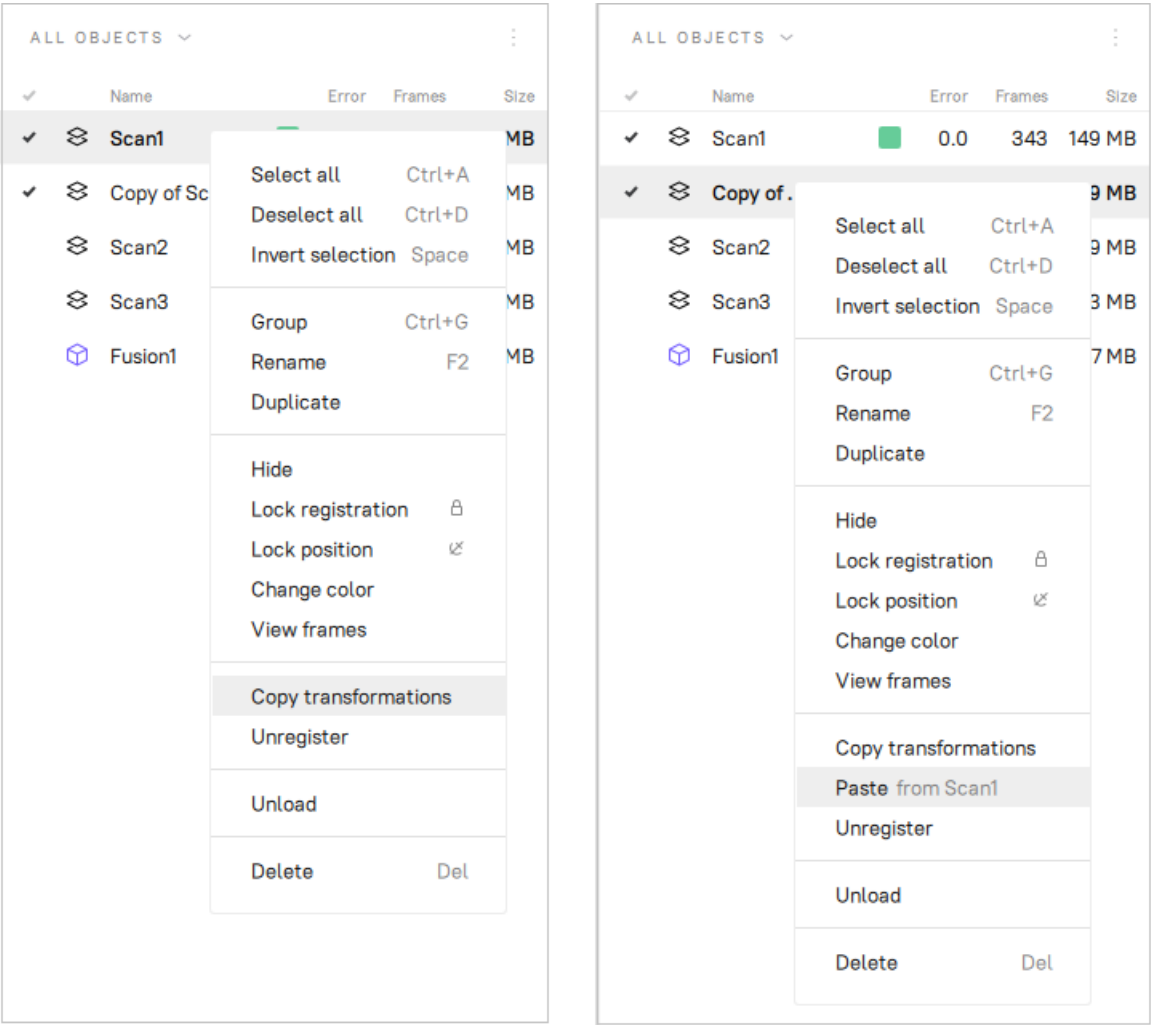


Figure 150: Transferring transformations: copying transformations (left) and pasting them (right)

1. You make backup copies of scans and then only work with the original scans.
2. You remove some excess parts of the scans using *Eraser*, run *Global registration*, apply *Outlier removal* and finally perform the *Fusion* operation.
3. After examining the resulting model, you conclude that you removed too much when working with the *Eraser* and/or the *Outlier removal*.

You have to undo all previous operations and once again repeat the sequence of actions, including *Global registration*. To avoid the latter and save time, you can instead transfer the transformations from the current scans to their backups and then continue working with the backups.


10.11 Ray Scan Triangulation

Application offers two ways to convert point cloud surfaces to the commonly used models:

- *Fusion* operation
- Special triangulation algorithm

The latter approach is preferable to fusion in terms of speed. It generates a polygonal mesh from the original point cloud by simplifying its structure.

To launch this algorithm, follow the steps:

1. Mark a scan from Artec Ray or Artec Ray II using the flag  icon in the *Workspace* panel.
2. Access *Tools* → *Ray Scan Triangulation* from the left toolbar.
3. If necessary, specify the *Decimation ratio* and set either of the threshold filters.
4. Click *Run*.

<i>Mode</i>	<i>Simple, Adaptive (distance-aware)</i>	Adaptive takes into account the distance from the scanner, whereas Simple removes points with the fixed step (<i>Decimation ratio</i>)
<i>Decimation ratio</i>	1–10	The larger the value, the more the points will be culled. 1 leaves the point cloud unchanged. 2 culls half of the points, 4 keeps some 25% of the total amount of points, 10 about 10%.
<i>Render mesh based on</i>	<i>Distinct colors for sections, One random color, Vertex colors</i>	It can color an output model on the basis of <i>Vertex colors</i> or sections constituting the point cloud scan. The latter yields multicolor model.
<i>Polygon edge length (max), mm</i>	Above 0.1 mm	Algorithm will remove triangles whose edge lengths are greater than the specified value.
<i>Polygon angle (min), deg</i>	1–60°	Triangles with angles smaller than specified limit (in degrees) won't be created in the resulting mesh. Extremely large values that are out of the recommended range may yield no mesh.
<i>Incidence angle (max), deg</i>	0.1–90°	If the angle between the normal to triangle and the scanner view direction is larger than the specified one, this triangle is subject to removal.
<i>Incidence angle between vertices (max), deg</i>	0.1–90°	The algorithm will remove triangles whose edges form angles (toward the scanner viewpoint) greater than the specified limit (in degrees).

10.12 Creating Models (Fusion)

Fusion is a process that creates a polygonal 3D model. It effectively melts and solidifies the captured and processed frames. Fusion is the most interesting part of the processing task because a polygonal 3D model is what most people expect to see when performing a 3D scan. To this end, you can use one of the following algorithms, each of which has a self-explanatory name (see also the summary in [Table 13](#)):

- *Smart fusion* adapts to data quality and detail level. Ideal for mixed or uneven datasets, including scans from different scanners. At low *Sharpness* acts like *Smooth fusion*; at high values, like *Sharp fusion*.
- *Sharp fusion* produces highly detailed results using uniform processing for all input. Best for consistent, high-quality data from a single scanner. Faster than *Smart fusion*.
- *Smooth fusion* generates smooth, low-noise surfaces with reduced detail. Suitable for noisy scans, quick previews, or when detail is less important.

- *Basic fusion* produces quicker results and constructs a noisier geometry at the same time.



Figure 151: Models of a human subject obtained using various algorithms: *Basic fusion* (left), *Smart fusion* (smooth, middle) and *Smart fusion* (sharp, right).





Figure 152: Models of a shoe sole obtained using various algorithms: *Basic fusion* (left), *Smart fusion* (smooth, middle) and *Smart fusion* (sharp, right).

Table 13: Comparison of fusion modes.

	Smooth Fusion	Sharp Fusion	Basic Fusion
Usage	Large, noisy data sets with patchy missing regions; scans of moving objects	Scans from Artec Spider; scans having regions with fine details and sharp edges	Fast results for large data sets; also for measurements
Eva	resolution no less than 0.5		
Spider	resolution no less than 0.15		
Spider II	resolution no less than 0.1		
Leo	resolution no less than 0.6		
Fill holes	Available		Not applicable
Features	Smoother results. Can compensate for slight movements, but not recommended for accurate measurements Relatively slow	Higher level of detail. Faster than <i>Smooth fusion</i> , but may intensify existing noise.	Resulting surfaces are relatively noisy.

To obtain a model:

1. Make sure the scans you intend to fuse have passed *Global registration*.
2. Select the scans in the *Workspace* panel using the  checkboxes.
3. Open the *Tools* panel.
4. Hover the mouse cursor over the *Fusion* label in order to activate the controls of the tool and the pop-up with the default parameters (see [Figure 153](#)).
5. Specify the necessary parameter values by clicking the  icon (optional).
6. Click *Run*.
7. View the model in the *3D View* window and in the *Workspace* panel once the algorithm finishes. The model name will include the fusion type (e.g., *Smart fusion*, *Sharp fusion*, *Smooth fusion*, or *Basic fusion*) followed by an index number.

The fusion algorithms use the following parameters:

- *Type*:
 - *Sharp*, *Smooth*, and *Basic*: For more details on the fusion types, see the [Comparison of fusion modes](#).
 - *Smart*: Blends the Smooth and Sharp modes based on the *Sharpness* slider. At 0%, it works like Smooth; at 100%, it behaves like Sharp.
- *Max mesh resolution, mm* is the step of the grid (in millimeters) that the algorithm uses to reconstruct a polygonal model. In other words, this parameter defines the mean distance between two points in a model. The lower the *resolution* value, the sharper the shape. When specifying values, keep in mind the default values, lower limits in [Table 13](#) and [Error](#).

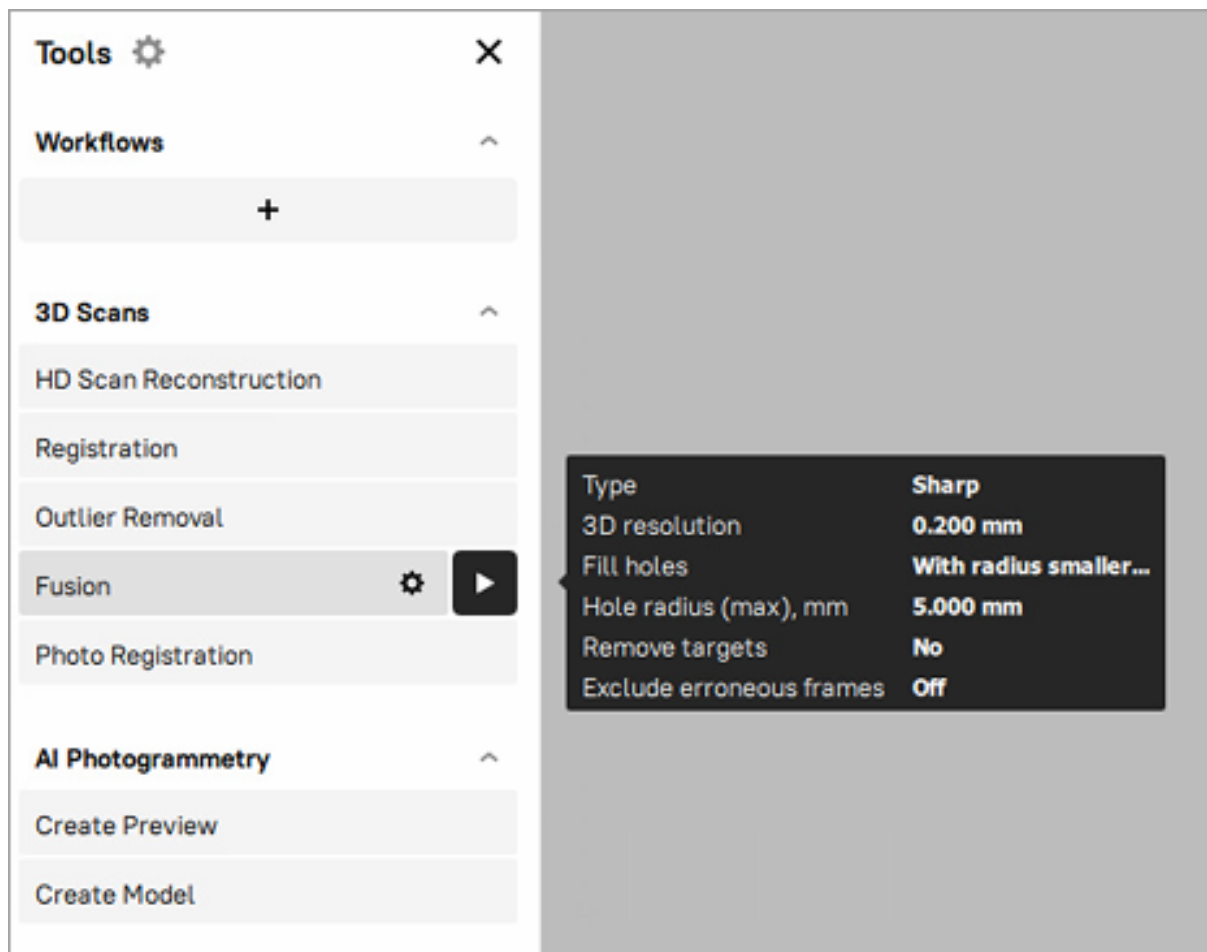





Figure 153: The *Fusion* pop-up with the default parameters.

- *Sharpness* specifies the level of detail in the final fusion and allows to switch from smooth geometry to higher resolution and sharper detailed geometry within a single tool
- *Fill holes* instructs the algorithm to fill holes in the mesh being reconstructed. The methods for filling the holes are as follows:
 - *With radius smaller* fills all holes with radius less than or equal to the specified value in the *Hole radius (max), mm* text box
 - *By relative radius* fills holes with relative radius less than or equal to the specified value in the *Relative hole radius (max), mm* text box based on the internal filling holes parameters of the scanner. Recommended for combined scans of different scanners or for Ray scans.
 - *Later, manually* prompts you to fill holes manually in the *Fix holes* panel, which opens automatically
 - *Manually by relative radius* prompts you to fill holes manually in the *Fix holes* panel, which opens automatically. Recommended for combined scans of different scanners or for Ray scans.
 - *None* fills no holes
 - *All (watertight)* automatically fills all holes in the mesh
- *Remove targets* allows you to erase small embossments from surfaces on which targets are placed (see [Target-Assisted Scanning](#)).
- *Glare-noise reduction* allows you to significantly reduce the glare related noise in the models obtained from the scans made with Artec Micro or Artec Micro II. This checkbox is only available for *Artec Micro* and *Artec Micro II* for the *Fusion* algorithm.
- *Error threshold* is a setting that automatically excludes all frames with error values above a set maximum threshold. Turn it on, and then enter the maximum error threshold value in the box that appears below.

10.12.1 Multi-preset Fusion

Starting from Artec 19, multi-preset fusion allows processing data from multiple scanners to create a single fusion. Artec Studio provides an interface to set the 3D resolution for each scanner type included in the scanned data.

The *Max mesh resolution* value defines the resolution for the primary scanner in the input field (i.e., the scanner with the highest resolution among those selected).

To set an each scanners resolution manually, click the gear icon . The resolution of each scanner type from the selected objects in the *Workspace* panel can be adjusted manually by clicking the  and  next to the respective input fields.

Note: Resolution limit toggle switches for all scanners, except the one with the highest resolution, can be turned off. When disabled, Artec Studio will ignore the resolution of

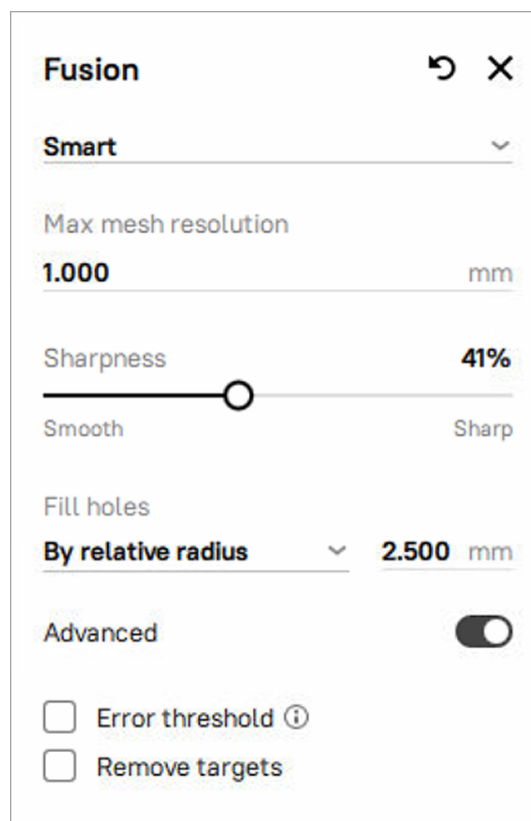


Figure 154: Tools panel: parameters of Smart fusion.

these scans and process data at the highest resolution, which may decrease performance.

10.12.2 Fusion-Algorithm Errors

Occasionally, defects appear in the 3D model after fusion; some are correctable by creating additional scans, whereas others are correctable by using the model-processing tools described in the next section.

Errors that can be corrected by capturing additional scans include low-amplitude noise on the surface (see [Figure 157](#), left). Normally, this error indicates that the affected area has a small number of frames. The number of frames needed to eliminate the noise depends on the reflective properties of the object's surface. To correct the error, you need one more scan to cover the noisy area (see [Figure 157](#), right).

Sometimes the cause of noise is an insufficient number of scanning angles. Areas captured at a larger angle have more noise than areas captured at a direct angle (i.e., 90 degrees). You can correct this error by scanning the area again using a better angle.

When the scanning conditions or the object features are such that you are unable to capture additional data, you can correct errors using the *Fix holes* (see [Fixing Holes](#)) or *Mesh smoothing* ([Mesh Smoothing \(Tools\)](#)) tools. If such errors are frequent, reduce the speed at which you move the scanner around the object, or increase the capture rate (see [Decreasing Scanning Speed](#)).

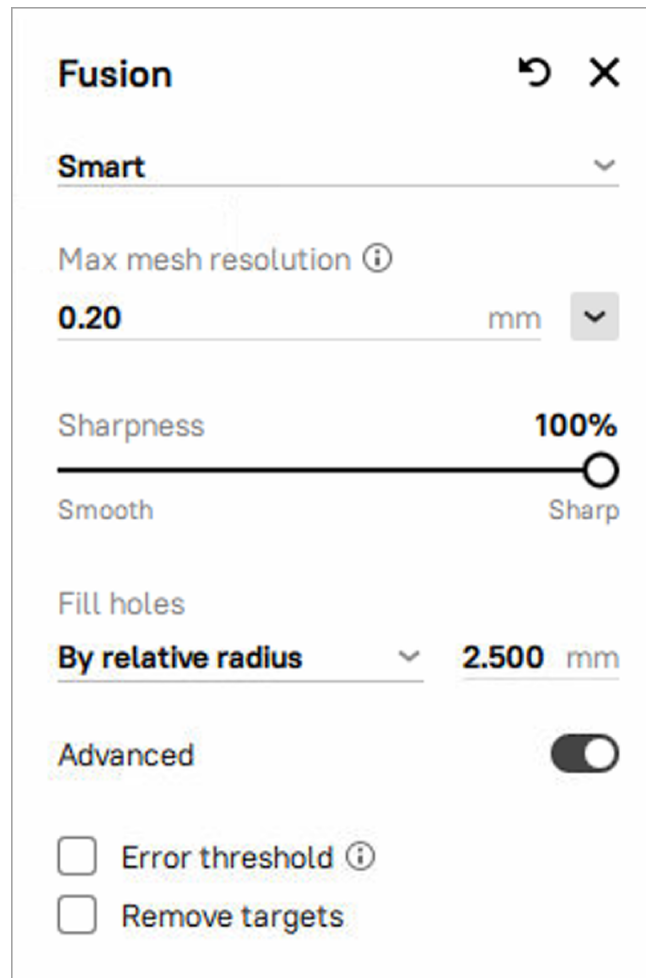


Figure 155: Multi-preset fusion with the max mesh resolution for Artec Spider II.

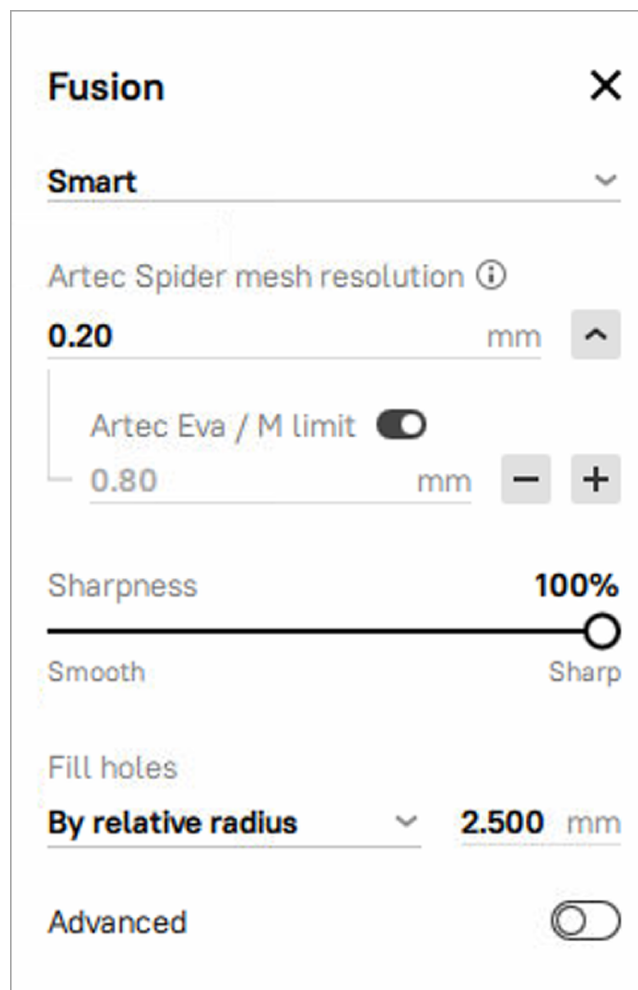


Figure 156: Input fields for setting the resolution of each scanner type used.

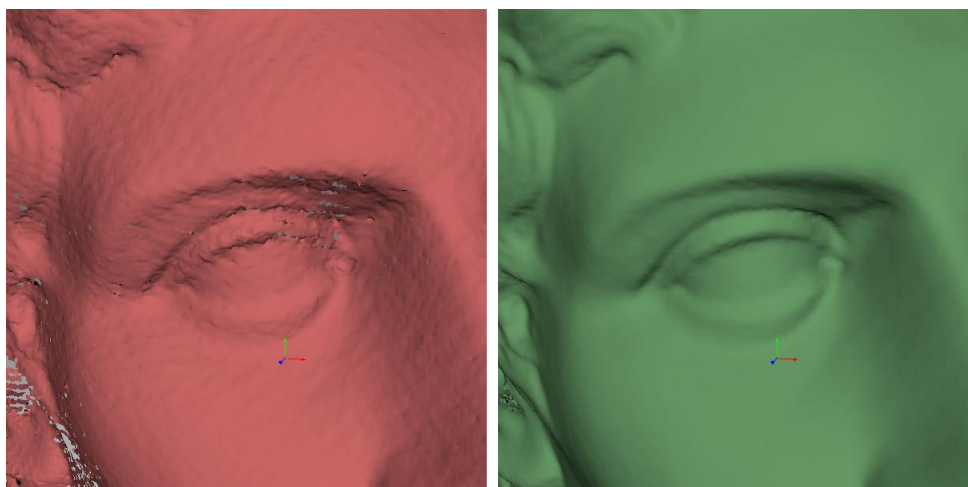



Figure 157: Surface noise caused by insufficient data (left) and improved model after adding one more scan (right).

10.13 Editing Models

The resulting fusion model may contain surface defects due to scanning or registration errors. Artec Studio provides a number of tools to correct such errors:

- *Repair* corrects the model's triangulation errors.
- *Small-object filter* removes small objects located near the model surface.
- *Fix holes* semiautomatically fills holes and smooths the model edges.
- *Hole filling* fills holes in the model automatically
- *Mesh smoothing* filters low-amplitude noise over the whole model
- *Smoothing brush* enables manual smoothing of the surface areas with the most noise
- *Mesh simplification* reduces the number of polygons in a model while minimizing lost accuracy
- *Isotropic remesh* creates isotropic mesh while keeping the processed mesh as close to the original as possible

Each algorithm processes all scans selected in the *Workspace* panel and replaces the original data with the results. If the algorithm is unsuccessful, you can restore the original data by clicking  (*Undo*) in the 3D window or *Workspace* panel.

See also:

[Boolean operations.](#)

10.13.1 Mesh Optimization (Tools)

In Artec Studio 18, several tools, including the *Small-object filter*, *Hole filling*, and *Mesh simplification*, have been combined into a single tool called *Mesh optimization*. Using all of them at the same time is optional, but it can provide you with better output when running the algorithm.

To start working with *Mesh Optimization* tool, select only the model you are currently editing in the *Workspace* panel, open *Tools* → *Mesh Optimization*. Once you set up all parameters that you need, click the *Run* button either on the pop-up of the *Mesh Optimization* tool or next to its name on the *Tools* panel to run *Mesh Optimization* algorithm.

10.13.2 Small-Object Filter (Tools, *Mesh Optimization*)

Small-object filter is a part of the *Mesh Optimization* tool which can help you erase outliers before fusion (see [Eliminating 3D Noise \(Outlier Removal\)](#)), Artec Studio may solidify and preserve them in the scene as small, distant fragments.

You can effectively remove these remaining outliers by using a filtering algorithm.

To remove these artifacts, make sure that *Remove Small Objects* checkbox is selected (see [Figure 158](#)). Additionally, you can adjust the following parameters:

- *Remove surfaces*
 - *All except largest* instructs the algorithm to erase all objects except the one with the most polygons
 - *Smaller than specified* erases from the scene all objects whose number of polygons is less than the amount specified in the *Polygon count (max)* parameter.

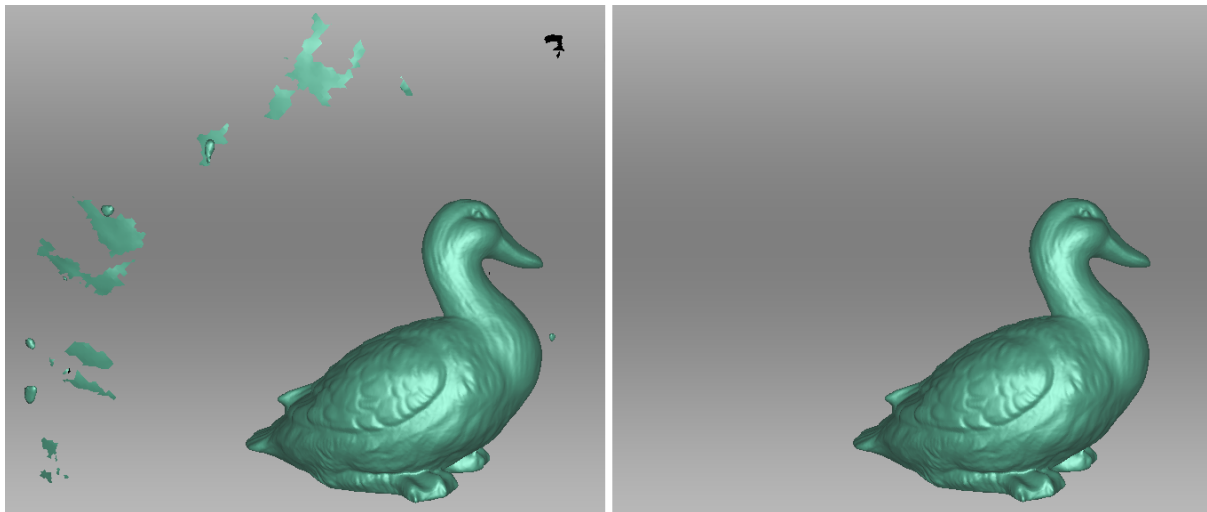


Figure 158: Filtering of small objects: before (left) and after (right).

10.13.3 Hole Filling

Sometimes the shape of an object or the scanning conditions prevent you from properly capturing of all parts of the scene. As a result, the fused 3D model will have holes. In such instances, you can use either of the hole-filling tools to interpolate the surface.

- [Bridges or Smart Hole Filling](#)
- [Automatic Hole Filling \(Tools, Mesh Optimization\)](#)

10.13.3.1 Bridges or Smart Hole Filling

The *Bridges* tab is intended to connect a pair of the edge fragments by constructing a surface that follows the curvature of the neighboring surfaces.

To create a bridge, follow the procedure:

1. Open *Fix holes* → *Bridges*. All holes will outline in red.
2. Specify two opposite fragments¹ between which a bridge will go (Figure 160). There are two ways to do this:

Quick method	Ctrl-key method
Perform the steps below for each fragment :	Click once anywhere in the <i>3D View</i> to activate this method and then perform the steps below for each fragment :
<ol style="list-style-type: none"> a. Point the cursor at the edge. A part of this edge will be automatically highlighted indicating a future fragment. b. Drag the cursor along the edge to find the desired fragment location. c. Click LMB to confirm the fragment. 	<ol style="list-style-type: none"> a. Press and hold Ctrl and then point the cursor at the edge. b. Press and hold Ctrl+LMB to specify a fragment beginning. c. Still holding Ctrl+LMB, drag the cursor to specify the entire fragment. d. Release Ctrl+LMB to confirm the fragment.

3. Once you've confirmed the second fragment, a bridge preview will appear.
4. Drag the square sizing handles to adjust the bridge width and position as necessary.
5. Adjust *bridge curvature* on both sides and *Bridge smoothness* as necessary.
6. Click *Build bridge* to confirm your bridge.

The table below lists the possible actions matched with the options and commands for this tool.

¹ Normally a bridge goes between two opposite fragments of one hole. In complex cases, you may use fragments on different holes or edges.

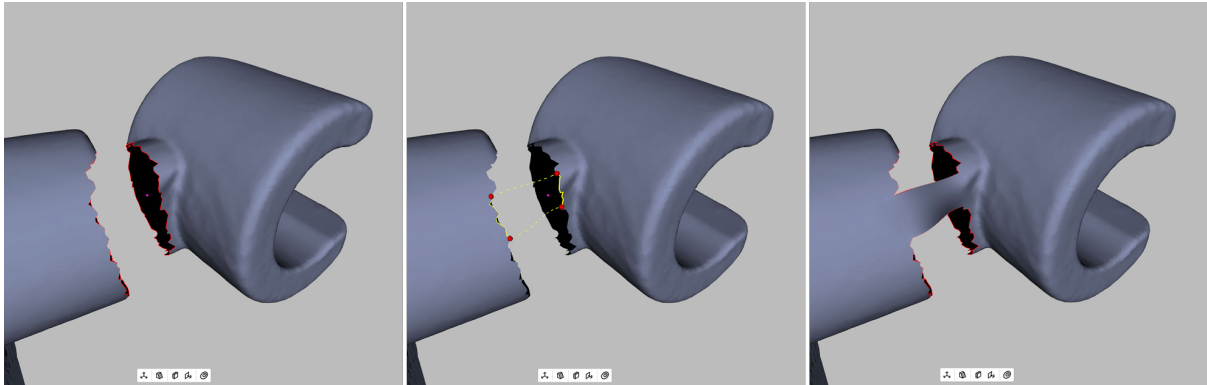


Figure 159: From left to right: original surfaces, bridge preview, actual bridge.

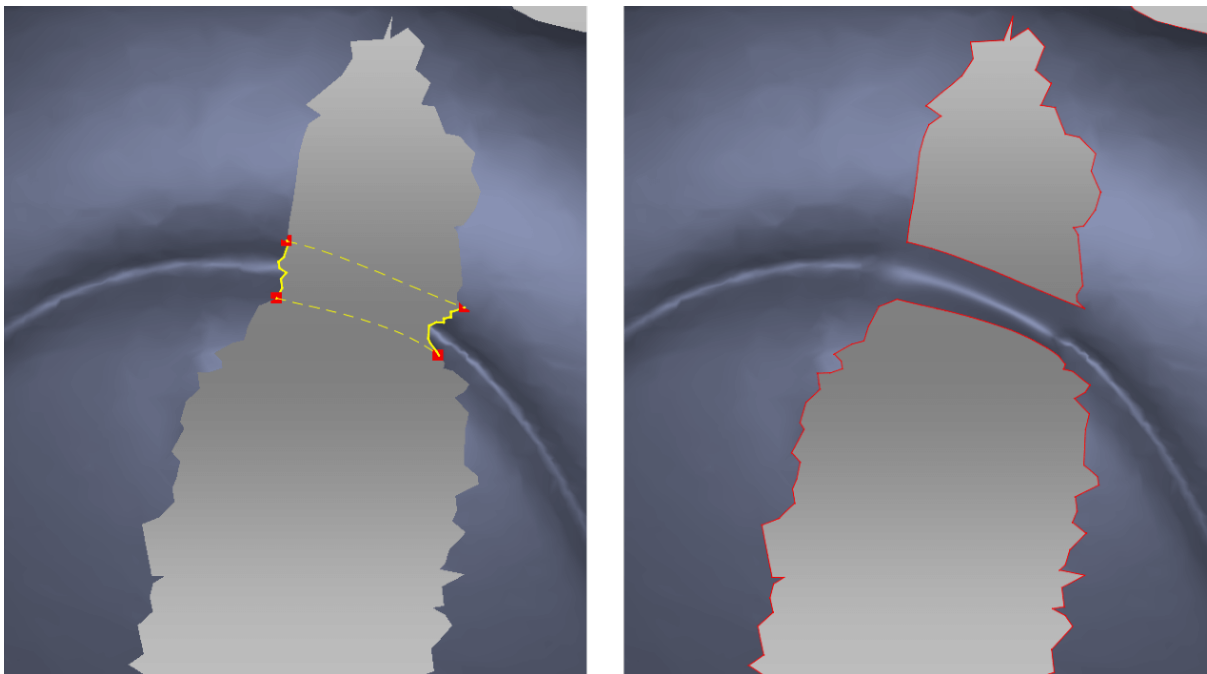


Figure 160: Specifying fragments. Correct fragments can resolve original geometry.

Prepare edges by removing raggedness	Select the <i>Smooth edges first</i> checkbox
Preserve the original geometry (Figure 160)	Clear the <i>Smooth edges first</i> checkbox
Smooth bridge surface	Use the <i>Bridge smoothness</i> slider
Edit bridge-preview position	Drag the square controls around the corners of the bridge preview
Adjust bridge tension	Use interactive sliders <i>Curvature (start, end)</i>
Delete bridge preview	Click <i>Clear preview</i> or <i>Delete</i> key

Smoothing or Keeping Edges

Smoothing edges might not always be beneficial to you. If the bridge failed to recreate the original geometry, try one or several actions from the following list:

- Clear the *Smooth edges first* checkbox.
- Use small or medium values of the *Bridge smoothness* slider (Figure 161).
- Select fragments correctly.

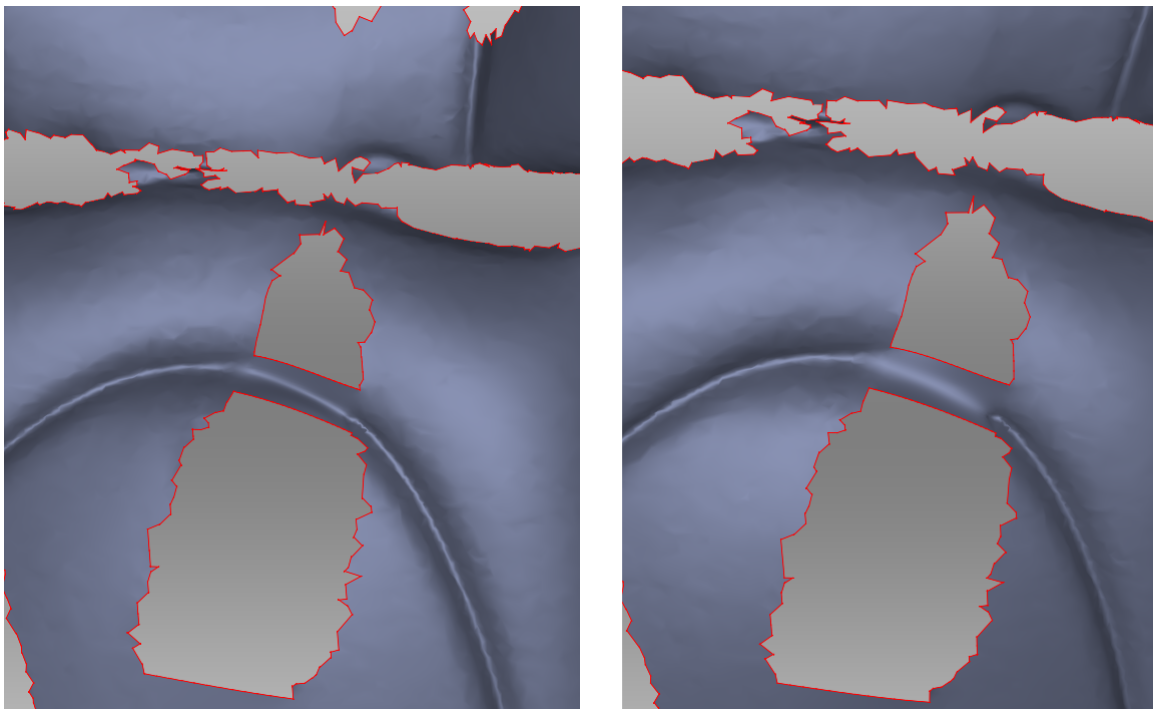



Figure 161: Small smoothness values on left and maximum on right.

10.13.3.2 Automatic Hole Filling (Tools, *Mesh Optimization*)

To quickly and automatically fill holes, make sure that *Heal bad polygons* checkbox of the *Mesh Optimization* pop-up is selected. The algorithm processes the following polygon types which can be selected by clicking the  icon next to the *Heal bad polygons* checkbox:

- Non-manifold
- Dangling
- Crossing
- Folded with angle (The angle can be specified in the angle field)

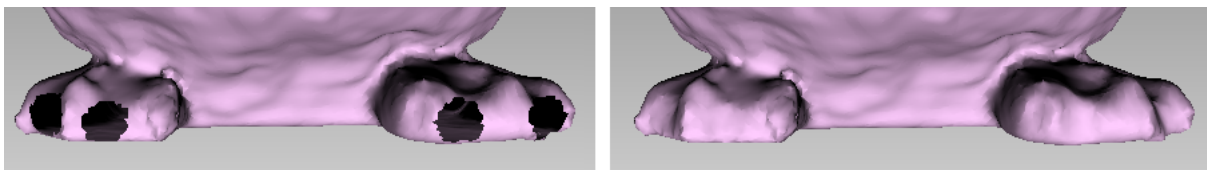


Figure 162: Hole-filling algorithm: original model on left, processed on right.

10.13.4 Mesh Simplification (Tools, *Mesh Optimization*)

The mesh produced after fusion may be less than optimal for some applications because it will contain a large number of polygons. This complexity will increase the amount of memory the model occupies, hindering further processing. To optimize the model size while retaining accuracy, toggle the *Mesh simplification* switch in the *Mesh Optimization* tool.

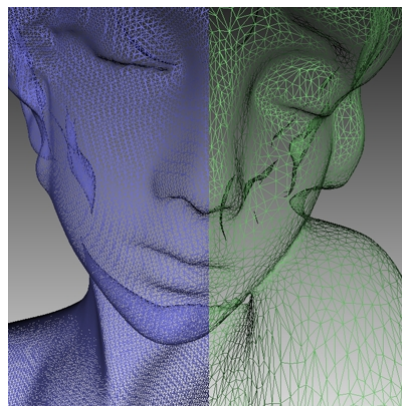


Figure 163: *Mesh simplification*: original mesh on the left, optimized mesh on the right.

Regular mesh simplification type allows to select the *Target when simplifying* option:

- *Shape deviation* optimizes model to a predetermined accuracy: the *Maximum shape deviation, mm* parameter defines the optimized model's maximum allowable deviation (in millimeters) from the original model. When the algorithm reaches this value, the optimization stops.

- *Remove small polygons* performs simple mesh optimization, removing triangles whose edge lengths are less than the *Polygon edge length (max)*, mm value (in millimeters).
- *Polygon count* simplifies the model by targeting the number of triangles specified in the *Polygon count* text box. The algorithm minimizes the resulting model's deviation from the original model, but the final deviation value will remain unknown until processing concludes. Use this method when you know how many triangles the resulting model should have.

Tip: To determine the number of triangles, reveal the *Properties* panel for the appropriate model in the *Workspace* panel.

- *Keep texture* is similar to the *Polygon count* algorithm, but intended for meshes with textures mapped by the *Atlas* method (see [Applying Texture](#)). This approach not only simplifies the polygon grid, reducing the number of triangles, but it preserves texture.

Tip: Since the UV methods tend to slightly reduce texture resolution, we recommend using either of them only when no raw scans are available. It is generally better to simplify models using one of the regular method and then reapply texture.

The three first algorithms in the list above have the additional parameter:

Keep edges maintains the model boundary. Mesh simplification on the scan edges may affect their geometry. Thus, if the shape of the boundaries is more important than the optimized mesh, select this checkbox. Otherwise, clear it, and the algorithm will simplify the boundary mesh.



Figure 164: Boundary-appearance options: *Keep edges* enabled (left) and disabled (right).

Note: Mesh simplification may take a long time when the parameters of the original and optimized models are significantly different (for example, if the deviation value is high in *Shape deviation* mode or if the required number of polygons in *Polygon count* mode is much smaller than the number in the original model). For very large 3D models the operation requires extensive memory resources and may fail owing to insufficient RAM. Free the memory by closing unused applications and by optimizing memory usage in Artec Studio, keeping in mind the recommendations in [Memory Management: Smart RAM Usage](#) and [Saving Project History](#).

The *Fast mesh simplification* algorithm works faster than the regular one.

- *Simplification ratio* option allows to select the percentage of polygons to keep in the simplified mesh.
- *Target polygon count* determines the number of triangles for the resulting model, depending on the value of *Simplification ratio*. You can find out how many are in the actual model by double-clicking it in the *Workspace* window.
- *Nonstrict polygon count* option:
 - If this checkbox is cleared, the value specified in the *Polygon count* text box remains constant.
 - If this checkbox is selected and the algorithm is unable to produce a surface with the specified number of triangles (*Polygon count*), Artec Studio will automatically update this value. In other words, improving the quality of the resulting surface is the primary objective.
- *Keep edges* maintains the model boundary. Mesh simplification on the scan edges may affect their geometry. Thus, if the shape of the edges is more important than the optimized mesh, select this checkbox. Otherwise, clear it, and the algorithm will simplify the boundary mesh.
- *Keep texture boundary* preserves all vertices on the boundaries of texture patches, causing them to be ignored by the algorithm. Consequently, there is no need to perform texturing again.

After adjusting the algorithm settings, click *Run* to start processing.

10.13.5 Defeature Brush (Editor)

Erasing certain geometrical imperfections often demands further processing of the resulting holes in the model. The *Defeature brush* combines functions of the *Eraser* and *Hole filling* tools and may boost your productivity. To use it, follow these steps:

Warning: If you edit a textured model, note the following. Since the texture will incorrectly fit the altered surface, the Defeature brush will remove it from the model. So you will need to repeat [texturing](#) after you finish editing.

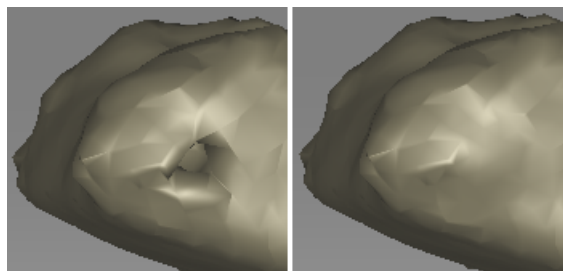


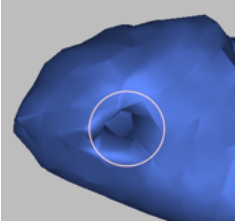
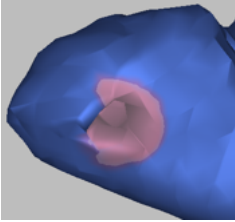
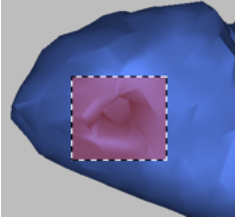
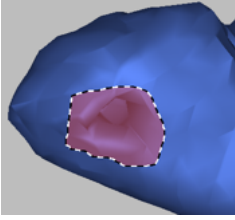



Figure 165: *Defeature brush*: imperfection on the scanned surface (left), results of applying the tool (right).

1. Select one model in the *Workspace* panel.
2. Open the *Editor* panel using the side toolbar and click either *Defeature brush* or hit D.
3. In the *Editor* panel, choose the required selection type.
4. Consult the [instructions](#) for each mode and select regions on the model that you want to modify. To clear all selections, click *Deselect*.
5. Click *Apply*. The software will delete the feature, close up the hole and smooth the surface.

To undo changes, click  in the 3D window or hit `Ctrl+Z`. Each click of the *Apply* button generates a command history entry. To undo several operations, use the dropdown menu of button  and select the lowest entry.

10.13.5.1 Selection Types

Type	Illustration	Usage
2D		Hold down <code>Ctrl</code> and use <code>Scroll wheel</code> to adjust the tool size. Paint with <code>Ctrl+LMB</code> to create a selection.
3D		See above.
Rectangular		Use <code>Ctrl+LMB</code> to select a rectangular region.
Lasso		Use <code>Ctrl+LMB</code> to freely outline an irregular region. You can release <code>LMB</code> (not <code>Ctrl</code>) and then continue clicking on desired points to select a desired shape.
Cutoff-plane		Create selection as in 2D mode. Once you have released the mouse button, a plane will appear. If necessary, adjust the plane level by using <code>Scroll wheel</code> while holding down <code>Ctrl+Shift</code> or orient the plane freely in 3D space. To this end, hit <code>Alt</code> to display the <i>designated control</i> . Then still holding the key, drag the required control ring. Note that it doesn't work with raw point clouds from Artec Point.

If you need to deselect any region, hold `Ctrl+Alt` and reselect this region. To clear all selections, click *Deselect*.

If the *Select through* checkbox is selected, all surfaces throughout the model are affected. If not, the brush only works on the visible surface.

See also:

[Hot keys in Editor](#).

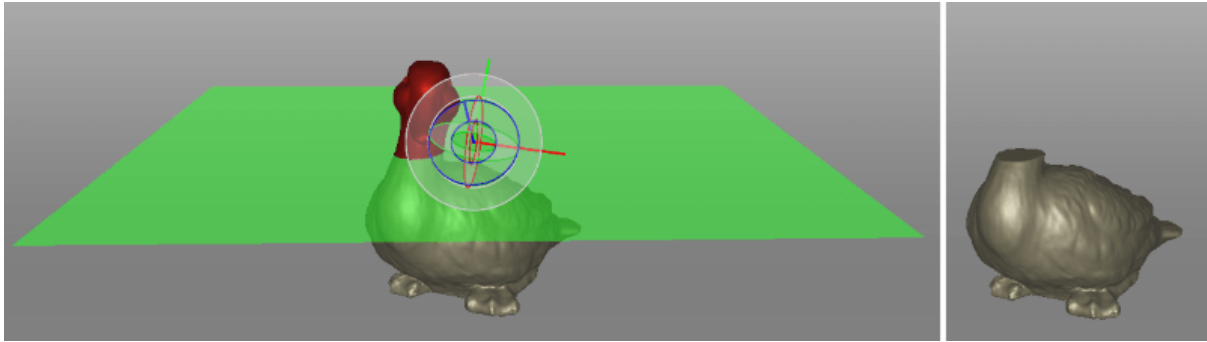


Figure 166: Applying *Cutoff-plane selection* in *Defeature brush*.

10.13.6 Smoothing

10.13.6.1 Mesh Smoothing (Tools)


The mesh smoothing algorithm evens out noisy areas in the 3D model. Artec Studio provides two such tools: automatic smoothing of the entire model and manual smoothing of specific areas identified using a brush (see [Smoothing Brush \(Editor\)](#)).

To run the automatic mesh smoothing algorithm, open the *Tools* panel and select *Mesh smoothing*. You need only set the *Steps* parameter (the number of algorithm iterations to be performed).


10.13.6.2 Smoothing Brush (Editor)

The *Smoothing brush* is a tool that you can employ selectively in specific areas without touching areas that require no alteration (for more information about automatic smoothing, consult [Mesh Smoothing \(Tools\)](#)).

To use the *Smoothing brush*,

1. Select just one model.
2. Open the *Editor* panel, and click the  icon or hit S.
3. Hit **Ctrl**, an orange region will appear around the cursor in the *3D View* window.
4. Change brush size if necessary:
 - Use either the **Ctrl+[** and **Ctrl+]** shortcuts or
 - Use **Scroll wheel**.
 - Enter a size (in millimeters) in the *Brush size* field.
 - Alternatively, you can adjust the slider bar in the *Smoothing brush* panel.
5. Set the smoothing strength if necessary:
 - Enter the desired value in the *Smoothing strength* field or
 - Adjust the slider bar.

6. Hold **LMB** and paint the surface region in order to smooth it. The tool will smooth the affected areas (see [Figure 167](#), right).

To undo changes, click  in the 3D window or hit **Ctrl+Z** as many times as needed to return to the original state of the model since each brush stroke generates a command history entry.

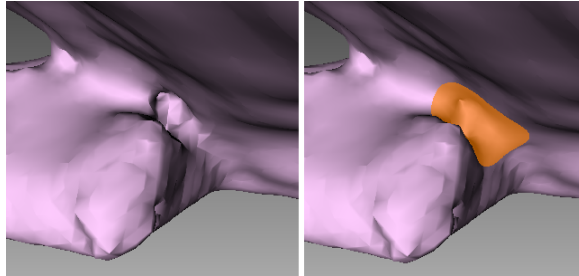



Figure 167: Before smoothing (left) and smoothing out a poorly captured area (right).

10.13.6.3 Smoothing Edges

The *Edges* tab allows you to smooth ragged edges of the model.

To smooth an edge or any part of it, follow the steps:

1. Open *Fix holes* → *Edges*. It will show the list of edges detected on the surface. These defects are sorted by their full length.
 - Mark the checkbox next to the edge in the list to select **a whole edge**².
 - In *3D View* window, hold down **LMB** and drag the square control to specify **a part of the edge**.
 - Use the *Select all* button to select **all edges**.
2. Artec Studio will highlight these edges in red and draw yellow curves alongside them depicting smoothed boundaries.
3. Use the *Strength* slider to control the edge-smoothing intensity as necessary.
4. Click *Smooth edges*.
5. Click *Apply* to confirm the results. If the results aren't satisfactory, use the  button to cancel recent changes.

² If the *Move camera to selection* option is checked, the model will automatically rotate to display the selected hole.

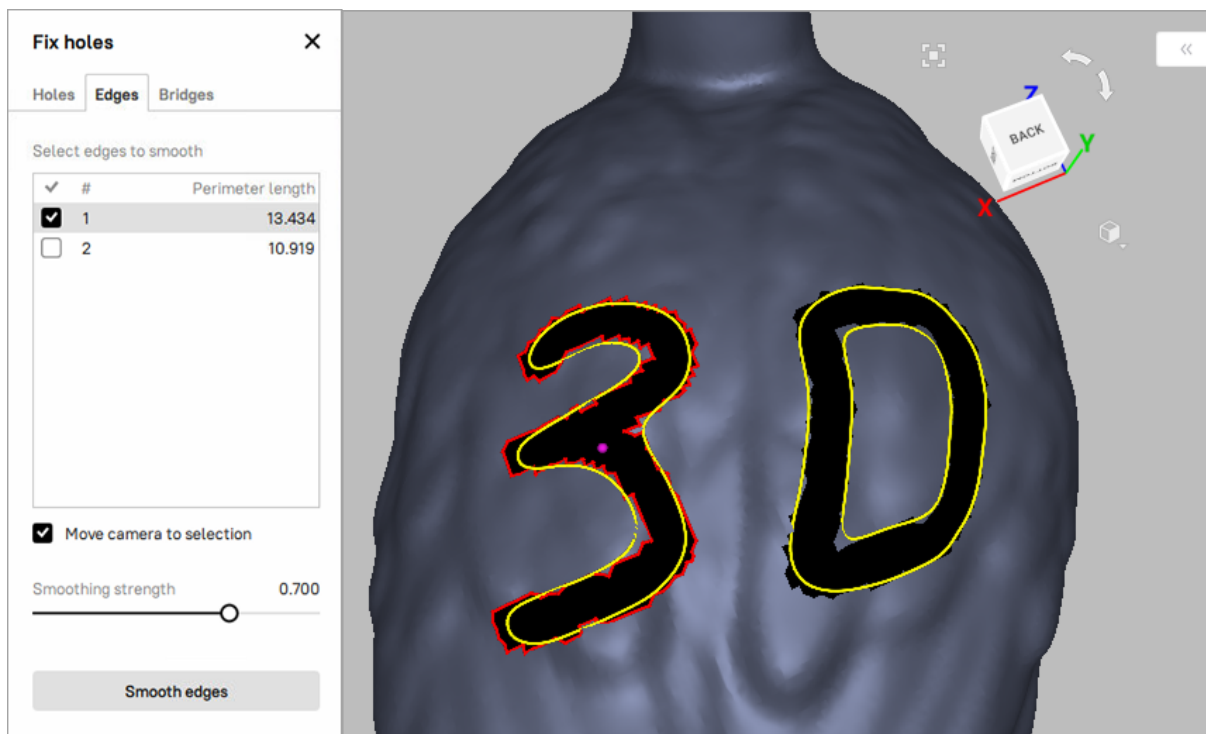


Figure 168: Boundary selection for edge smoothing

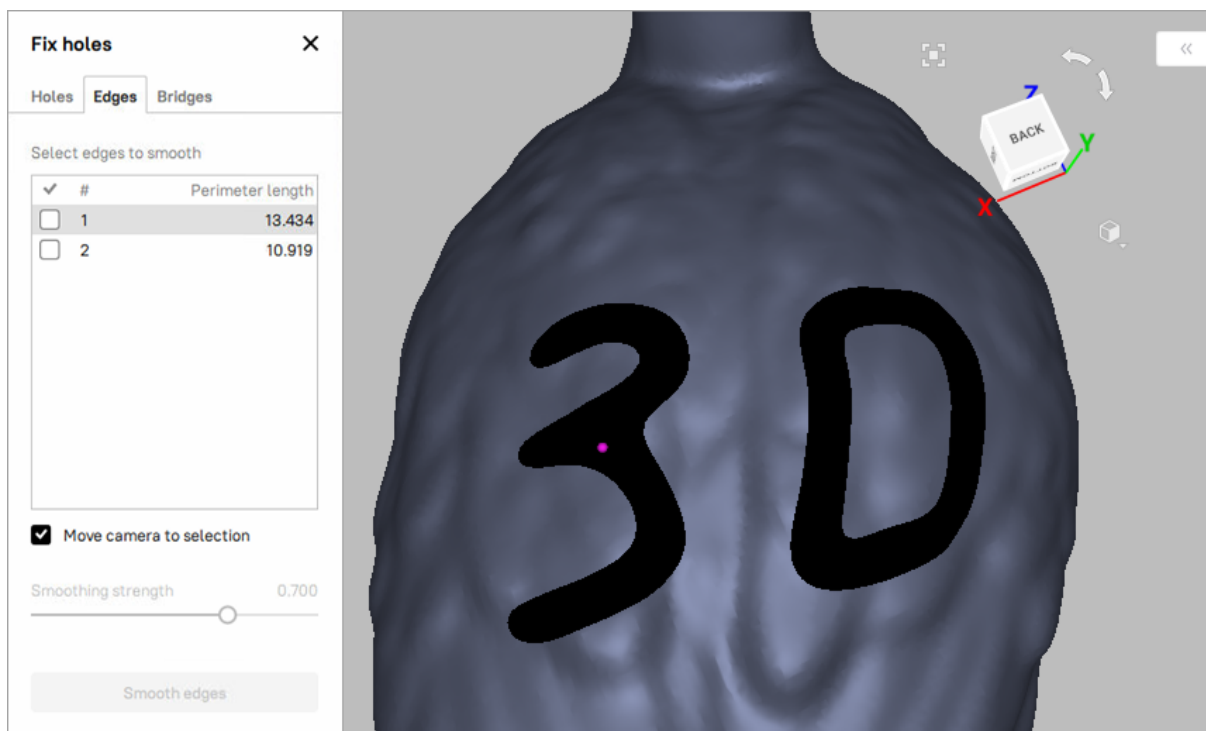


Figure 169: Edge-smoothing algorithm results.


10.13.6.4 Fixing Holes

The *Holes* tab provides *Flat* and *Smooth* hole filling options for respective surfaces.

1. Open *Fix holes* from the side panel.
2. Select the *Holes* tab. It will show the list of holes detected on the surface. These defects are sorted by their perimeter length.
3. Select a hole either in *3D View window* or mark the checkbox next to it in the list. Artec Studio will highlight these holes in red (see [Figure 170](#)).

Note: If the *Move camera to selection* option is checked, the model will automatically rotate to display the selected hole.

Hint: Use the *Select all* and *Deselect all* buttons in the panel to select or clear all selections, respectively.

4. Select a suitable filling mode. If you are filling a hole on a flat surface of the mesh, go for the *Flat* mode, and go for the *Smooth* mode to fill tricky holes in the curved parts of the mesh.
5. Click *Fill holes* to repair your model.
6. Click *Apply* to confirm the results. If the results aren't satisfactory, use the  button to cancel recent changes.

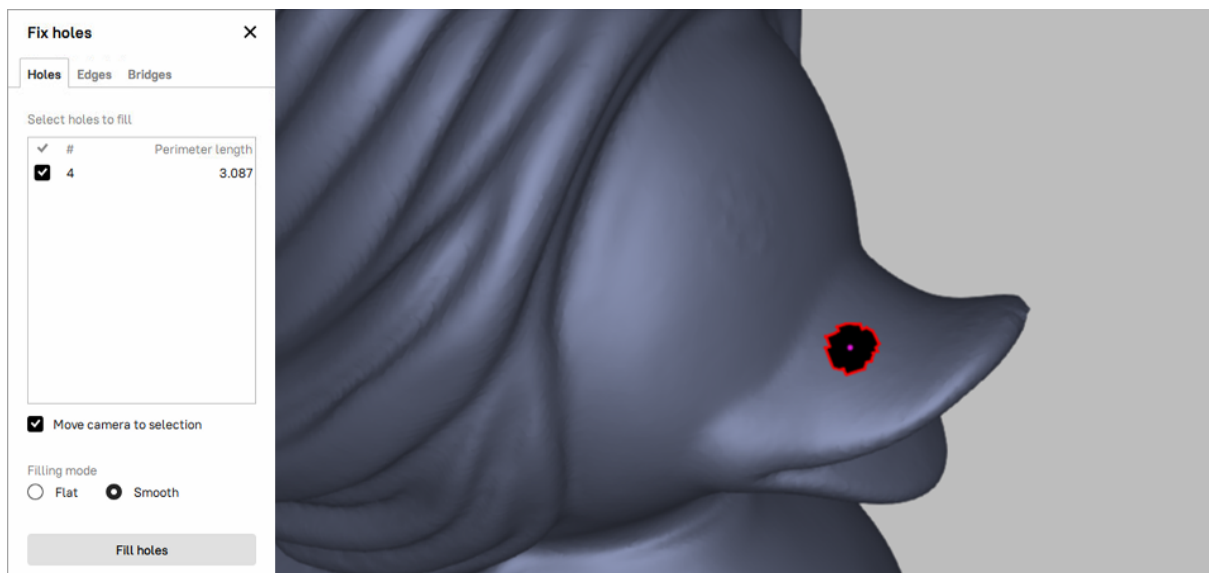


Figure 170: One hole on a curved surface, marked for correction.

If you try to exit the *Fix holes* mode without accepting changes, the software will ask you for confirmation.

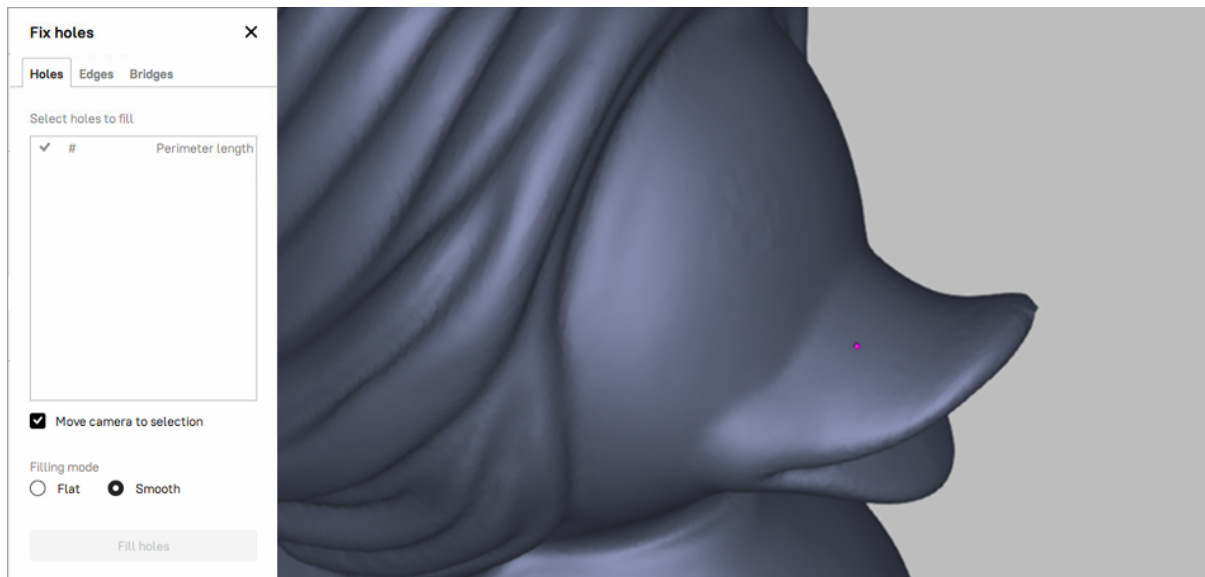


Figure 171: Result from running the *Fill holes* algorithm using the *Smooth* mode.

10.14 Photo Registration

The photo registration algorithm in Artec Studio enables you to apply textures to models using photographs. Photos of the object can be used to project textures onto fused models. This advanced texturing approach can be used to capture complex textures and significantly enhance models.

10.14.1 Preparing Object

To obtain best texturing results, it is important to follow the below given tips before scanning and taking photographs.

1. Before taking photos, make sure the object has prominent texture features.
2. For large objects with monochromatic surfaces, add additional features in the background to highlight the texture. However, if you will have to rotate the object, it is better to use a plain background.
3. Provide adequate and uniform lighting. It is recommended to use external studio lighting for cameras with low light-sensitivity. Do not use the flash.
4. In the case when exposure is too big to hold the camera in hands, it will help to use a tripod.
5. Make sure the object remains stationary during scanning and taking photos. If you need to turn or move the object to scan all sides, it is recommended to take photos immediately after scanning in one position, before moving the object to scan in another position.

10.14.2 Capturing Photos

The photos for registration can be captured using any SLR camera or a smartphone with a good camera. For optimal results, it is important to capture good quality photos that are sharp and bright, and not noisy and blurred. Here are some best practices for capturing good quality photos for texturing.

1. Capture photos from a proper and fixed distance. The object must be at the center of the photo and occupy the most space, with minimal background details.
2. Adjust and fix the focal length, exposure and aperture.

Note: A best practice is to capture all photos with the same settings.

1. Capture subsequent photos of the object with at least 66% or *2/3 overlap* while moving the camera. Take a series of photos, much like the texture frames captured by Artec scanners.
2. Photograph each element of the object at least 3 times.
3. Avoid taking photos of any additional objects that can disturb the texture of the object you're scanning, like a pedestal the object is placed on.
4. It is recommended to convert all photos to .jpeg format and preserve their EXIF information.

Color corrections or white-balance corrections can be applied to photos for post-processing, but it is advisable to process all the photos in the same manner. Avoid geometrical transformations, resizing, distortion corrections, or color-space transformations.

10.14.3 Importing Photos

1. After all the necessary photos have been captured, save them to a folder in your system.
2. Obtain the 3D model of the object using the standard procedures until fusion.
3. Import all the necessary photos, using the *File → Import → Import photos* menu option.

Note: Starting from version 17, you can import pictures from several different cameras or the same camera but with different exposition settings.

Artec Studio will automatically sort the imported pictures by focal length, camera type and resolution and place them into separate sets of photos. These sets will appear in the *Workspace* panel and in the *3D View* window. Pictures with random parameters will be placed to the *Unusable* set of photos.

Before [registering the imported photos](#), you can [inspect their quality](#).

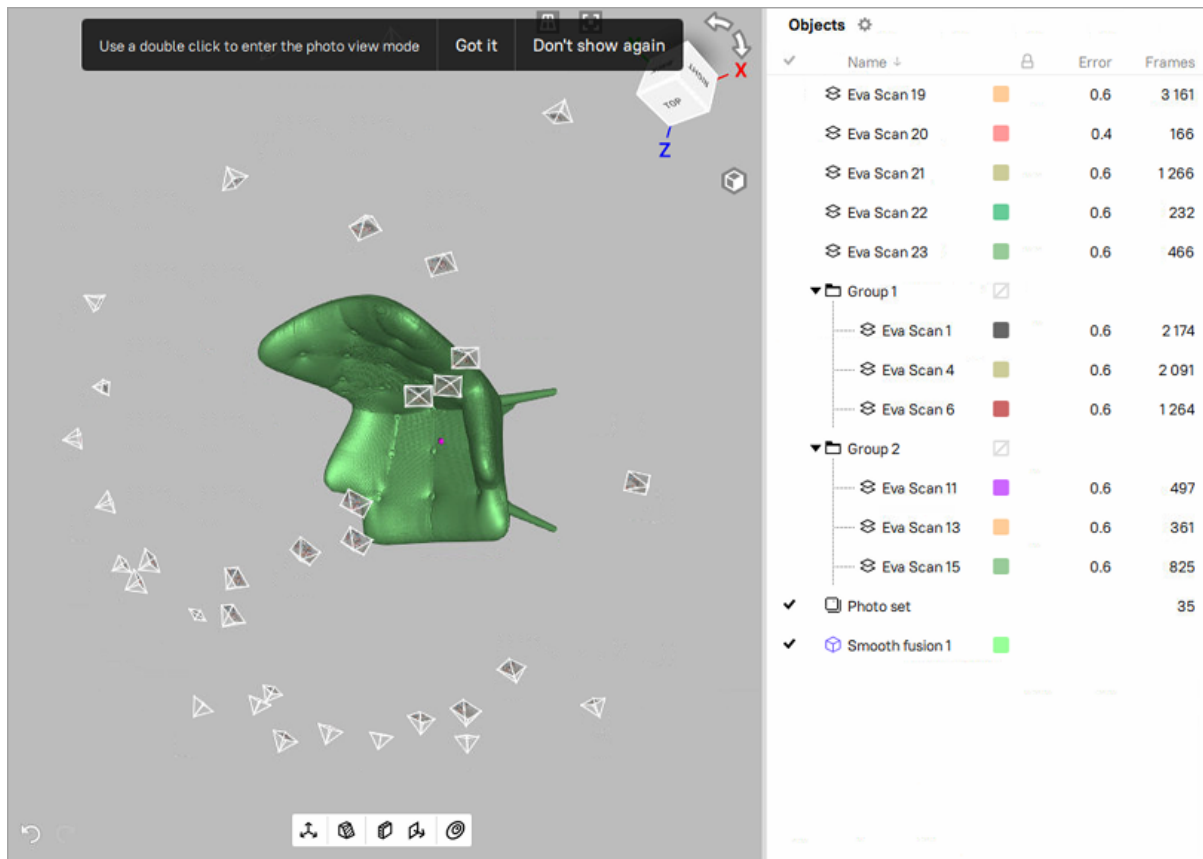


Figure 172: An imported set of photos in the *Workspace* panel and in the *3D View* window.

10.14.4 Inspecting Quality Of Photos

Starting from Artec Studio 17, it is possible to assess each captured photo for adequacy of texture capturing or misalignments before completing photo registration. To inspect the quality of the imported photos, follow these steps:

1. In the *Workspace* panel, double-click a set of photos or right-click a set of photos and select the *Show photos*. The entire list of photos it contains will appear.
 - For each photo, its name, focal length, and camera data will be provided.
2. Double-click an individual picture to inspect it closer. It will be opened in a super-imposition viewing mode:

Note: By default, all objects in the *3D View* window except the pictures of the selected set will be hidden. To see other objects, select the *Show other selected objects* option.

- To compare the model's texture with a reference picture or check for misalignments, use the *Show photo* toggle or press **Ctrl+Q**. The 3D model will appear in the *3D View* window.
- To zoom in and out, use **Scroll wheel**.

- To move the picture, hover over it and drag it holding down `Scroll wheel`.
- To exit the viewing mode, press either `LMB` or `RMB` and drag in any direction.

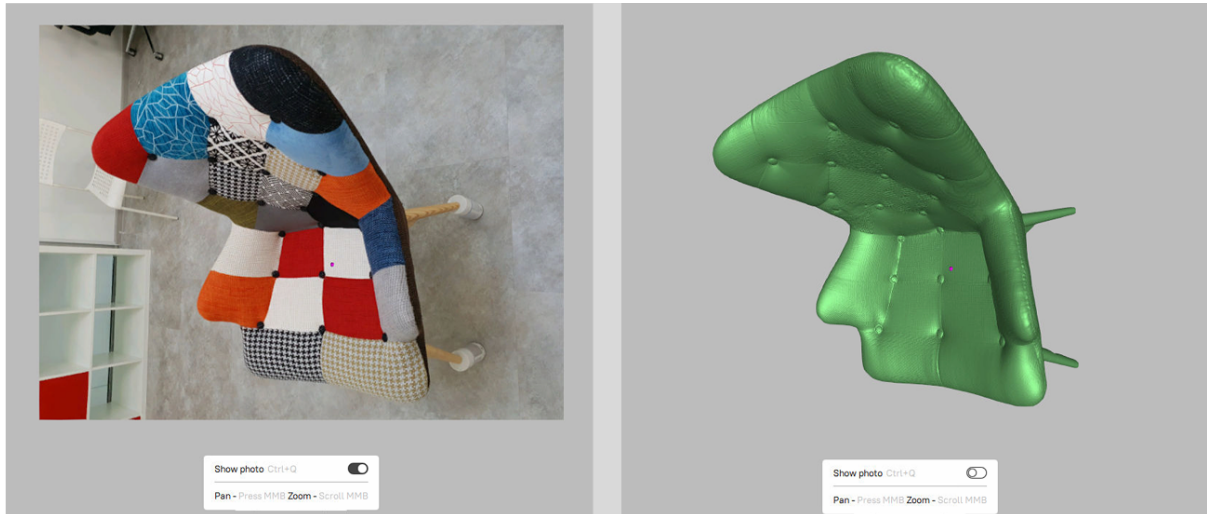


Figure 173: Inspecting the quality: a—the *Show photo* toggle is on, b—the *Show photo* toggle is off.

3. To delete a picture from the set of photos, click it in the *Workspace* panel by `RMB` and select *Delete* from the context menu. You can also press `Delete` on the keyboard.

10.14.5 Registering Photos

To register photos for use in further texturing of the model, follow these steps:

1. In the *Workspace* panel, select all the scans of the model, the fusion and the desired sets of photos (all three items).
2. Open *Tools* → *Registration*.
3. Select *Photo* as the registration type in the *Registration* pop-up.

Note: Artec Studio automatically sorts the imported photos, and groups them into sets based on their settings (focal length, resolution, camera type, orientation etc.). Inapplicable photos are removed into a separate photo set.

4. Set the photo registration parameters as necessary. See [Photo-Registration Parameters](#).
5. Click *Run*.

Once the photos are registered, [follow the Texturing procedure](#) and apply the texture to the model.

10.14.6 Photo-Registration Parameters




Registration  


Photo 

Settings for Artec Eva / M

Default FOV

60.000

Optimize for

Speed 

Max. feature reprojection error, px

4.000

Max. avg. reprojection error, px

4.000

☒ Image pre-processing

Run

Cannot apply algorithm to the current selection

Figure 174: Photo-registration parameters

<i>Default FOV</i>	The default value is 60.	Defines the camera's field of view. Photos usually contain this parameter in their meta-data. If Artec Studio fails to extract the FOV from the metadata (e.g., if the metadata is missing this information), it will use the value specified in the Default FOV field.
<i>Optimize for</i>	Speed/Quality	Suggests two options for prioritizing optimization.
<i>Max. feature reprojection error, px</i>	The default value is 4.	Sets the threshold for reprojection error during intermediate filtering in reconstruction.
<i>Max. avg. reprojection error, px</i>	The default value is 4.	Sets the threshold for the final filtering of observations and 3D points after the main reconstruction cycle.
<i>Image pre-processing</i>	On/Off	When enabled, it applies contrast to scanner images. Useful for Eva, Leo, or Spider when capturing objects from large distances or with dark textures.

10.15 Texturing

Artec scanners are equipped with a color camera, allowing you to capture 3D surfaces with texture and expanding the range of objects available for scanning. Texturing is a process that projects textures from the individual frames onto the fused mesh.

10.15.1 Preparing Model

To take advantage of texture, do the following:

1. Make sure the *Don't record texture* checkbox is cleared.
2. Adjust the capture frequency for texture frames if necessary (see [Texture-Recording Mode](#) or [Frequency for Capturing Texture Frames](#)).
3. Avoid turning off the flash bulb.
4. Adjust the texture brightness in *Preview* mode by using the eponymous slider in the *Scan* panel.
5. Scan the object using a tracking algorithm of your choice. Captured frames are marked with the checkerboard icon in the *Workspace* panel (surface-view mode) (see [Figure 84](#), right).
6. Process the data and create a model, consulting the list in the beginning of [Data Processing](#) or [Use Autopilot](#).
7. Run a mesh-simplification algorithm for the resulting model (see [Mesh Simplification Tools](#), [Mesh Optimization](#)) to accelerate the texturing process.

8. Use the *Texture* panel to apply the texture to the model.

10.15.2 Applying Texture

10.15.2.1 Create Texture

The 3D model obtained after fusion contains no texture information. To apply textures onto a model, switch to the *Create* tab and do the following:

1. Open the *Texture* panel.
2. Select a model from the *Model to texture* list (see [Figure 175](#)). Artec Studio will apply the textures to this model. The model selected in Workspace will automatically be active in this list.
3. In the *Texture source* section, the scans from which you created the model (these scans have the required textures) or the photos you registered using *photo registration* will be selected. Otherwise, select the necessary source data manually.
4. Select the required *Output texture size* and other options as necessary.
5. Click *Apply* to start the texturing process.
6. Finally, when the texture is ready, [adjust it](#) as necessary.

Note: To optimize resource utilization, Artec Studio unloads all surfaces from memory, except those needed for texturing, before running the applying procedure. For a more detailed description of selective project-data loading, see [Memory Management: Smart RAM Usage](#).

The following texture settings can be adjusted before texturing:

- *HDR*—Enables working with HDR data from Artec Ray II when texturing and activates additional texture adjustment controls, such as *Color adaptation*, *Light adaptation*, and *Intensity*. If disabled, the texture is converted to a standard format.
- *Remove targets*—Paints out targets by applying surrounding texture information (targets are used to facilitate scanning—see [Target-Assisted Scanning](#)). It makes sense with the *Remove targets* enabled before producing this fusion model (see [Creating Models \(Fusion\)](#)).
- *Reduce glare*—Eliminates glare spots on texture. It requires many texture frames captured from different perspectives.

Note: Check whether the source scans include sufficient number of frames (especially texture frames). If necessary, increase [texture-frame rate](#) and rescan. Glare reduction is a time consuming algorithm. If you plan to obtain a high-resolution texture, we advise you to first tweak the

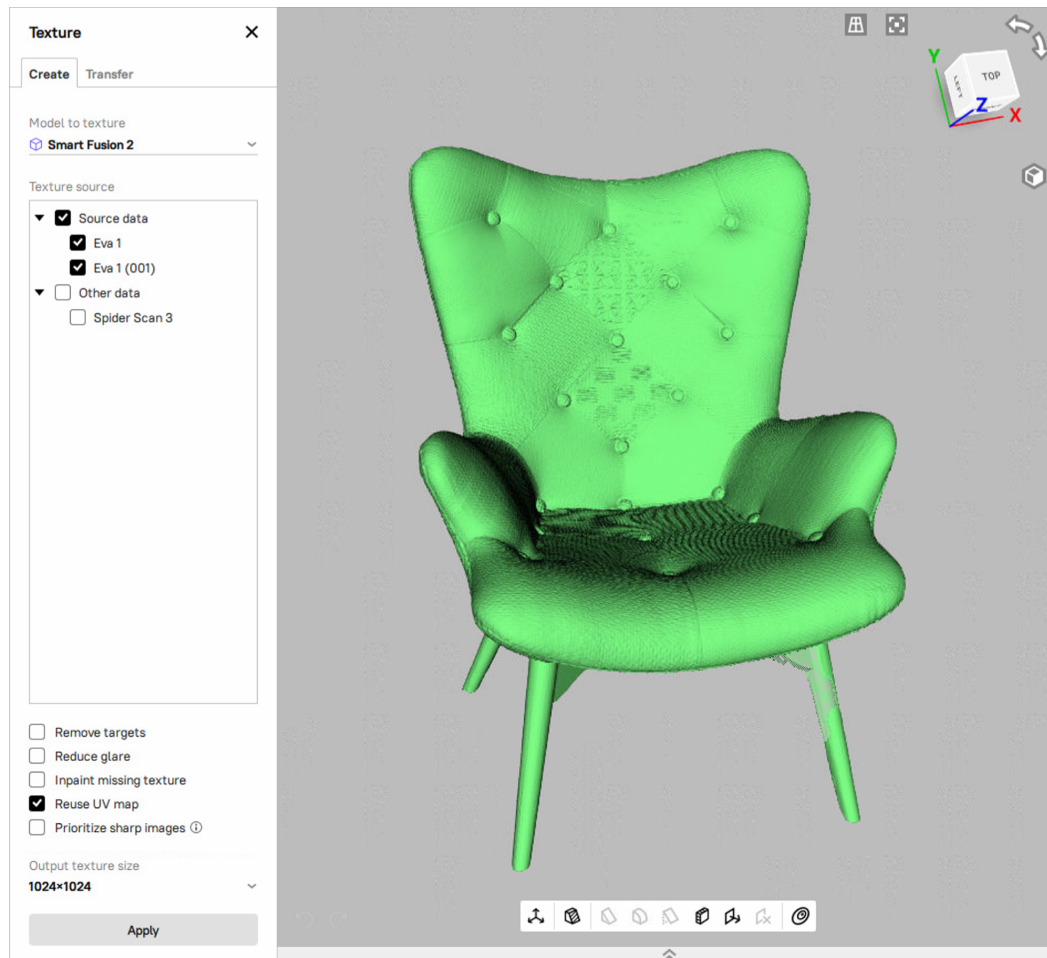


Figure 175: Adjusting texturing parameters.

settings on low values (for example, 512 x 512) and then reapply texture with the required *Output texture size*.

- *Inpaint missing texture*—Allows you to apply a texture to regions with no texture information by spreading it from the neighboring regions.
- *Prioritize sharp images*—Uses sharp, detailed photos when blending textures. Improves texture clarity when enabled. Recommended for photo-based textures captured in good lighting.
- *Reuse UV map*—Allows you to re-apply the already applied texture several times faster to reduce or increase its resolution (*Output texture size*).
- *AI Texture Enhancement*—Applies HD texture image for further texturing.
- *Output texture size*—Defines the output texture size. Texturing with the 16K resolution (16384x16384) is only available if your graphics card features at least 3 GB of GPU memory.

The texturing algorithm cuts the surface into pieces, then unfolds and nests these pieces flat and fits them into the specified image size (see [Figure 176](#) (right) and [Figure 112](#) in *Displaying Boundaries of Texture Atlas*).



Figure 176: Texture mapping methods: mesh with texture applied (left) and texture-atlas sample (right).

10.15.2.2 Transfer Texture

To replicate texture from a textured model instead of raw scans, switch to the *Transfer* tab. Ensure that you've selected this model in the *Model to texture* list. Using texture from a textured model might be useful in the following cases:

- Original scans are lost.
- Intention to replicate texture altered using *Texture healing brush*.
- Speed up texturing identical models or models undergone *Defeature brush* operations.

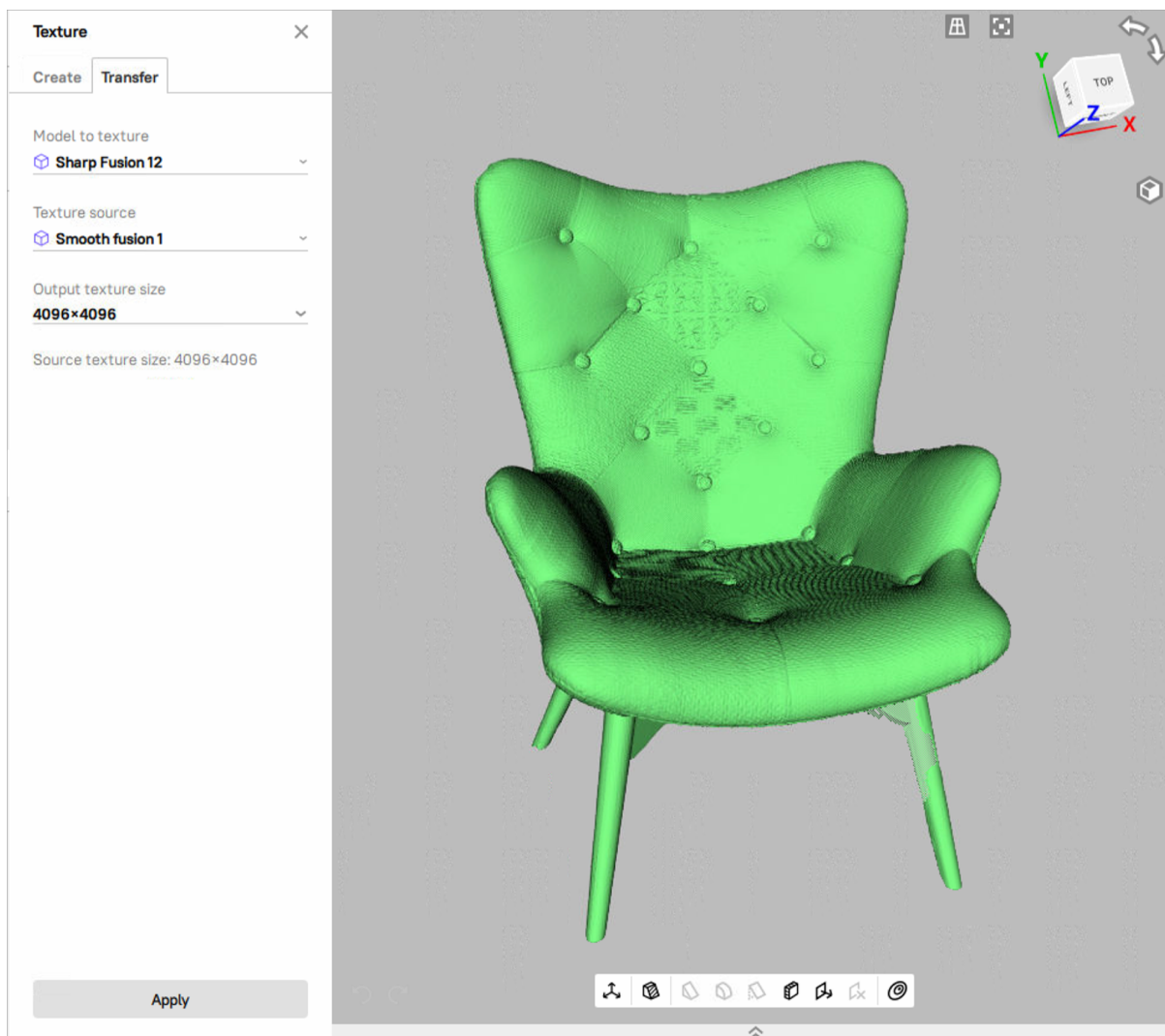


Figure 177: Transferring texture from a textured model.

Warning: We recommend avoiding texture application on models that have undergone significant changes in geometry or orientation. The algorithm may apply the texture incorrectly if you have done any of the following:

- *Position* or *transform* the model relative to its source scans

- *Nonrigid Alignment*
- Erase major parts of the model

Perform these operations only after texturing.

10.15.3 Texture Adjustment

After the texturing is complete, you can adjust the texture on the model (see [Figure 179](#)).

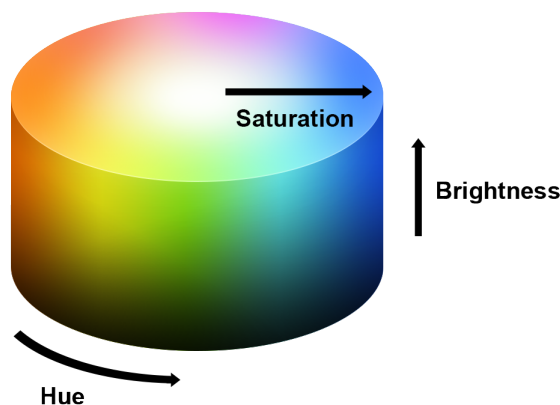


Figure 178: Hue, saturation and brightness representation.

You can adjust the following texture parameters by way of the corresponding sliders (see [Figure 178](#) for details):

- Brightness
- Saturation
- Hue
- Contrast
- Gamma correction

For models textured with HDR data, the following parameters are available:

- Color adaption
- Light adaption
- Intensity

The initial position of the *Hue* slider corresponds to the current texture color. Dragging it left or right corresponds to rotation counterclockwise or clockwise, respectively, on the color wheel.

After making the necessary changes, click *Done* to transfer the resulting textured model to the *Workspace* panel.

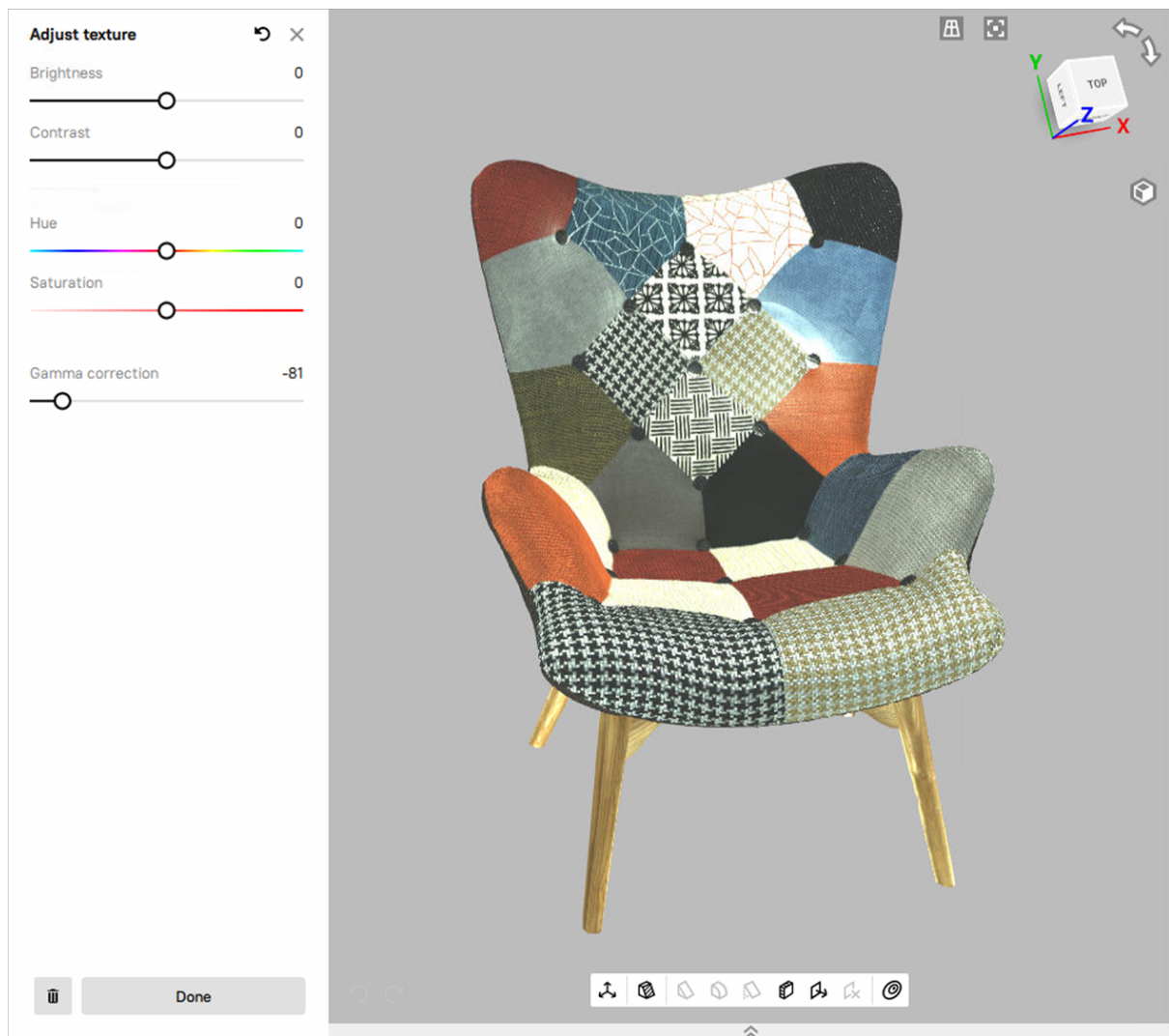


Figure 179: Texture adjustments.

To reopen the texture-adjustment dialog, follow the steps:

1. Select a textured model in *Workspace*.
2. Use **RMB** to call the context menu.
3. Select the *Adjust texture* option from the list.

10.15.4 Texture-Healing Brush: Manual inpainting

You can manually inpaint missing textures using the *Texture-healing brush*. This tool is based on the same algorithm as the *Missing texture inpainting* option covered in [Applying Texture](#). The algorithm fills missing or incorrect texture areas by using information from neighboring regions. The left image in [Figure 180](#) shows a small texture imperfections on the armrest of the figurine, while the right image shows the result after inpainting.



Figure 180: Texture-healing brush: before application (left) and after (right).

To launch the tool and inpaint texture, do the following:

Hint: We advise you to first back up your model by selecting the *Duplicate scans* command from its context menu since the undo function is unavailable in this tool.

1. Select the textured model in the *Workspace* panel.
2. Open the *Editor* → *Texture-healing brush*.
3. Hold down **Ctrl** while using **Scroll wheel** or **[** and **]** keys to adjust the tool size. It should not exceed the size of the region that needs texture correction.

4. Paint over the region of interest using **LMB** while holding down **Ctrl** so that the tool (a circle or a spot) only rolls over the problem area. Try to avoid touching neighboring areas. Use the *Deselect* button to clear all the selections.
5. Repeat the previous step as needed.
6. Click *Apply* to accept the changes or close the panel to reject them.


Note: If you paint an area in which the number of polygons exceeds the value specified in the settings dialog (see [Warnings](#)), a message will appear prompting you to either ignore the value, which means that processing may take longer, or cancel the operation.

10.16 Preparing Models To Export


10.16.1 Moving, Rotating and Scaling (Transformation Tool)

The *Transformation tool* allows you to move, rotate, scale and mirror objects relative to the global coordinate-system axes.

To access this tool, open the *Editor* panel and select *Transformation tool* or hit **T**. The panel will open, displaying four tabs that correspond to different modes for altering the object position in the global coordinate system. The name of the active mode appears at the bottom of the *3D View* window.

To revert your changes inside the tool, use the *Reset* button. Artec Studio applies changes when you leave the tool. Use the  (*Undo*) button in the *3D* window or hit **Ctrl+Z**.

Hint: To quickly move objects to the origin and align them with the camera viewport, use the *Auto-position* button.

Note: The *Transformation tool* does not affect objects with the Lock object status (). See [Locking Object's Position](#) for details.

10.16.1.1 Translate

To enter translation mode, click the *Translate* tab or hit **T**. Three input fields will appear in the *Editor* panel showing the current origin coordinates (in millimeters) of the local coordinate system. The initial position of the local coordinate system will be in the center of the global one. To translate an object, do either of the following:

- Enter the new coordinate values for the local system using the input fields in the *Editor* panel. To adjust the position only along a specific axis, first hit the corresponding **X**, **Y** or **Z** key.

- Translate the object in the *3D View* window by dragging the corresponding control (see [Figure 181](#)):
 - *Square* in the center to move it freely
 - *Arrow* to move it along a specific axis
 - *Lines between arrows* to move it along the two axes simultaneously

Note: Orienting the object may be easier if you first specify a new position for the origin of the local coordinate system: double-click on the desired surface point in the *3D View* window.

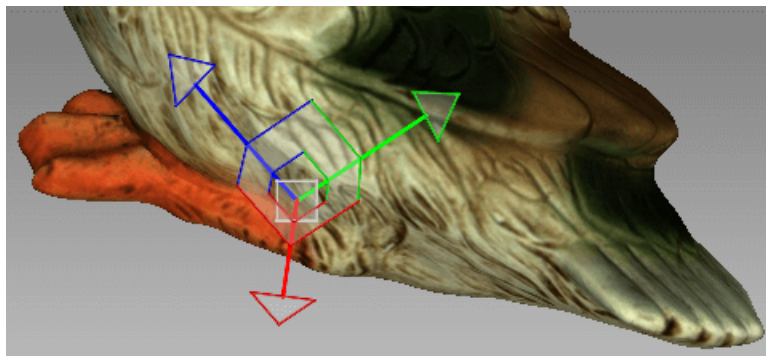


Figure 181: Translation control

10.16.1.2 Rotate

To enter rotation mode, click the *Rotate* tab or hit **R**. Three input fields containing the Euler-angle values will appear in the *Editor* panel. Initially, all values are set to zero. To rotate the object, do either of the following:

- Enter the new angle values (in degrees) using the input fields in the *Editor* panel.
- Drag one of the three circles (see [Figure 182](#)) to rotate the object. Hitting the key that corresponds the required axis (**X**, **Y** or **Z**) will hide the controls for the other axes.

Note: Orienting the object may be easier if you first specify a new position for the center of the local coordinate system: double-click on the desired surface point in the *3D View* window.

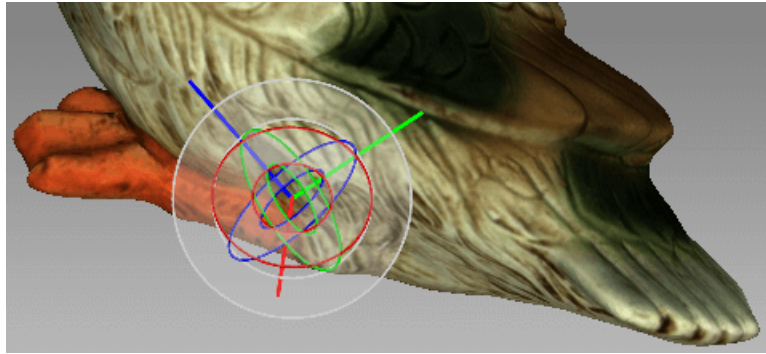


Figure 182: Rotation control

10.16.1.3 Scale

To enter scaling mode, click the *Scale* tab or hit *S*. A single input field with the current scale value (1.000) will appear in the *Editor* panel. You have two options for scaling the object:

- Enter the new scale value in the field.
- Drag the origin of the control (Figure 183) or either of its round ends in the *3D View* window.

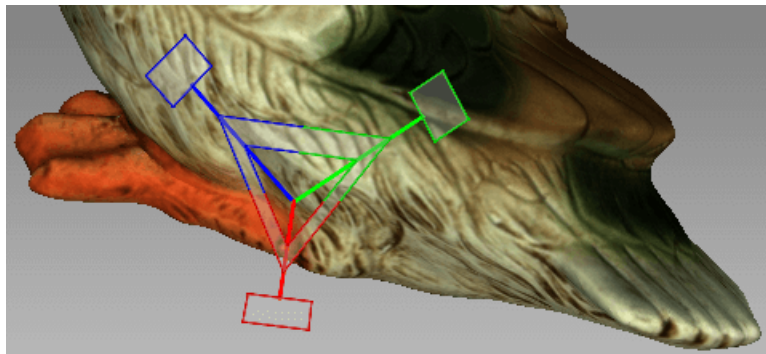


Figure 183: Scaling control

10.16.2 Placing Objects on Coordinate Plane (Positioning Tool)

You may need to place the model on one of the coordinate planes (e.g., for aesthetic reasons or when preparing the model for measurements, for capturing a screenshot, for exporting and so on). Instead of adjusting the model position using the *Rotate* and *Translate* modes of the *Transformation tool*, you can use the special *Positioning* tool. To do so, follow these steps below.

1. Open the *Editor* panel from the side toolbar and click either *Rough positioning* button or hit *P*.
2. Choose the *Rough* tab—a rough positioning is available for all the *object types*, whereas the *Precise* option works only with CAD objects.

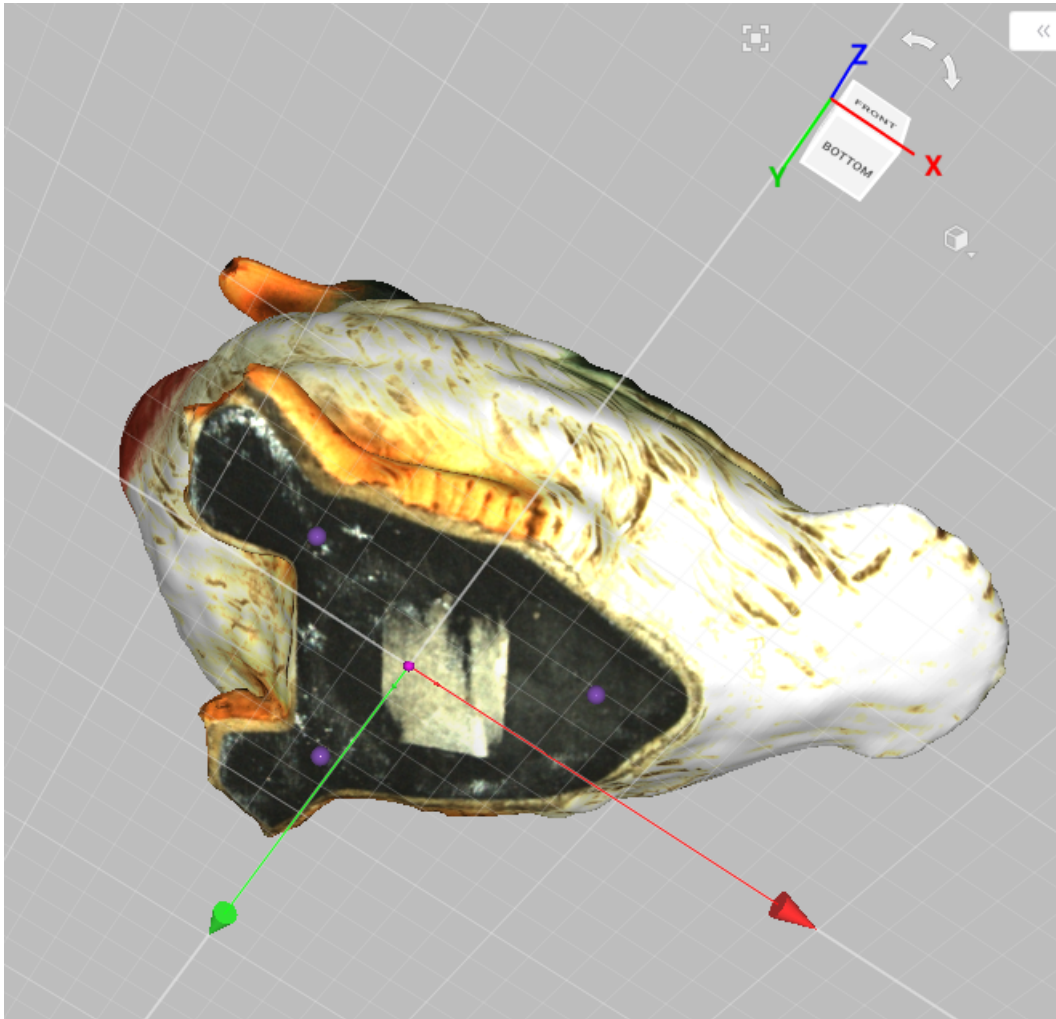


Figure 184: Positioning the model in the global coordinate system.

See also:

[Setting constraints for CAD primitives](#)

3. Ensure that the coordinate axis grid is shown. Otherwise hit **G** or select the *Grid* command from the *Scene settings*.
4. Choose the coordinate plane in which you want to place the model by activating one of the following options: *XOY*, *YOZ* or *ZOX*. Note that you may skip this step and return to it after Step 3.
5. Use **LMB** to specify at least three points on the surface; the plane will automatically pass through their center of mass (see [Figure 184](#)). The following conditions will then apply:
 1. For each additional point you specify, Artec Studio rebuilds the plane. Click *Clear points* at any time to redefine the points.

Note: Three points determine a plane. When you're dealing with nonplanar surfaces, however, three points may be insufficient. In that case, the more points you specify, the more precisely a plane will fit the surface.

2. In addition to the plane passing through the center of mass of the points you select, the coordinate origin will shift to that location as well.
3. The position of the coordinate origin is adjustable, as described below.
6. Invert the direction of the coordinate axis, if desired, by clicking the *Invert Z* button for the *XOY* plane, *Invert X* for *YOZ*, or *Invert Y* for *ZOX*.
7. If appropriate, adjust the model's position relative to the coordinate origin:
 1. **Shift** + **LMB**—rotate the model around the axis that is currently normal to the plane
 2. **Shift** + **RMB**—move the model along the plane in a fixed direction
 3. **Shift** + **LMB** + **RMB**—move freely along the plane
8. Hit *Apply* to fix the model on a specified plane or close the panel to cancel positioning.

To discard changes of object position, hit **Ctrl+Z**.

Tip: The *Enable automatic base removal* option may come in useful to position scans automatically after the scanning completes (see [Base Removal: Erasing a Supporting Surface](#).)

Note: The *Positioning* tool does not affect objects with the Locked object status (🔒). See [Locking Object's Position](#) for details.

10.17 Workflows

10.17.1 Overview

Artec Studio 20 introduces customizable Workflows, enabling users to create, save, share, and reuse predefined sequences of algorithms. The feature replaces the previously used *Auto* mode with a more powerful and flexible *Workflow* editor. It aims to support customization, standardization, and collaboration between users of Artec Studio.

This feature solves the problem by letting users create reusable Workflows with saved algorithm settings. These workflows can be saved to files, shared across systems, and loaded by different users of Artec Studio.

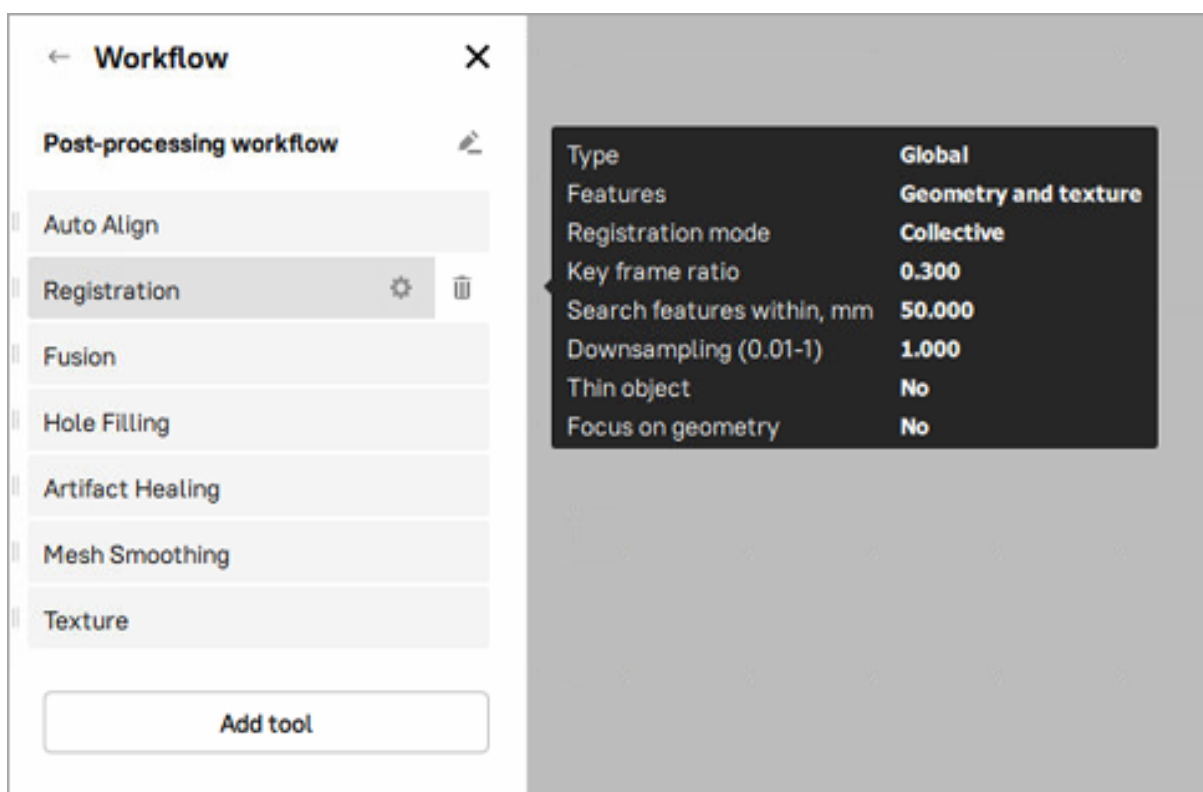




Figure 185: Example of post-processing workflow

10.17.2 Creating Workflow

To create a workflow:

1. Select the objects in *Workspace* that you want to process
2. Go to the *Tools* panel
3. Click the plus (+) under *Workflows*

4. If needed, click the edit icon () and enter a custom name and description
5. Click the arrow icon () next to the name field to save the workflow name and description
6. Click the *Add tool* button to add algorithms that are valid for the selected objects

Note: There's no need to save created workflows manually. Artec Studio will automatically save it when you return to the *Tools* panel or close it.

10.17.3 Exporting/Importing Workflows

Each workflow is saved both:

- In the list of workflows within the *Tools* panel
- As a file on disk


All workflows are saved in a shared folder, accessible by any version of Artec Studio that supports workflows, at the following location:

```
C:\Users\<username>\AppData\Roaming\Artec\Artec Studio <version>\  
→workflows\workflow_<ID>.aswf
```


Each file contains the workflow name, description, list of algorithms and custom settings, and the Artec Studio version.

All created workflows can be exported to a file with the *.aswf* extension. Later, if you or your colleagues need to import the exported workflows, this can be easily done.

To export workflows:

1. Click the gear icon () next to the *Tools* label in the *Tools* panel
2. Click the *Export workflows* option
3. In the *Export Workflows* pop-up window, select the workflows that you want to export
4. Click the *Export* button
5. Select the destination folder for export and confirm your choice

To import workflows:

1. Click the gear icon () next to the *Tools* label in the *Tools* panel
2. Click the *Import workflows* option
3. In the *Import Workflows* pop-up window, choose one of the following:
 - Select *Append new items* to add workflows to the existing list
 - Select *Replace existing items* to overwrite the current Workflows
4. Select the workflows file to import and confirm your choice

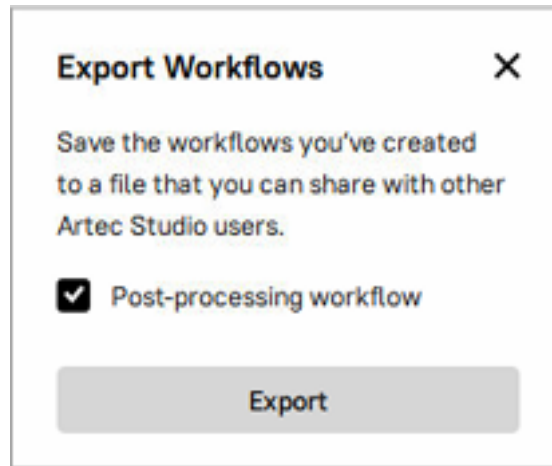


Figure 186: Export workflows

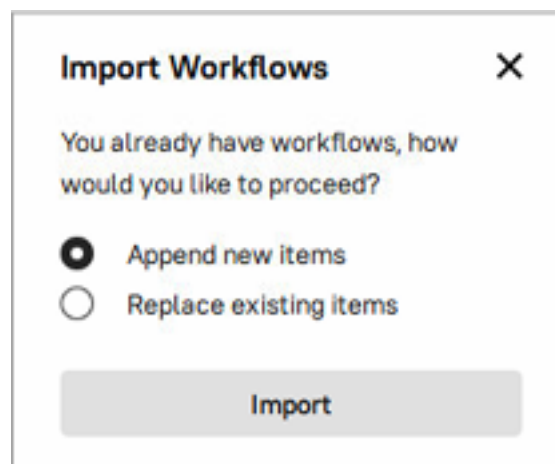


Figure 187: Import workflows

The workflows from the files will automatically load and appear in the *Tools* panel under the *Workflows* section.

10.17.4 Running Workflow from Artec Studio

Once the workflow is created, you can run it in three ways: from the *Tools* panel, directly from the Workflow editor, and from the command line (refer to the [Launching Artec Studio with Workflow from CLI](#)).

To run the workflow from the Workflow editor:

- Click the *Run* button at the bottom of the Workflow editor

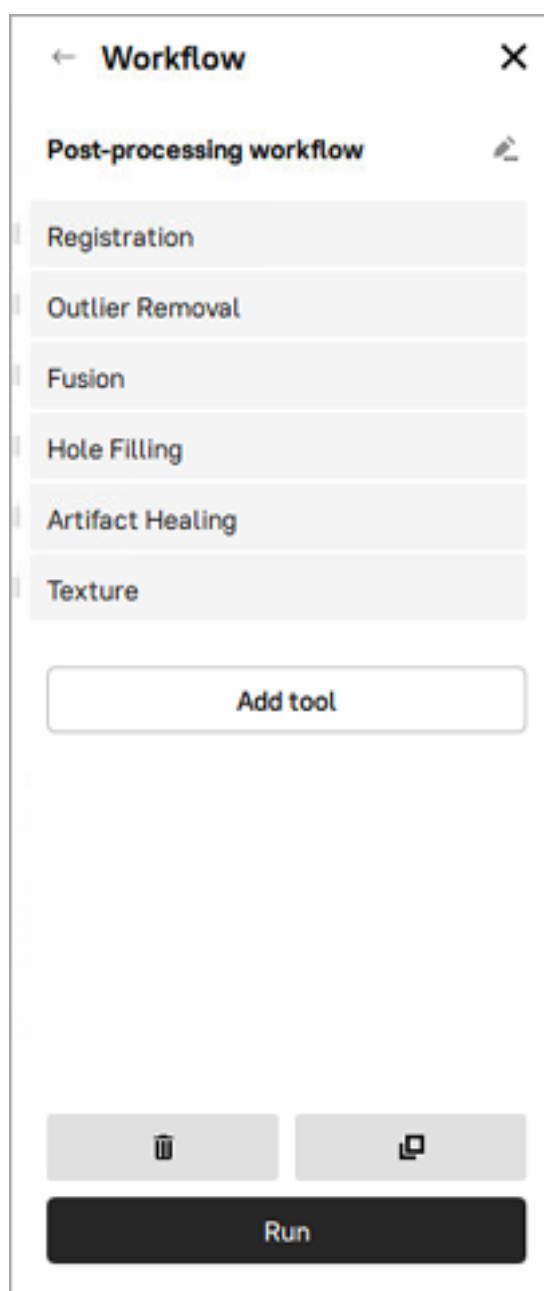


Figure 188: Workflow editor

To run the workflow from Tools:

1. Hover the mouse over the workflow name row

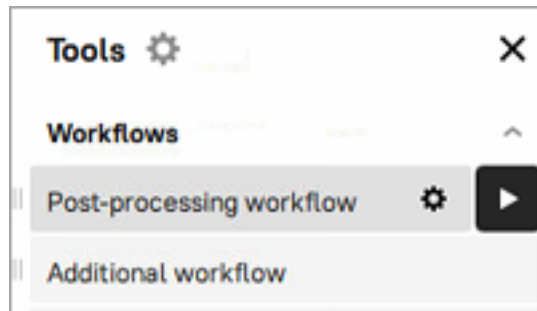



Figure 189: Workflow hovered

2. Click the play icon ()

The workflow starts running.

While the workflow is running, a green arrow () will appear next to each completed algorithm. Once all algorithms are finished, the *Done* button will show. Click it to return to *Tools*.

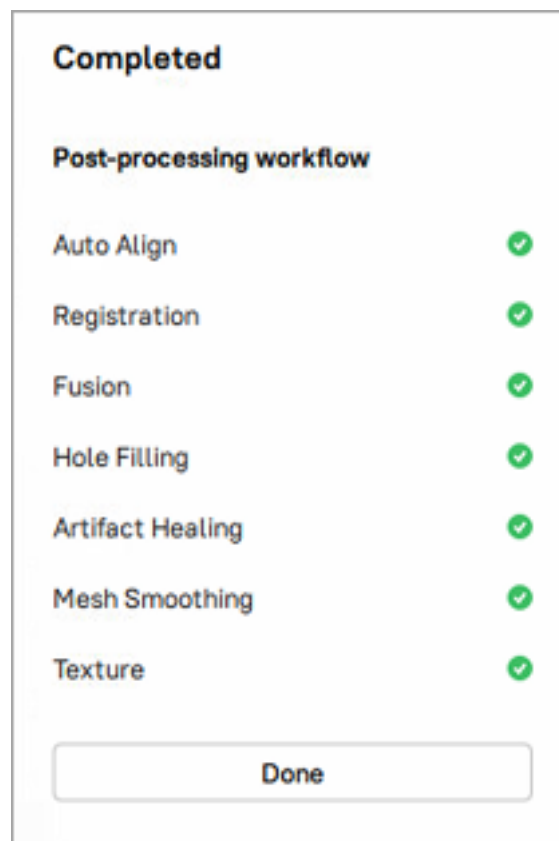


Figure 190: Workflow completed

10.17.5 Launching Artec Studio with Workflow from CLI

You can launch Artec Studio with a predefined workflow directly from the command line. This is useful for automating processing steps on prepared scan data.

Note: If you launch a workflow using the `--workflow-file` parameter, the workflow will *not* appear in the **Tools** panel under **Workflows**, and it will not be available for reuse in future sessions.

To make the workflow visible in the **Tools** panel and permanently available in Artec Studio, you need to import it first. For details on how to import workflows, see [this section](#).

To use this feature, you need:

- A saved Artec Studio project (.a3d) with scanned data
- A previously created workflow file (.aswf)

For example, the following command will launch Artec Studio, open the specified project, run the specified workflow, and then close the application with the window minimized during execution.

```
"C:\Program Files\Artec\Artec Studio <version>\astudio_pro.exe C:\
↪Path\To\Your\Project\your_project.a3d" --workflow-file "C:\Users\
↪<username>\AppData\Roaming\Artec\Artec Studio <version>\workflows\
↪workflow_<ID>.aswf" --close-after --minimize
```

Note: Keep in mind that if your file contains have more than one workflow, you must specify the workflow name using the `--workflow-name` parameter. Multiple workflows cannot be launched at the same time.

Command-line parameters:

- `--workflow-name`: Name of the workflow to launch (as saved in the *Tools* panel)
- `--workflow-file`: Path to the workflow file (.aswf)
- `--close-after`: Automatically closes Artec Studio after the workflow completes
- `--minimize`: Minimizes the application window during execution
- `--help`: Shows the *Help* window with all available options


10.17.6 Automatic Processing

See also:

[Use Autopilot](#)

Automatic processing is a special mode for the *Tools* panel that saves time and simplifies postprocessing. It allows you to run all postprocessing algorithms available in the *Tools* panel, such as *Registration* (*Global*, *Rough serial*, *Fine*, *Photo*); *Outlier removal*; *Fusion*; *Mesh optimization* (*Small-object filter* or *Hole filling*) and *Mesh smoothing*, with just a single button click.

Each algorithm setting and parameter is based on the values can be set and adjusted in the *Auto mode*. To change these values:

1. Toggle the *Auto mode* switch on.
2. Select a specific scanner type via the *Preset* dropdown list.
3. Using *Add tool*, add the new algorithm from the list to the auto mode.
4. Click the  icon to open a parameters pop-up of the added algorithms.
5. Make the necessary alterations and close the parameters pop-up.
6. Repeat the previous steps for the required algorithms.
7. Click *Run* button to begin automatic processing.

Changing the scanner preset type resets all the parameters to the default ones (for the selected preset).

Keep in mind that the algorithms run in the order in which they are listed, starting with *Registration* and ending with *Normal inversion*. Thus, if you want to run the *Mesh smoothing* before *Mesh optimization*, for instance, you must do so manually.

Unlike manual processing, automatic processing runs without the need for constant user attention, so it is more convenient when processing large objects: you can configure the settings, start the process and leave it unattended. It can also process objects of any size, reducing the number of mouse clicks to get the result.

10.18 Mirroring

Artec Studio allows to mirror the 3D data. The application uses the local rotation center as a mirroring center (see [Global Coordinate System and Rotation Center](#)). If it isn't specified, Artec Studio employs the global coordinate center.

To mirror the model, follow the steps:

1. Open *Editor*
2. Access [Transformation tool](#)
3. Select the *Mirror* tab

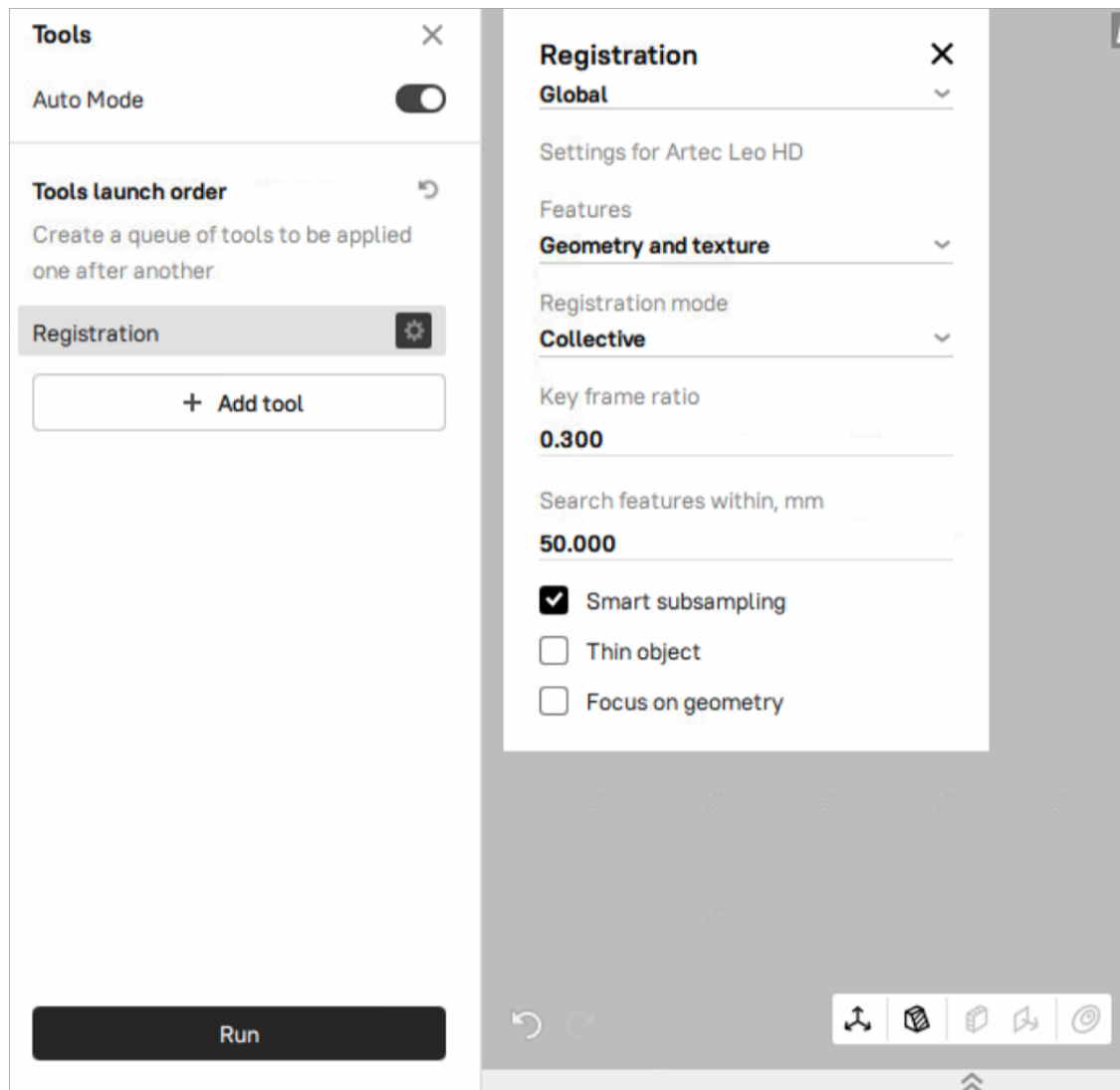


Figure 191: Manual adjustment for the specific scanner type.

4. If necessary, double click the model to specify a rotation center
5. Select an axis to mirror the object along. Press the respective button—for example, *Along axis Y*.



Figure 192: Mirroring in action.

To revert your changes, use the *Reset* button. For details, consult [Moving, Rotating and Scaling \(Transformation Tool\)](#).

10.19 Isotropic Remesh

Isotropic remesh is an operation that modifies 3D model in the way that new mesh triangles have uniform size. Software packages where the models from Artec Studio are intended to be used may impose these requirements.

The algorithm produces an isotropic mesh, but doesn't necessarily decrease the polygon count. However, the output file is often smaller than the original one through the uniform triangles.

To produce a uniform mesh,

1. Mark the model using the ✓ flag
2. Open *Tools* → *Isotropic remesh*
3. Specify the *3D resolution, mm* value if necessary
4. Click *Run* button.

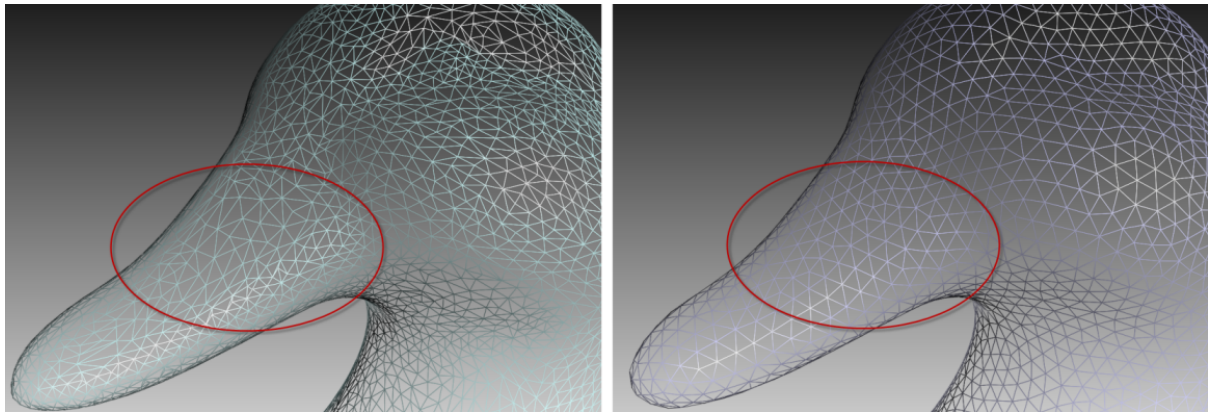


Figure 193: Isotropic remesh operation in action: original model on left, processed one on right.

10.20 Normal Inversion

Normal direction determines the visibility of a surface in 3D graphics. Learn how to show normals of the objects in Artec Studio 3D View, see [Representation of Normals and Boundaries](#).

Normal inversion allows one to turn the model inside out. This operation may be useful when you need to manufacture some mating parts, like molds; or obtain a model based on its cast (e.g., turn the footprint cast into a shoe last, see [Figure 194](#)).

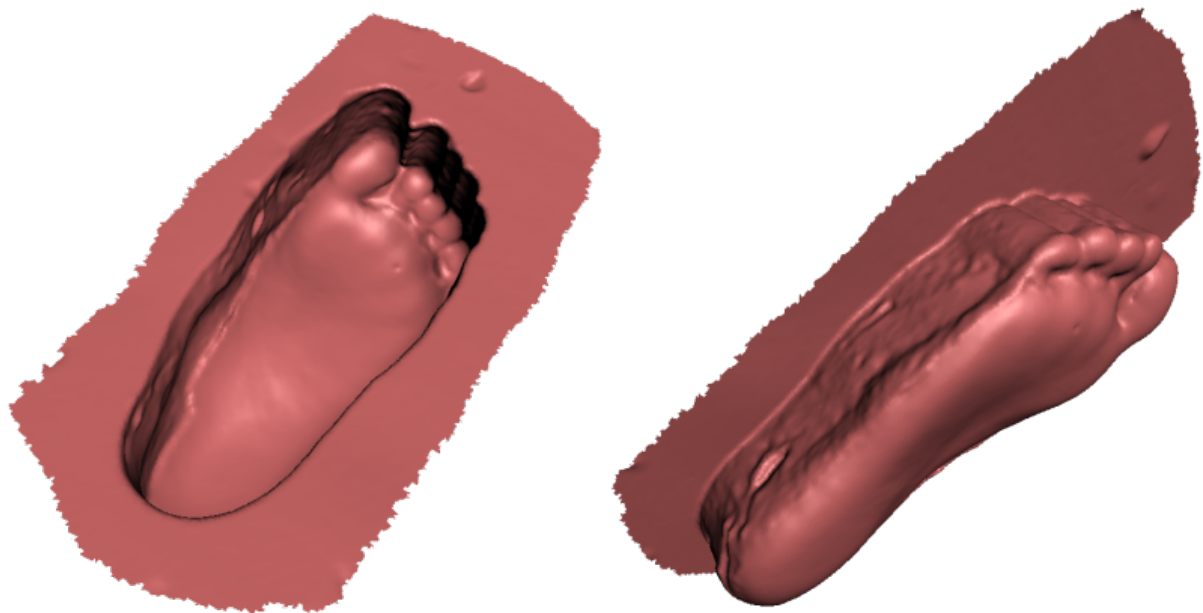


Figure 194: Normal inversion application: obtaining a foot model (right) from its cast (left).

To invert normals on a particular model,



1. Mark the model using the  flag

2. Open *Tools* → *Normal inversion*
3. Click *Run* button.

10.21 Correcting Triangulation Errors

Some algorithms may introduce triangulation errors into the resulting model. These errors include the following:

- *Unattached vertices*. Points that are not vertices of any of the triangles
- *Vertices with identical coordinates*. Vertices that have the same coordinates
- *Faces containing invalid vertices*. Triangles that point to nonexistent vertices
- *Singular faces*. Triangles for which at least two of the three vertices coincide.
- *Faces with equal signature*. Faces with fully coinciding sets of vertices
- *Edges incident to three or more faces*. Edges that are adjacent to three or more faces
- *Faces with wrong orientation*. Faces whose normals point in a direction opposite to those of the adjoining faces

To correct these errors, mark a model in the *Workspace* panel by using the  flag and hit **Ctrl+R** or select the *Window* → *Repair* menu command. If the algorithm detects no triangulation errors, Artec Studio will notify you that it has found no defects. Otherwise, the *Repair* panel will open, displaying the above-mentioned list of defects to be corrected. Next to the names of the defects, a column will appear stating the number of defects of a certain type found in the model. You can select all defects by pressing *View all*. Doing so will display in the model all the defective vertices and triangles using colored points. You can disable display of any particular defect type by removing the  icon next to the corresponding name, or disable them all by clicking *View none*. To correct the defects, click *Repair all*. Clicking the *Apply* button accepts the changes.

WORKING WITH CAD OBJECTS

Starting from version 15, you can work with CAD objects in Artec Studio. You can either create *CAD primitives* and then export them into CAD files or *import* CAD objects designed in external applications. This allows you to:

- Modify and design new parts for existing objects;
- Reverse engineer scanned objects;
- Ensure quality control by comparing scanned objects to their CAD models.

Starting from version 17, Artec Studio supports two kinds of CAD primitives that differ in the way they are created:

- Fitted CAD primitives that Artec Studio fits into the selected part of one or multiple models/point clouds;
- Independent CAD primitives that are created independently on the model.

11.1 CAD Primitives Types

At present it is possible to construct the following types of primitives:

- Cylinder,
- Cone/Truncated cone,
- Sphere,
- Plane,
- Torus,
- Box.

A torus is a donut-like figure, which is determined by the radii of its outer and inner circumferences: major and minor radii, respectively.

There is also another type of the fitted CAD primitives called surfaces:

- Freeform patch,
- Autosurface.

11.2 Constructing CAD Primitives

You can construct two kinds of CAD primitives: fitted and independent ones.

See also:

[Importing CAD models](#)

11.2.1 Constructing Fitted CAD Primitives

Fitted CAD primitives are constructed on the basis of polygonal meshes (models) and then are fitted into the latter.



Figure 195: From left to right: original object, scanned model, a set of constructed primitives.

A *freeform* patch can be thought of as a sheet of paper that you wrap around the portion of the object's surface. The freeform patch can be used for complicated surfaces that are not covered by usual types of primitives, such as surfaces of organic objects, for example. The following parameters are required for constructing a freeform patch:

- *Padding* – the percentage by which the selected surface area is expanded before building the patch.
- *Number of points* – the number of control points (patch mesh nodes) on each axis of the patch.
- *Order* – the order of splines used for building the patch.

Note: The more points and the higher the order of splines, the more detailed surface curvature and the closer fit to your model you can get. However, you need to keep in mind that increasing the number of points and the order of splines requires more CPU time for fitting the primitive.

Autosurface allows you to build a CAD primitive in the form of a surface that partially or completely covers the model. The autosurfaces address the problem of quick transformation of organic shapes into CAD objects, as well as the problem of approximating massive meshes with CAD objects suitable for further use in CAD software packages. An autosurface is constructed as a set of patches of approximately the same size.

The following parameters can be adjusted for constructing an autosurface model:

- *Patch aggregation mode* – Merges square cells into larger patches. Instead of setting a patch count, you control detail with a *Patch factor* slider. This results in a more accurate model that also occupies less space.
- *Allow T-Nodes* – Defines the form of patches.
- *Allow triangles* – Allows the resulting model to include triangles in cases where they are more optimal.
- *Number of patches* – Defines the allowed number of patches in the resulting model. Not applicable in *Patch aggregation mode*.

Note: The suitable number of patches depends on the size of the selected part of the object's surface and the number of polygons in the original mesh. For massive meshes with a high number of polygons, more CPU time for constructing the autosurface is required.

Note: An autosurface model can be exported to an external CAD software as a CAD model.

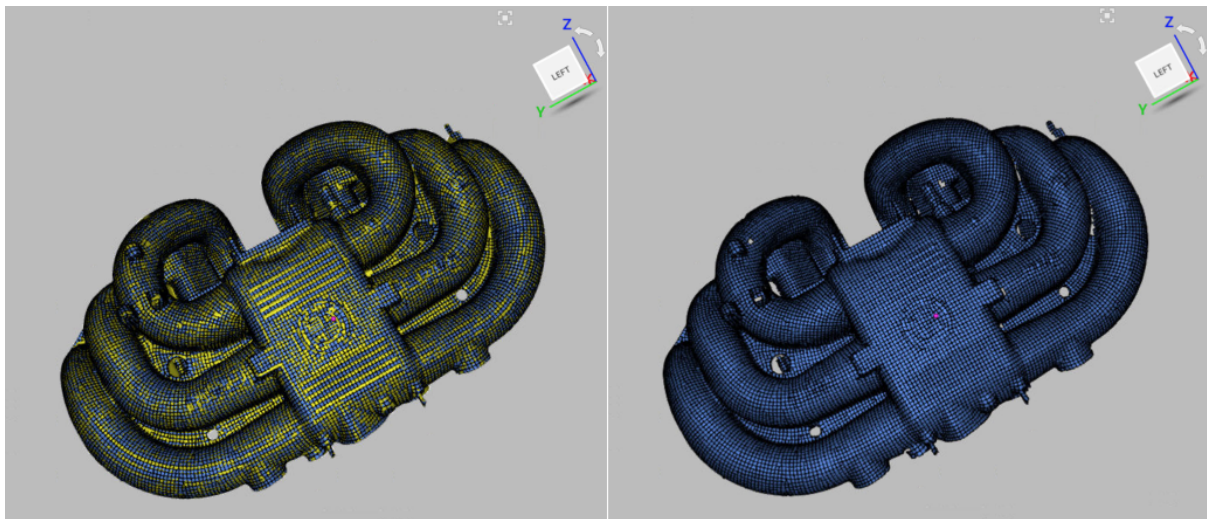








Figure 196: Mesh converted to the fitted autosurface with 25,000 patches (left) and the autosurface itself (right).

To construct a fitted CAD primitive, follow these steps:

1. Load a polygonal model in which you will fit the CAD primitive.
2. Open the *Construct* panel. The *Fit* tab will be opened.

3. Select one of the available primitive types you want to construct (in the example below it is *Cylinder*).
4. Choose *Selection type* and specify the required area on the one or multiple models/point clouds:

- *2D brush* () and *3D brush* () slightly differ in how they work: the former is circular and marks the model surface on the basis of the current viewpoint, whereas the latter is sphere-shaped and selects the surface that falls inside that sphere. Use the *Brush size* slider to change the brush size.
- *Lasso* () allows you to specify a polygon on the surface of the objects by clicking the vertices of that polygon. A surface is selected that falls inside it.
- *Lasso* () and *2D brush* () allows you to select the object's back-face using the *Select through* checkbox.
- *Segment* () is the most convenient of the selection tools. It automatically expands the area you mark with your brush and shows you the result. Thus, you can evaluate which of the regular primitives Artec Studio identified. This selection tool has two settings available: the *Brush size* slider to adjust the size of your brush and the *Segmentation sensitivity* slider to adjust the degree of expansion of the area marked with your brush (the higher the sensitivity, the more Artec Studio will expand the marked area).

Note: The *Segment* option is not recommended for the *Freeform* CAD primitive or for simplified models (models with fewer polygons).

To select an area on the object or multiple objects, use **Ctrl+LMB** above the model surface. To deselect, use **Alt+LMB** above the selected area.

To clear the current selection partially, use **Ctrl+Alt+LMB** above the selected area.

Use the *Invert* button to invert selections, and also use the *Deselect* button to reset all the selections you made.

Note: When you create an *Autosurface* CAD primitive, it can cover the model partially or completely, or cover the parts of multiple objects. If you select an area on the model, the primitive will only approximate the marked area. If no area is selected, then the entire model will be approximated.

5. Once the required area has been selected, choose a *Fitting mode*:

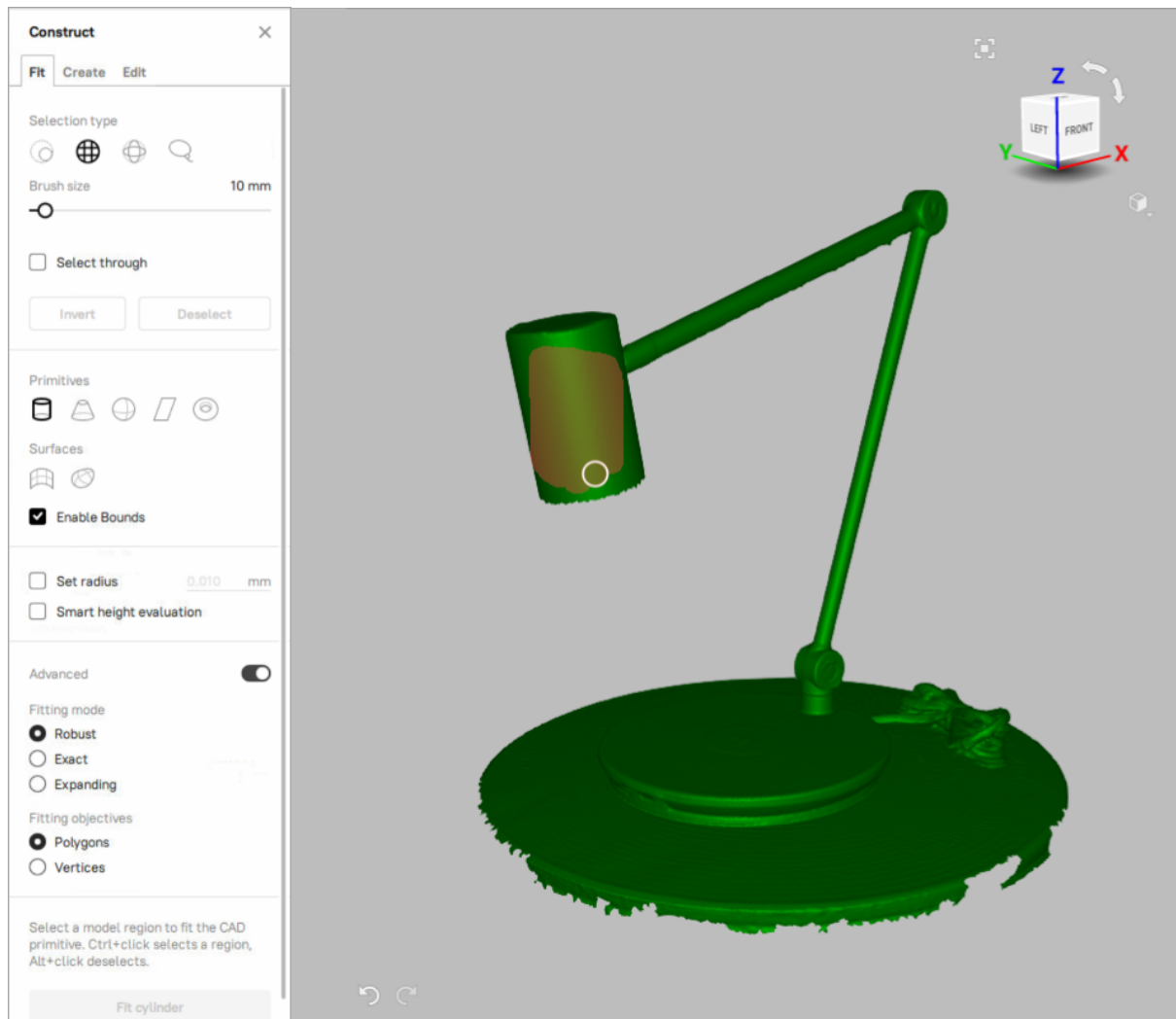


Figure 197: The Fit tab of the Construct panel: specifying the area using the 3D brush.

- *Expanding* mode requires the user to mark just a small spot on the object. The algorithm will search the model corresponding to the shape of the selected primitive, and fit the primitive at the borders of the found location.
- *Robust* mode works with the area that the user has selected. However, if there are any conflicting surfaces, the “Robust fit” will ignore them and will work with the largest selected area.
- *Exact* mode only works on the area the user has selected. The algorithm allows you to select custom areas for a future primitive and control its size, even if the object isn’t exactly primitive-shaped.

Note: It is not recommended to use the *Expanding* mode with the *Segment* selection tool as their implementing algorithms contradict to each other.

Note: The *Fitting mode* is not applicable for surfaces.

6. Click the required primitive icon on the *Primitive type* bar.
7. If the selected primitive (sphere, cylinder or truncated cone) should fit into a hole of a given depth, such as a hole in a plate, then check the *Smart height evaluation* option. In this case, Artec Studio will use an algorithm that provides a more accurate fitting of the primitive to the objects.
8. If necessary, specify the desired parameters of the primitive to be created (see [CAD Primitives Types](#) for the description).
9. Click *Fit cylinder* button (or *Fit sphere*, etc.) to confirm your choice. Artec Studio will create a CAD primitive and fit it into the selected area.

11.2.2 Constructing Independent CAD Primitives

To construct an independent CAD primitive, follow these steps:

1. Open a new project or load a polygonal model which you will modify with the CAD primitive.
2. Open the *Construct* panel and go to the *Create* tab.
3. Select one of the available primitive types you want to construct (in the example below it is *Cylinder*).
4. Specify the parameters of the CAD object to be created:
 - For a cylinder—its radius and height
 - For a cone—its radius, height, aperture, and *Truncated* checkbox

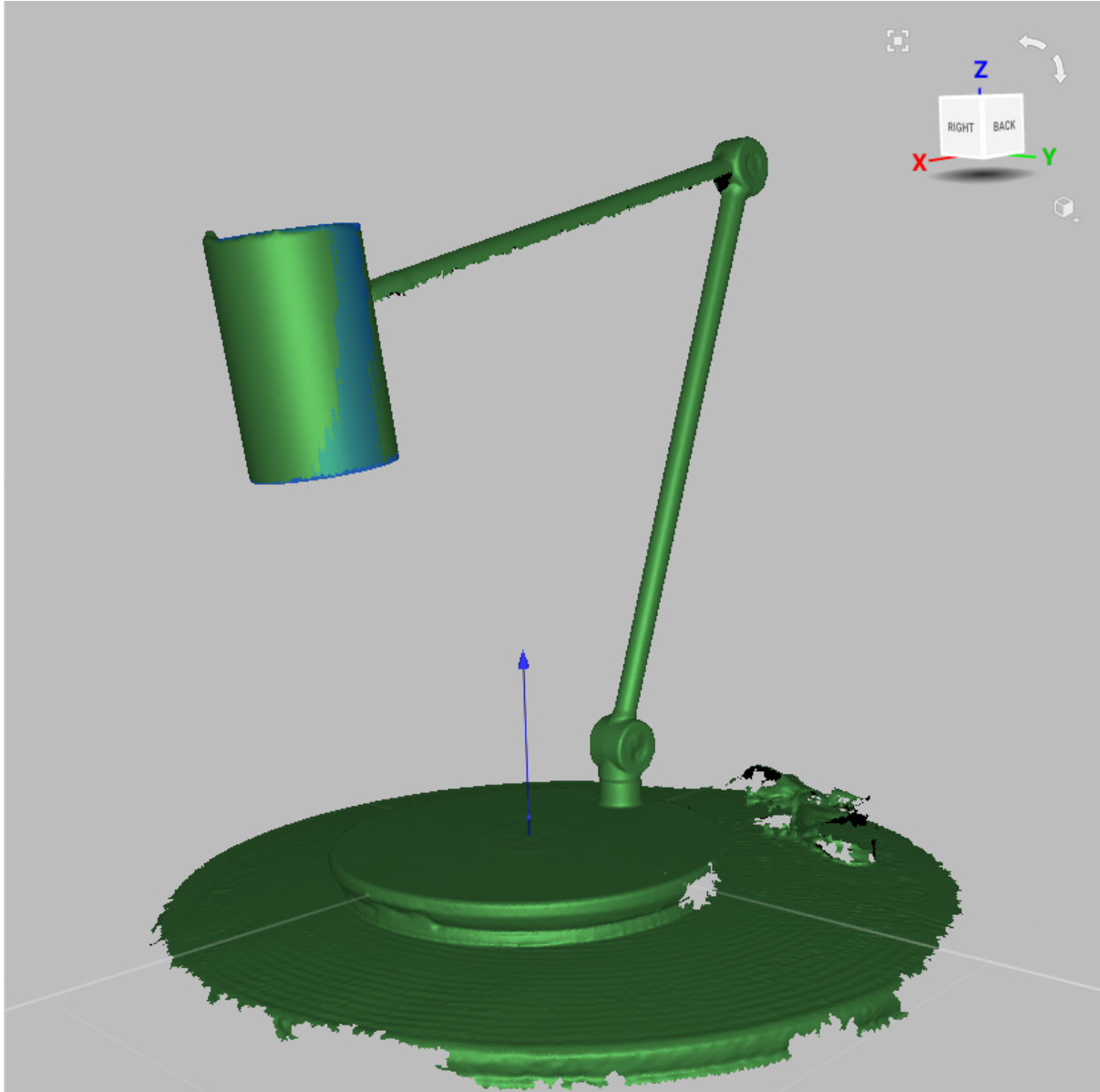


Figure 198: Cylinder (blue) fit into the model.

- For a sphere—its radius
- For a plane—its width and height
- For a torus—its major and minor radii (see [CAD Primitives Types](#) for torus description)
- For a box—its width, length and depth

5. Position the CAD object as needed.

- To move the primitive, click and drag the appropriate gizmo control while the *Translate* tab is active.
- To rotate the primitive, click and drag the appropriate gizmo control while the *Rotate* tab is active.
- You can also specify the translation of the object and its axes rotation changing the corresponding parameters in the *Translate* and *Rotate* tabs respectively.

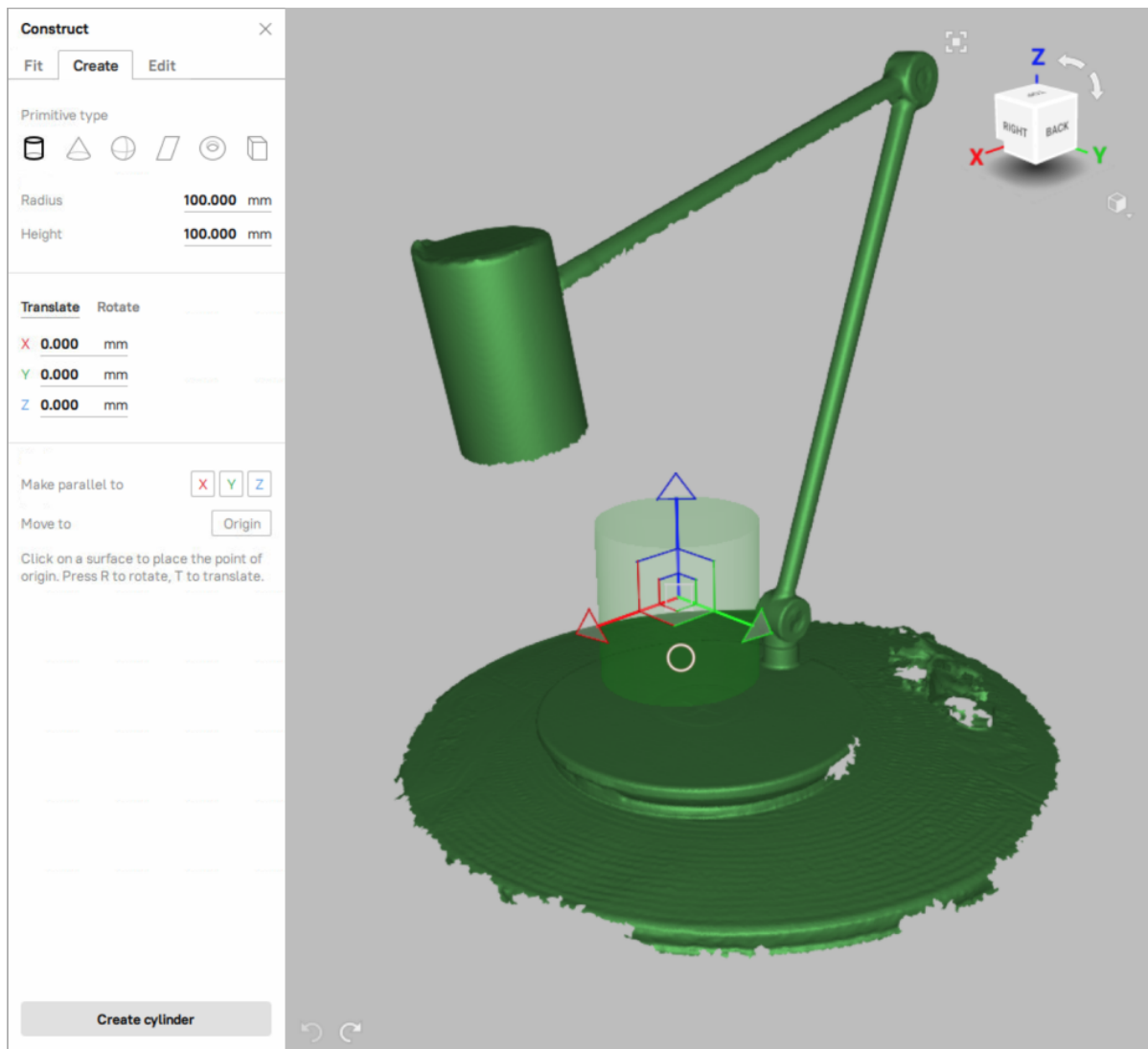


Figure 199: The Create tab of the Construct panel: specifying the CAD cylinder parameters.

6. Click *Create cylinder* button (or *Create sphere*, etc.) to confirm your choice. Artec Studio will create a CAD primitive and position it as specified.

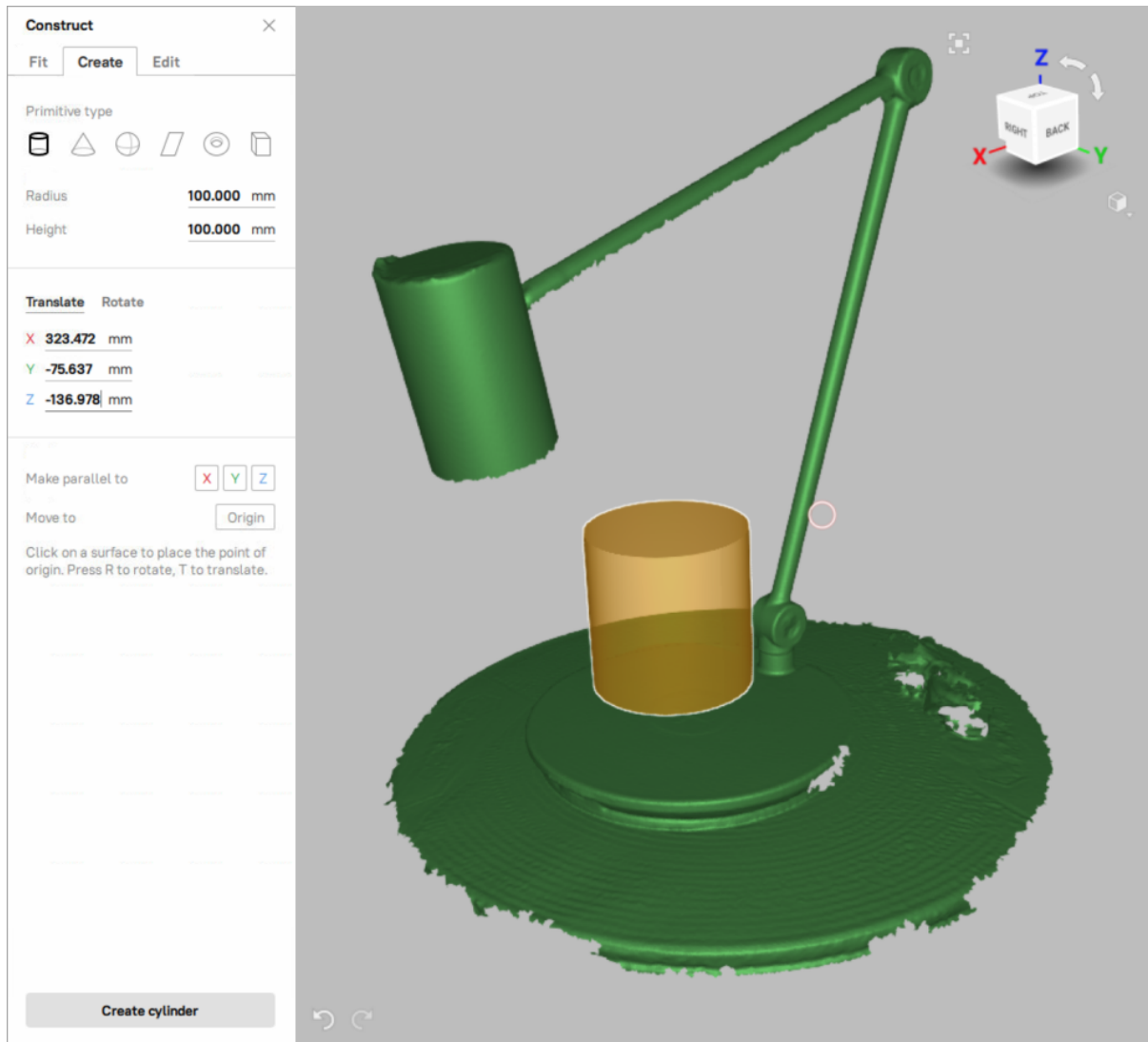


Figure 200: Constructed cylinder (orange).

Note: Make sure that the CAD primitive is positioned properly before creating it. Once it is created, its position will be fixed and you will not be able to change it.

11.2.3 CAD Primitive Properties

To see the properties of the created CAD primitive, do the following:

1. Click the name or the icon of the primitive in the *Workspace* panel.
2. At the bottom of the *Workspace* panel, click the *Properties* section to expand it.

The presence of certain geometric parameters in the *Properties* section will depend on the type of the selected CAD primitive (see the table below).

Table 14: Presence of geometric parameters in the *Properties* section for different CAD primitives.

Primitive	Radius	Width	Height	Aper- ture	Faces
Cylinder	Yes	No	Yes	No	No
Truncated cone/Cone	Yes	No	Yes	Yes	No
Sphere	Yes	No	No	No	No
Plane	No	Yes	Yes	No	No
Torus	Yes (major and minor radii)	No	No	No	No
Box	No	No	No	No	Yes

For the freeform primitives the *Properties* section displays:

- *Points* – the number of points used for constructing the surface
- *Order* – the order of splines indicating the degree of surface smoothness
- *Padding* – the expansion of the surface, relative to the selected area

11.2.4 Converting CAD to Mesh

It is possible to convert CAD models and CAD primitives to a mesh in Artec Studio (17 and above).

To convert CAD to mesh,

1. Select the CAD object you want to convert in the *Workspace* and right-click on it.
2. Open *Tools* → *Convert CAD to Mesh*.
3. To adjust the level of detail (i.e., count of polygons) in the resulting mesh, change the value of *Accuracy* as required. A higher value results in a more detailed mesh and vice versa.
4. Then, click *Run*.

Artec Studio then converts the CAD to a mesh (PLY). The original CAD object remains intact too.

Alternatively, to convert CAD to Mesh using a default *Accuracy* value,

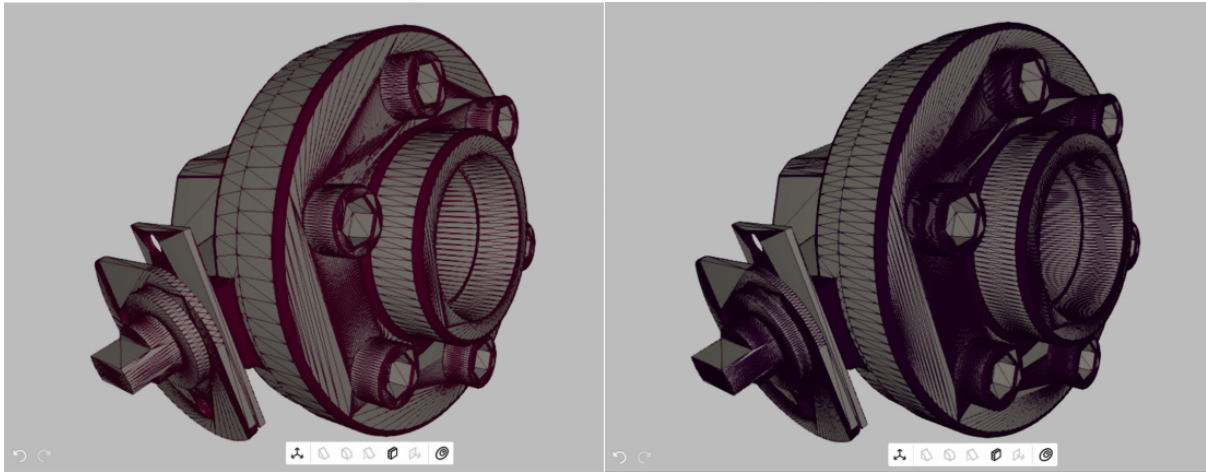


Figure 201: CAD model converted to a mesh with 72 (left) and 144 (right) accuracy values.

1. Select the CAD object you want to convert in the *Workspace* and right-click on it.
2. Select *Convert to mesh* option.

Artec Studio then converts the CAD to a mesh (PLY). The original CAD object remains intact.

11.2.5 Disassembling CAD objects








If the imported CAD model is recognized as an assembly, you can split it into its individual parts. The Disassemble option can be found in the context menu of the *Workspace* panel only if the selected element is a CAD assembly.

Once the option is selected, the *Workspace* panel will display a new group named after the assembly. This group will contain the individual parts it was disassembled into and the original assembly will stay on the same level with the new folder.

11.3 Setting constraints for CAD primitives

After creating CAD primitives, you can adjust their size and relative position by applying various constraints to them. Artec Studio supports the following kinds of constraints: conditions (they are set for one primitive) and relations (they are set for two or more primitives). Below see the table of available constraint types.

Table 15: Constraint types for primitives.

Icon	Kind of constraint	This constraint ...	Applicable to ...
	Relation	requires the axes (or normals) of the selected primitives to be parallel	cylinder, cone, plane, torus
	Relation	requires the axes (or normals) of the selected primitives to be perpendicular	cylinder, cone, plane, torus
	Relation	sets a given angle between the axes (or normals) of the selected primitives	cylinder, cone, plane, torus
	Relation	requires the selected primitives to be coaxial	all types of primitives except plane
	Condition	sets a given value for one of the sizes of the selected primitive, for example, cylinder radius/height, torus minor/major radius, etc.	cylinder, cone, sphere, torus
	Relation	requires the selected sizes of the selected primitives to be equal	cylinder, cone, sphere, torus
	Condition	prohibits changes to the primitive during the Refit operation	all types of primitives

Note: Independent CAD primitives, as well as *Freeform* and *Autosurface* CAD primitives do not support any constraints.

You can set several different constraints for each primitive. There is no limit to the number of constraints.











Note: You cannot set constraints for CAD primitives created in Artec Studio version 16 and earlier.

Applying constraints to CAD primitives consists of two stages. First, you specify the desired constraints, and on the second stage, you force Artec Studio to rebuild the primitives to meet the constraints you set (the refitting process).


To specify and apply constraints to CAD primitives, follow these steps:

1. Open the *Construct* panel and create the CAD primitives you need (see [Constructing CAD Primitives](#) for details).
2. Click the desired primitive. The *Constrain* pop-up toolbar appears with icons for the applicable constraint types (see an example of such a toolbar for the case of a cylinder in [Figure 202](#), a and [Figure 203](#), a).

Note: If you are having difficulty selecting a CAD primitive, you can hide other objects in the *3D View* area that may interfere, i.e., meshes, scans, imported CAD models.

3. Click the icon of the desired constraint type.
4. Perform the appropriate actions depending on the constraint type you selected:
 - For  (lock), no actions are required.
 - For , click one of the icons of primitive sizes on an additional pop-up tool bar if it appears (see an example in [Figure 202](#), b). Specify the desired primitive size value and click  on the appropriate pop-up toolbar (see [Figure 202](#), c).
 - For , , , and , click all other primitives to be involved into the new relation (see an example in [Figure 203](#), b). When done, click  on the appropriate pop-up toolbar (see [Figure 203](#), c).
 - For , select one of the primitive sizes on an additional pop-up toolbar (it appears if two or more sizes are available). Then click the second primitive and select one of its sizes. To establish an equality relationship between the two selected sizes, click  on the appropriate pop-up toolbar.

The corresponding constraint icon will be displayed next to each primitive participating in the constraint but no changes to the size or position of the primitives will occur at this point (see examples in [Figure 202](#), d and [Figure 203](#), d). A pop-up toolbar with the *Refit* button will appear at the top of the *3D View* window.

5. Repeat steps 2 to 4 to add more constraints if required.
6. Before proceeding to the next step, you can click the icon of any constraint and make the necessary changes or remove it by clicking  on the constraint's pop-up toolbar.
7. To apply the newly added constraints to the CAD primitives, click the *Refit* button on the panel at the top of the *3D View* window.

The primitives will be rebuilt to satisfy the specified constraints. [Figure 204](#), b presents the result of applying both constraints illustrated in [Figure 202](#) and [Figure 203](#).

Note: If the constraints are applied successfully, the symbols in their icons remain yellow, otherwise—the symbols turn red.

8. If red constraint icons appear as the result of step 7, follow step 6 to change or remove such incompatible constraints, and then repeat step 7 if necessary.

Note: Actions with constraints, as well as the *Refit primitives* command triggered by the *Refit* button are recorded in *History* and can be undone or redone (for example, using the

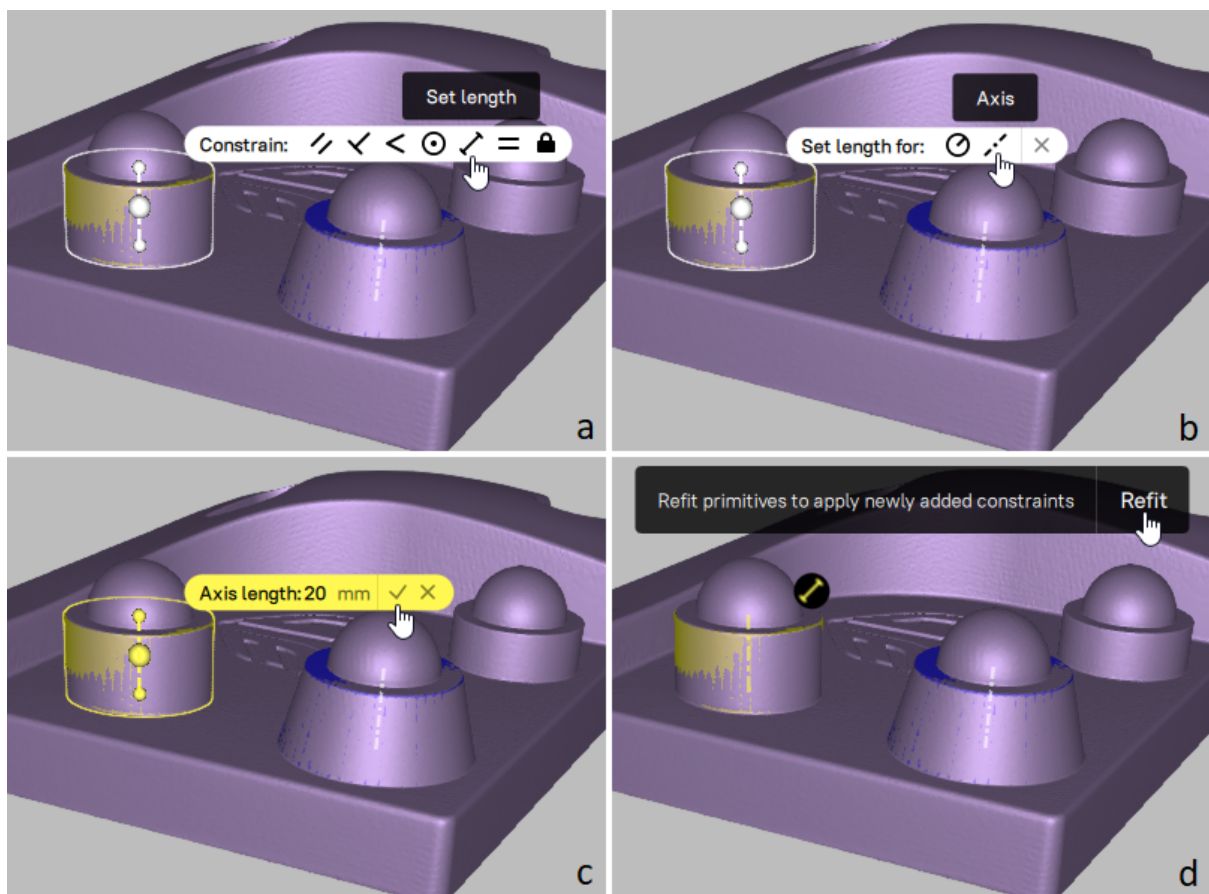


Figure 202: Example for specifying CAD primitive constraints: setting the height of a cylinder.

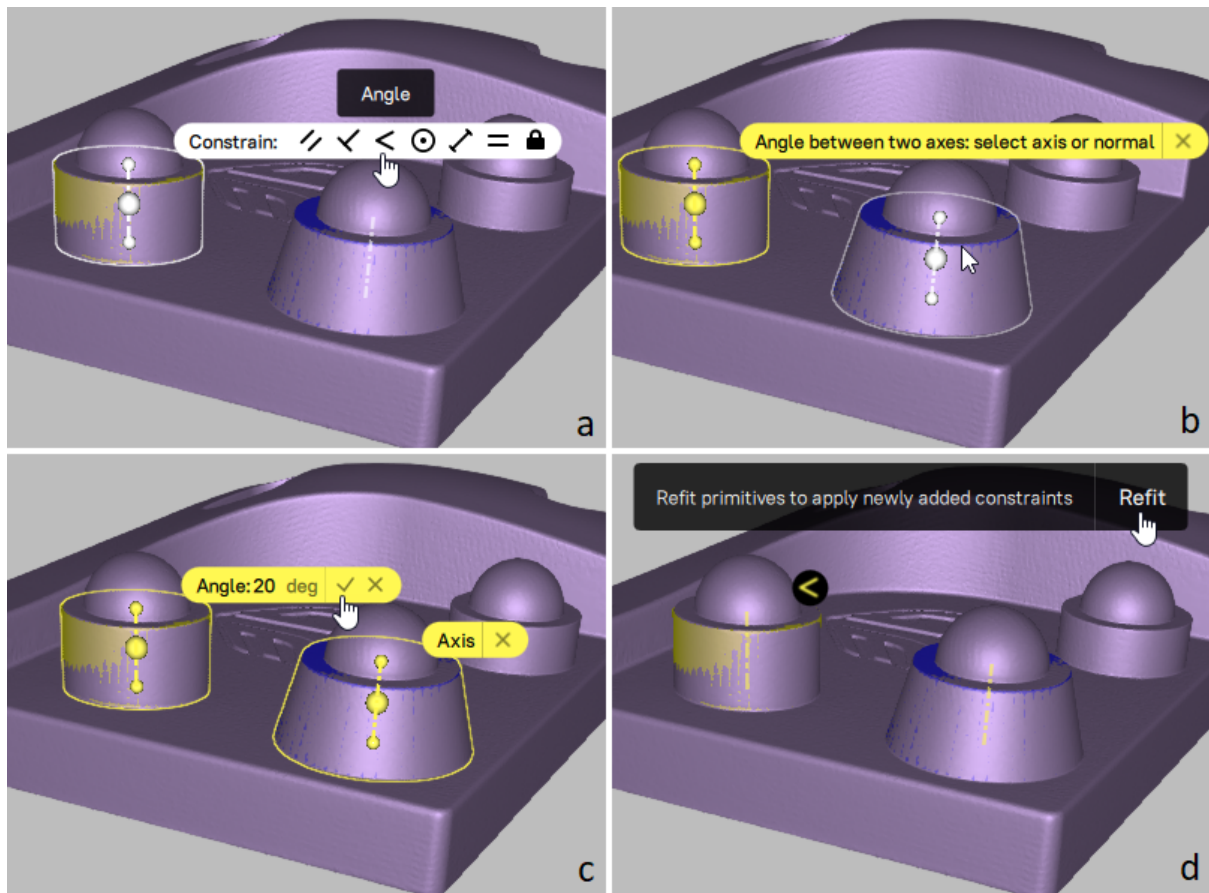


Figure 203: Example for specifying CAD primitive constraints: setting the requirement that the axes of two primitives are at a given angle to each other.

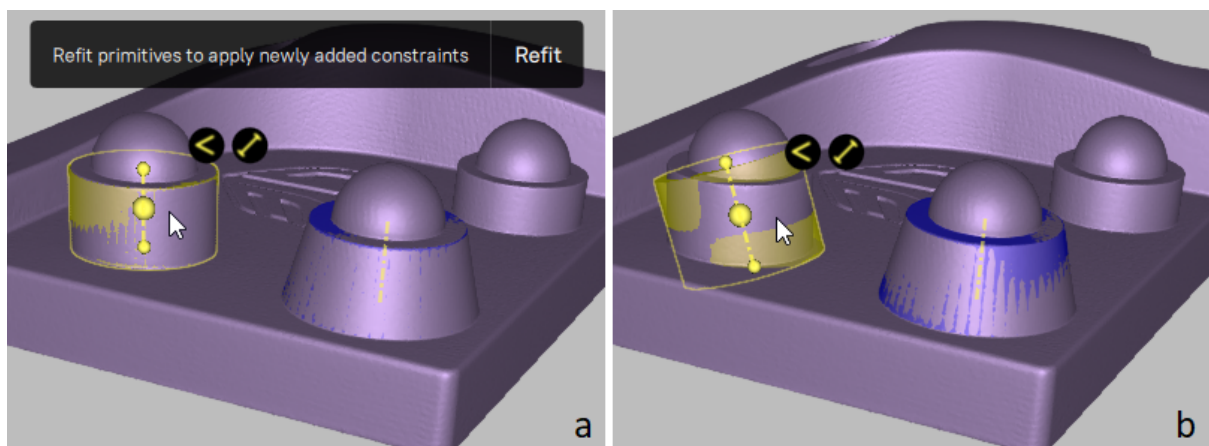



Figure 204: Example for applying CAD primitive constraints.

Undo and *Redo* buttons).

To add more constraints, repeat the above procedure (steps 1 to 8).

To modify the constraints applied to your CAD primitives, perform steps 6 to 8 of the above procedure before closing the *Construct* panel. You can also switch to the *Show CAD constraints* mode to view and modify constraints without the *Construct* panel. To turn it on, use the *View* → *Show CAD constraints* menu command.

To cancel the constraints applied to CAD primitives last time you pressed the *Refit* button, use the *Undo* command. The previous state of the involved CAD primitives will be restored, however, the constraints themselves will remain unchanged.

To remove a constraint, click its icon and then  on the constraint pop-up toolbar. In this case, the result will be the following:

- The constraint will be removed.
- The CAD primitives participating in this constraint (their size, position, orientation) will not be affected.

11.3.1 Ambiguity of some constraints

For some relations, the result of applying the constraint is ambiguous. For example, the condition that the axis of one primitive is directed at an angle to the axis of another one is not enough to determine the direction of the axes. This problem has an infinite number of solutions. In this case, Artec Studio will choose one of the solutions. For the solution to be unambiguous, additional constraints must be used.

Let us explain this with the following example. Suppose we have two primitives: a cylinder and a plane (see [Figure 205, a](#)), and we would like to adjust the position of the plane so that its normal becomes perpendicular to the axis of the cylinder. For this, we specify and apply the corresponding constraint (✓). The result obtained after refitting the primitives is shown in [Figure 205, b](#). It is correct, but not what we expected. To get the desired result, we need to set an additional constraint, for example, we can lock the cylinder for changes (see the corresponding result in [Figure 205, c](#)).

11.4 Positioning CAD Primitives

The *Precise positioning* mode benefits from the presence of parametric data in the scene. Use the *Precise* mode to quickly and accurately position CAD primitives, and thus scans and models to which they belong.

1. In the *Workspace* panel, select the models and primitives you want to align.
2. Open *Editor* → *Precise positioning*.

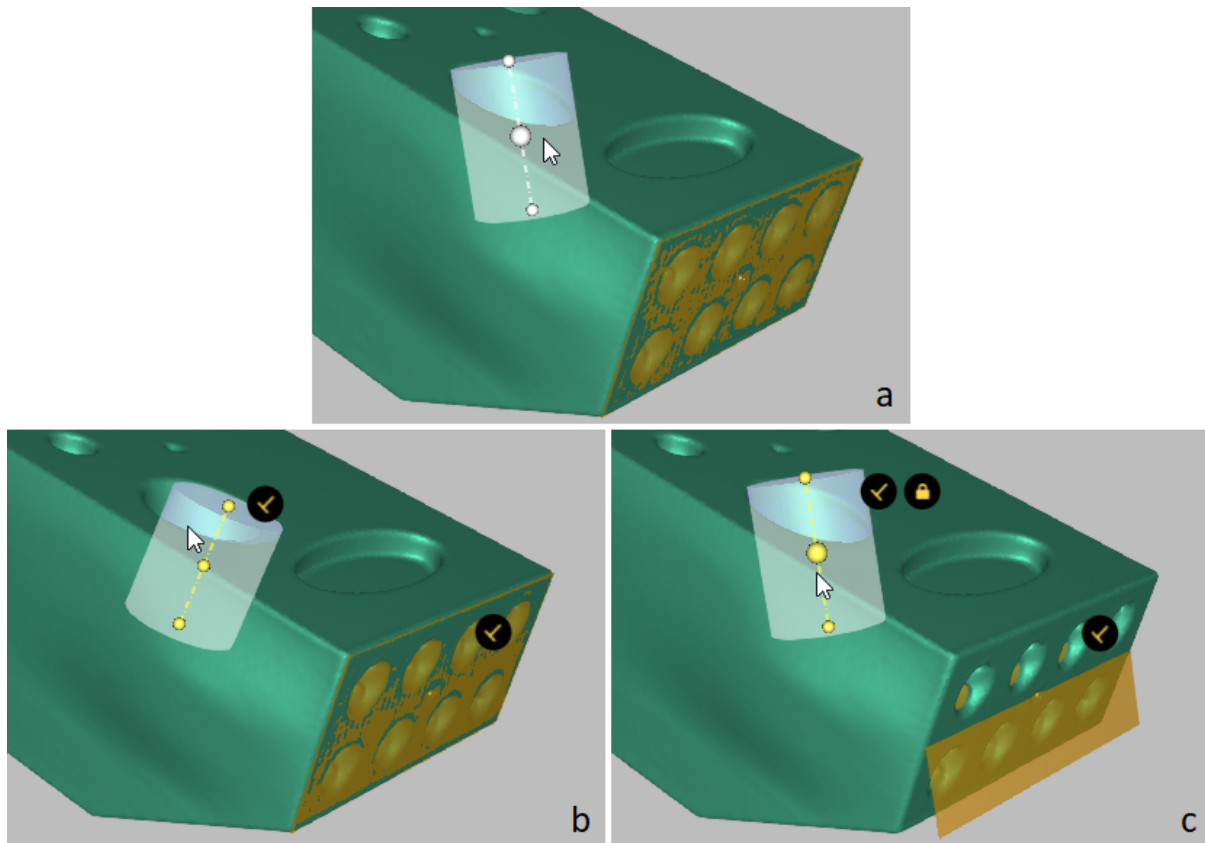




Figure 205: Example of ambiguous CAD primitive constraints.

3. In the *Primitives* box, select the CAD primitive you intend to position. Below the *Primitives* box you will see the available positioning options (see [Table 16](#) for details), which appear as buttons and vary with the type of the selected primitive.

Note: *Freeform* and *Autosurface* CAD primitives are not available for precise positioning.

4. If some other objects belong to the parent group of the selected primitive and you want to apply the same positioning actions to them, check *Apply to all objects in parent groups*.
5. Click either of the self-explanatory positioning buttons. Artec Studio will position the primitive in accordance with the selected option and disable this button. You will see the alignment information in the *Primitives* box next to the name of the selected primitive.

Every positioning action is recorded in the local history, so you can undo or redo it:

- To undo an action, use *Edit* → *Undo*, click  in the 3D window, or Ctrl+Z.
- To redo an action, use *Edit* → *Redo*, click  in the 3D window, or Ctrl+Y.

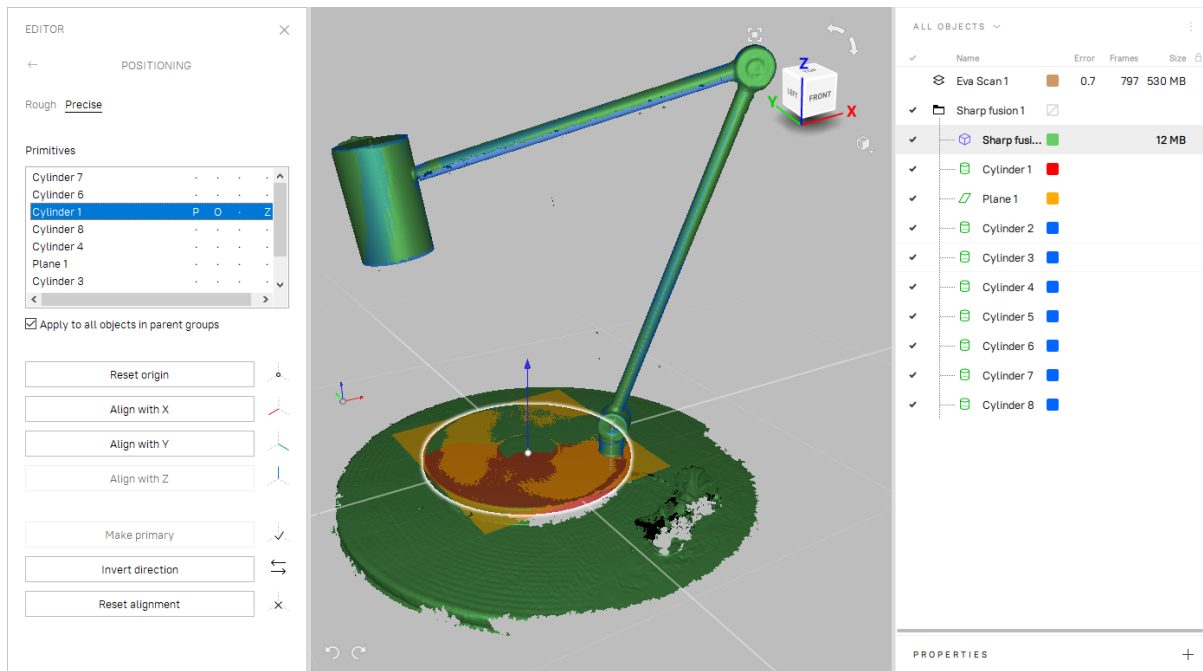


Figure 206: Editor → Precise positioning: the aligned CAD primitive is highlighted.

Table 16: Actions for primitives.

Button	Purpose	Status
<i>Move to origin</i>	Place the selected primitive's point to the coordinate origin. For details, see Primitives' Points To Use for Positioning .	O
<i>Align with X/Y/Z</i>	Align the primitive with the respective axis.	X, Y or Z
<i>Align with YOZ/XOZ/XOY</i>	Align the <i>plane</i> primitive with the respective coordinate plane.	YOZ, XOZ or XOY
Any	CAD primitive that you first align with any coordinate axis or plane is considered primary. A primary object will be given a priority when conflicting alignments occur.	P
<i>Make primary</i>	Make another object primary and remove this status from the current primary one	
<i>Reset origin</i>	Undo the <i>Move to origin</i> action.	
<i>Invert direction</i>	Invert direction of the axis or plane in the applied alignment	/
<i>Reset alignment</i>	Reset all the positioning actions applied to the primitive	

Note: The *Precise positioning* tool does not affect locked objects (🔒). See [Locking Object's](#)

[Position](#) for details.

See also:

[Exporting CAD objects](#), [Distance Maps](#) and [Sections and Volume](#).

11.4.1 Primitives' Points To Use for Positioning

Depending on the type of a CAD primitive, you can use the following points in the *Move to origin* action.

Table 17: Primitives' points to use in the Move to origin action.

Type of primitive	Points for positioning
<i>Cylinder</i>	3 points: the center of the cylinder and the intersections of the cylinder axis with its bases
<i>Plane</i>	The center of the plane
<i>Sphere</i>	The center of the sphere
<i>Cone</i>	3 points: the cone vertex, the middle of the cone axis, and the intersection of the axis of the cone with its base
<i>Truncated cone</i>	3 points: the middle of the cone axis and the intersections of the axis of the cone with its bases
<i>Torus</i>	3 points: the center of the torus and the intersections of the axis of the torus with the sides of the box into which it is inscribed

To select the center of a primitive for using in the *Move to origin* action, click the primitive or select it in the *Primitives* box. The selected point and the outline of the primitive will be highlighted in white ([Figure 207](#), left).

When you hover the cursor over the primitive's axis, other points for positioning will appear on it. To select any of the possible positioning points, click on it. The selected point will be highlighted in white ([Figure 207](#), right).

11.5 Editing meshes using CAD objects

In Artec Studio, you can not only generate 3D forms through 3D scanning, but also create complicated shapes through combining meshes, CAD primitives, and CAD models. The following tools for engineering tasks are currently available:

- [Boolean Operations](#)
- [Splitting Object By Surface](#)

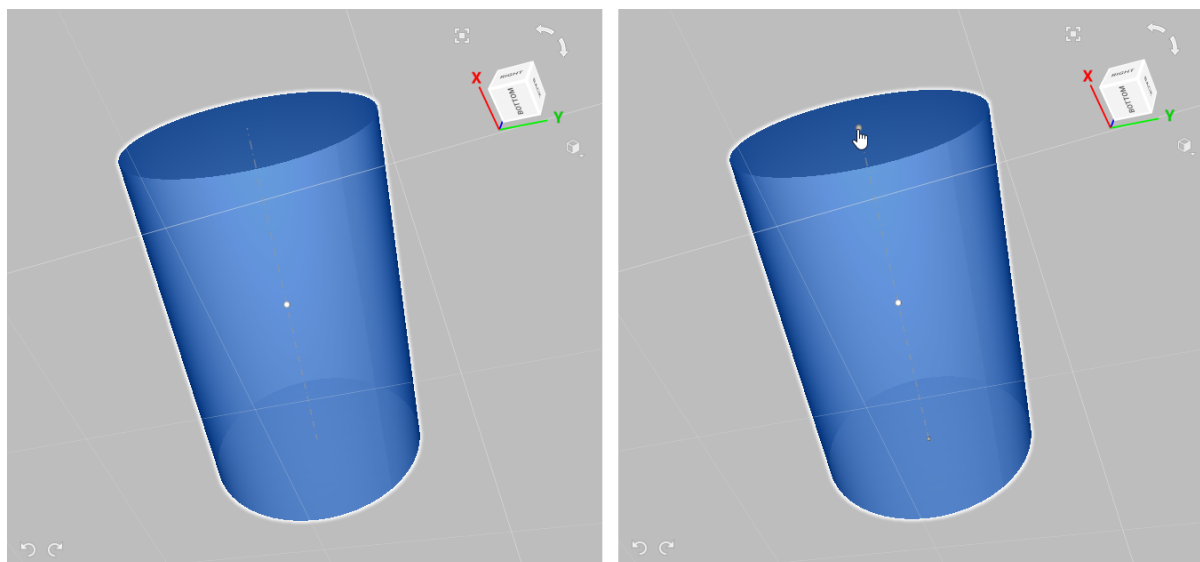


Figure 207: Selecting a point for positioning.

11.5.1 Boolean Operations

Starting from version 17, the basic set of Boolean operations is available in Artec Studio. You can create unifications and intersections between meshes and CAD objects, as well as subtract objects from each other.

The table below lists the available Boolean operations.

Table 18: Types of Boolean operations

Icon	Boolean operation	This operation ...
	Unification	creates a new mesh by merging one or more objects with each other
	Subtraction	creates a new mesh by subtracting one or more objects from another one
	Intersection	creates a new mesh that is the common part of two or more source objects

Boolean operations in Artec Studio can be applied to meshes, CAD primitives, imported CAD models and assemblies (collection of multiple objects). The following combinations are possible: mesh and mesh, mesh and CAD primitive, mesh and CAD model, mesh and assembly etc. The result of the operation is always a new mesh. The number of objects used in one operation is not limited, for example, you can create a Boolean unification by merging several objects.

Note: If you perform Boolean operations on a set of two CAD models, you will get a mesh as a result, not another CAD model.

To perform a Boolean operation, follow these steps:

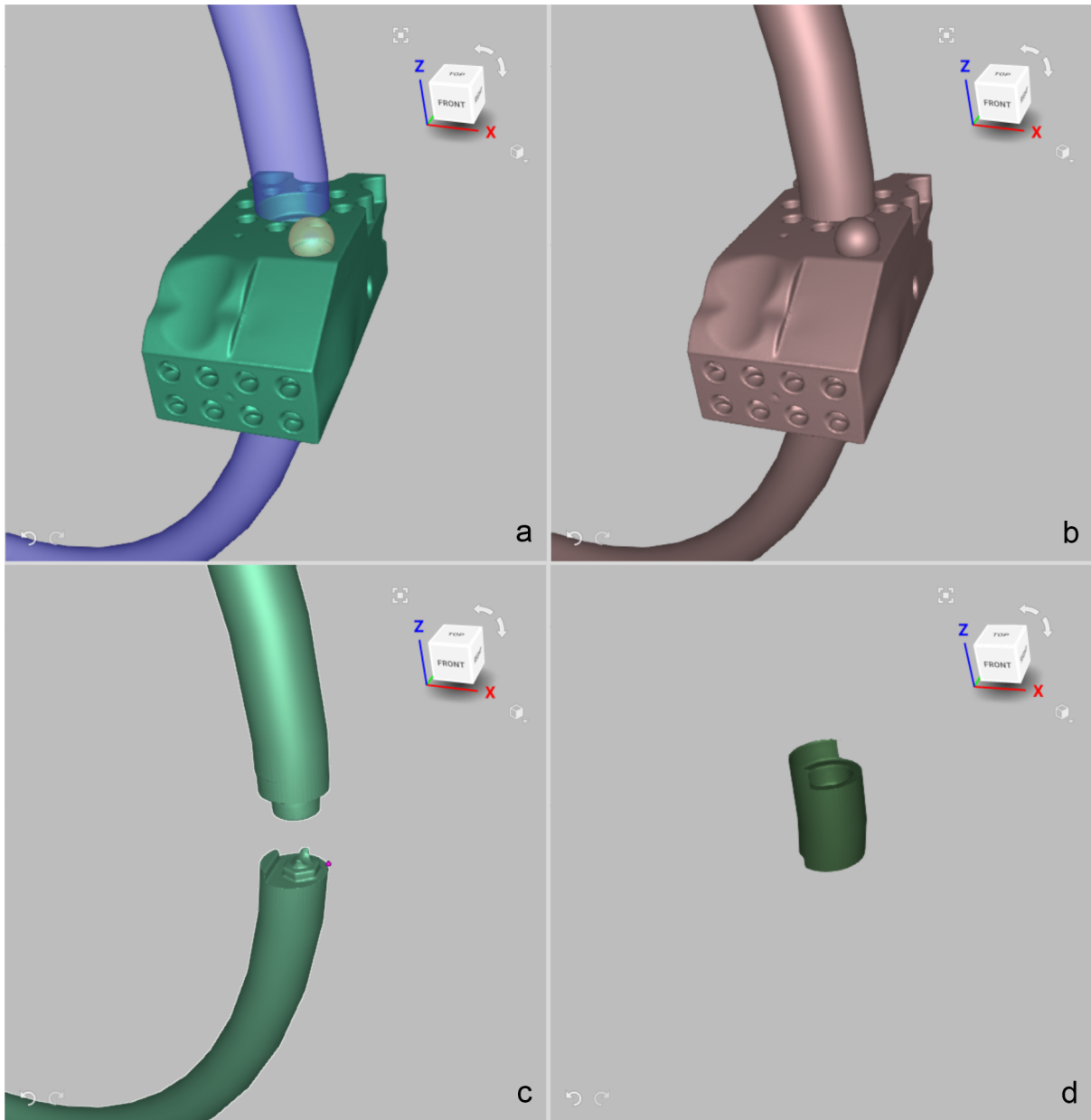






Figure 208: Examples of Boolean operations with objects: a—source objects, b—Boolean unification, c—Boolean subtraction, d—Boolean intersection

1. Open the *Construct* panel and go to the *Edit* tab.
2. Click the icon of the desired Boolean operation.
3. Specify the objects for the operation.
 - For  (Boolean unification):
 - a. Click *Add object* in the *Objects to merge* field.
 - b. Select one or more objects.
 - For  (Boolean subtraction):
 - a. Click *Add object* in the *Subtract from* field.
 - b. Select an object.
 - c. Click *Add object* in the *Objects to subtract* field.
 - d. Select one or more objects. If only one object is selected in the *Objects to subtract* field, you can swap the objects selected for the operation by clicking the  button.
 - For  (Boolean intersection):
 - a. Click *Add object* in the *Objects to intersect* field.
 - b. Select one or more objects.

Note: To select an object, click it in the *3D View* window or click its name in the *Workspace* panel. To deselect an object, click the x button to the right of its name in the *Construct* panel. Upon selection, the objects are appropriately highlighted in the *3D View* window.

1. In order to preview the result of your boolean operation, enable the *Preview* toggle switch in the panel.

Note: The *Preview* option is currently available only for the *Subtraction* and *Intersection* operations.

2. If you need to keep the source objects intact, check the *Keep initial objects* option. Otherwise, they will disappear from the *Workspace* panel after the operation is completed.
3. Click the *Create mesh* button to confirm the operation. Artec Studio will create a Boolean unification (or Boolean subtraction, etc) mesh.

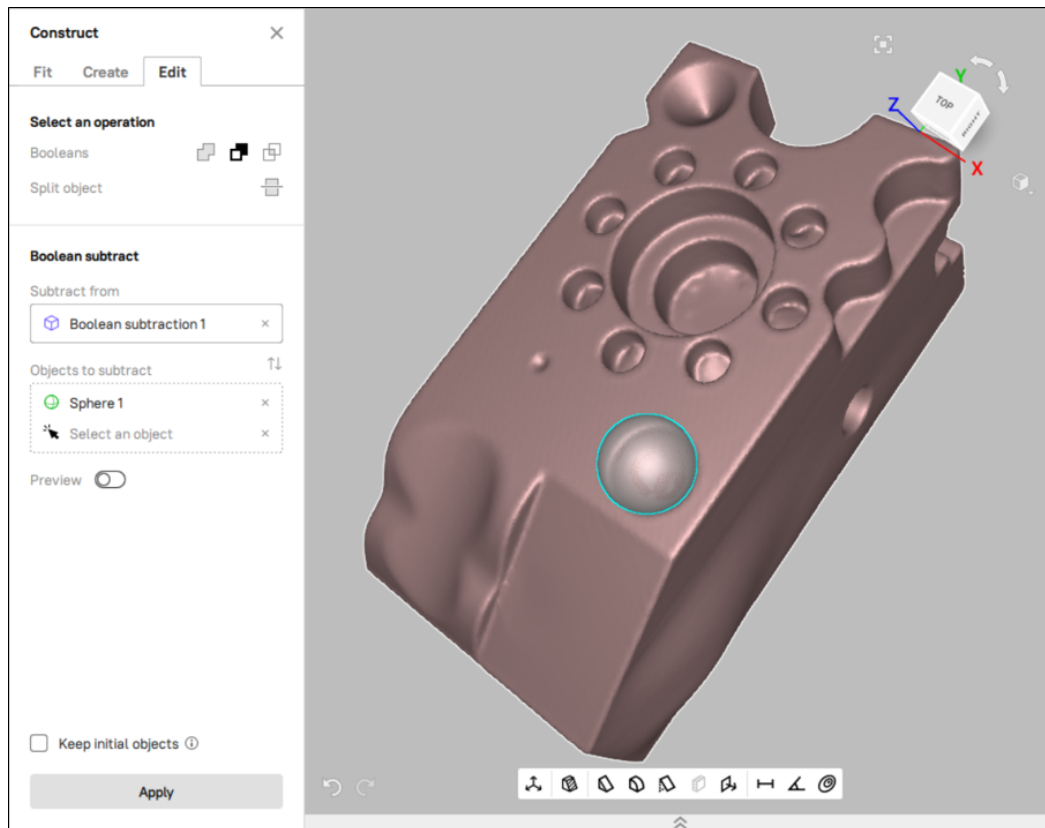


Figure 209: Selected objects are highlighted before the boolean operation

11.5.2 Splitting Object By Surface

You can split a mesh or CAD object into segments using one or more pre-built surfaces or planes. The result of split by each individual surface is two separate parts of the source object. The contact zone of these parts is sealed for both segments. The new parts appear as two separate objects in the *Workspace* panel.

The split tool can be used in particular to precisely divide an object into manageable chunks for further 3D printing.

To split a mesh by one or several surfaces, follow these steps:

1. Open the *Construct* panel and go to the *Edit* tab.
2. Click the *Split object* (≡) icon.
3. Specify the objects for the operation:
 - Click *Add object* in the *Object to split* field.
 - Select a mesh that you want to split.
 - Click *Add object* in the *Cutting surface* field.
 - Select one or more surfaces.

Note: To select an object, click it in the *3D View* window or click its name

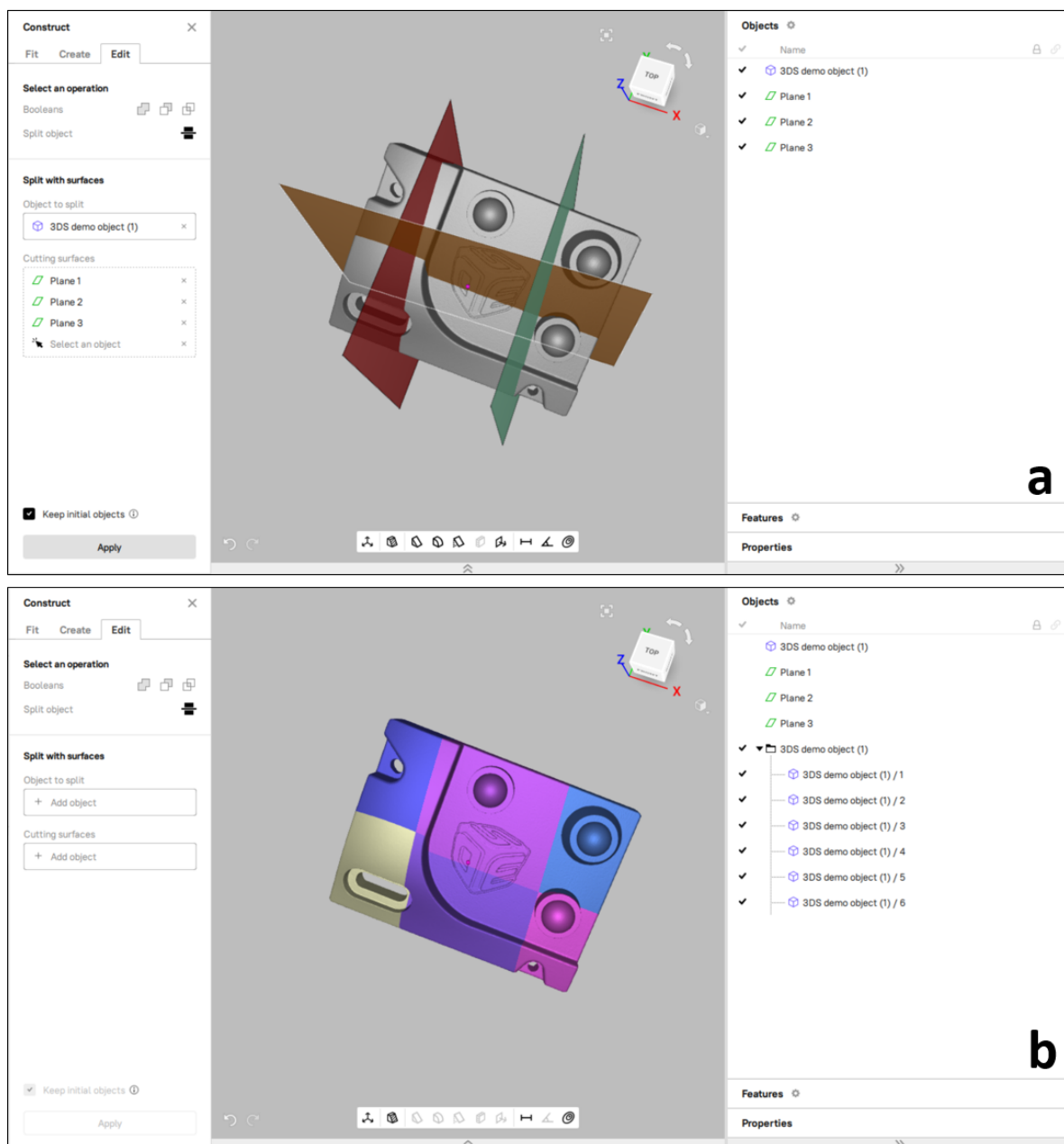


Figure 210: Example of splitting a mesh using 3 pre-built planes: a—before splitting, b—after splitting

in the *Workspace* panel. To deselect an object, click the x button to the right of its name in the *Construct* panel.

4. If you need to keep the source object intact, check the *Keep initial objects* option. Otherwise, they will disappear from the *Workspace* panel after the operation is completed.
5. Click the *Apply* button to confirm the operation. Artec Studio will split the object by the specified surface(s).

11.6 Working with Imported CAD Models

Imported CAD models can be aligned or *compared* with polygon models (fusion operation outputs).

11.6.1 Alignment

When aligning CAD models with polygon models, don't use Nonrigid alignment and employ many point pairs (5–6 pairs). You can also align an imported CAD model with a mesh precisely by specifying datums.

For details, consult *Datum Alignment*, *Best Fit Alignment with Points* and *Specifying Point Sets (Markers) and Editing their Positions*.

ADDITIONAL MODES

This chapter describes other Artec Studio modes, such as

- [Multicapturing](#)
- [Measurement Tools](#)
- [Copying Log Records](#)
- [Feedback Form](#)

12.1 Multicapturing

Artec Studio enables synchronized scanning with multiple scanners. This mode is helpful when capturing a large object from several angles using more than one scanner simultaneously. Multicapturing with several scanners implies that the system knows their position in advance. This condition simplifies and accelerates data processing considerably. For this reason you must calibrate the relative positions of the scanners before capturing. The resulting calibration data, which includes scanner IDs and their spatial orientations, is referred to as a [bundle](#).

Important: Using multiple Artec scanners requires your workstation to integrate as many independent USB host controllers as connected scanning devices.

The entire procedure is given below and covered in the following sections.

1. Calibrate the relative position of each device (i.e., create a bundle)
 1. Capture the test object using all bundled scanners (see object requirements in [Bundle Creation](#))
 2. Manually align the resulting scans using the *Align* tool to compute the relative position of all scanners
 3. Create the bundle using the *Create bundle* panel
2. Use the *Multi* panel to capture scans

12.1.1 Bundle Creation

12.1.1.1 Preparation

Perform the following steps to prepare the devices and the environment:

1. Select device positions. The scanners' combined field of view should cover the required area.
2. Fix the scanners in the chosen positions. If you plan to use hardware synchronization (see [Hardware Synchronization for Eva](#)), attach the scanners to the tripods by securing them with thumbscrews while allowing the wires to hang freely.
3. Select and set up the calibration object. Any object with a geometry-rich surface is a candidate. Avoid selecting objects with simple geometries for calibration (e.g., planes, spheres or cylinders). You may use several objects as a composition when creating a bundle. We recommend object installation at the distance corresponding to the middle of the operating range for the chosen device type.

12.1.1.2 Capturing

4. Use either the *Capture* or *Multi* panels to make scans. The latter option is more convenient, as it allows you to capture the video data stream simultaneously from several scanners. For details regarding this mode, see [Performing Multicapture](#).

If you install the scanners at **small angles** relative to each other (i.e., you can see the same object area simultaneously through different scanners), you need **not rotate the object**. In this case, you can take calibration scans either sequentially or concurrently. In case of sequential scanning, make sure the object is fixed safely and remains motionless during the scan.

If you set up the scanners at a **large angle** and their fields of view have no overlap, use the *Multi* panel to start the capture sequence and **then turn** (move) the object to enable all scanners to capture the same parts.

Note! It is important that all scanners capture a large portion of the object or scene (but not necessarily the same portion) in each frame, because the position of all subsequent frames—as well as the scanners themselves—will be determined by their predecessors. Also, the relative positions of the scans will determine the intercalibration of the devices.

12.1.1.3 Alignment

5. If the cameras are far from each other and the object was moving, then you should register the scans using the *Fine registration* and *Global Registration* algorithms.
6. Next, proceed to the *Align* panel and align the captured scans as *Alignment* describes. At that point, everything will be ready for bundle creation.

12.1.1.4 Bundle

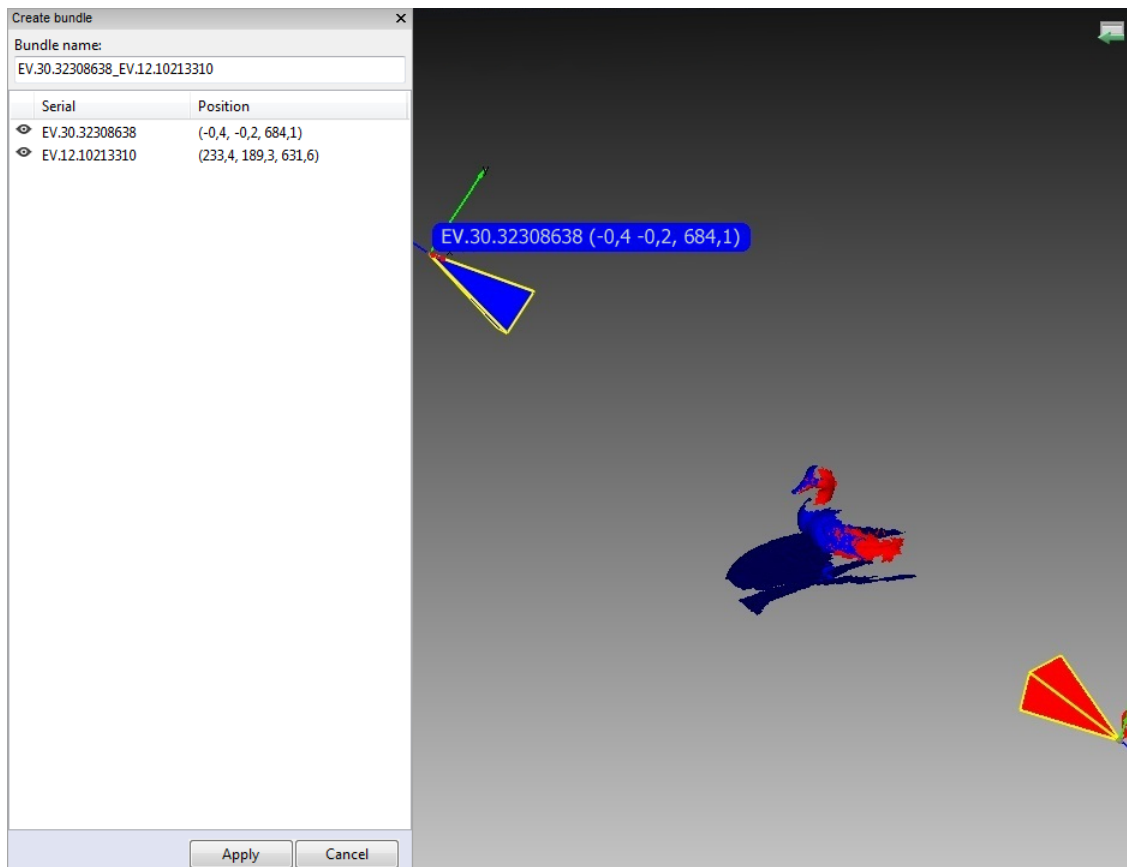



Figure 211: Bundle-creation window.

7. From the menu, select *File* → *Create bundle*. A warning message will appear if you forget to align the scans. Otherwise, the bundle-creation panel will appear (see [Figure 211](#)). The *3D View* window will show the selected scans, the position and viewing direction of the scanners (by means of an appropriately colored pyramid), the device ID, and the scanner coordinates. It will display a list of connected devices and corresponding information.
8. Add a device to the bundle or remove one by inverting the  image in the leftmost column of the list. The order of devices in a bundle refers to the scan order in the *Workspace* panel.
9. A bundle name will appear in the field at the top of the bundle-creation panel. By default it contains the serial number of the bundled scanner. Before creating the

bundle, you can easily change this name by typing in the corresponding field. Click *Apply* at the bottom of the panel to create and install the bundle.

Note: Once you have created the bundle, you can no longer move the scanners relative to one another. If even one device has changed position, you must recreate the bundle.

12.1.2 Performing Multicapture

Multi mode allows you to capture 3D reality simultaneously from several devices.

1. Select *File* → *Multicapture (bundle)*. The panel will open (see [Figure 212](#)).
2. Either use one of the existing bundles or specify the scanner list manually.

Note: In multicapture mode the system possesses information about the relative scanner positions. Therefore, scans captured by bundled scanners differ from manual scans in that the matching frames from different scanners are already in the same coordinate system.

1. Select the *Use bundle* checkbox. A dropdown list of all installed bundles will appear in the panel. Active bundles are highlighted in black, inactive bundles in gray. Artec Studio considers the bundle active if all bundled devices are installed and connected to the PC.
2. Select *Synchronization type* from the *Options* tab in the *Multicapture* panel.
 - In *Software* mode, scanners are synchronized via USB, *Windows* and Artec Studio, and the slave-scanner actuation time always varies (~10 milliseconds) owing to the numerous links in the chain.
 - In *Hardware* mode, scanners are synchronized via cables (see [Hardware Synchronization for Eva](#) for details). Hardware synchronization provides high precision and repeatability for slave-scanner actuation time (about 1 millisecond with a precision of less than 10 microseconds, thanks to microelectronic processes).

Note: We recommend hardware synchronization in most circumstances; when capturing moving objects, it is mandatory.

3. Click *Preview* to start capture.

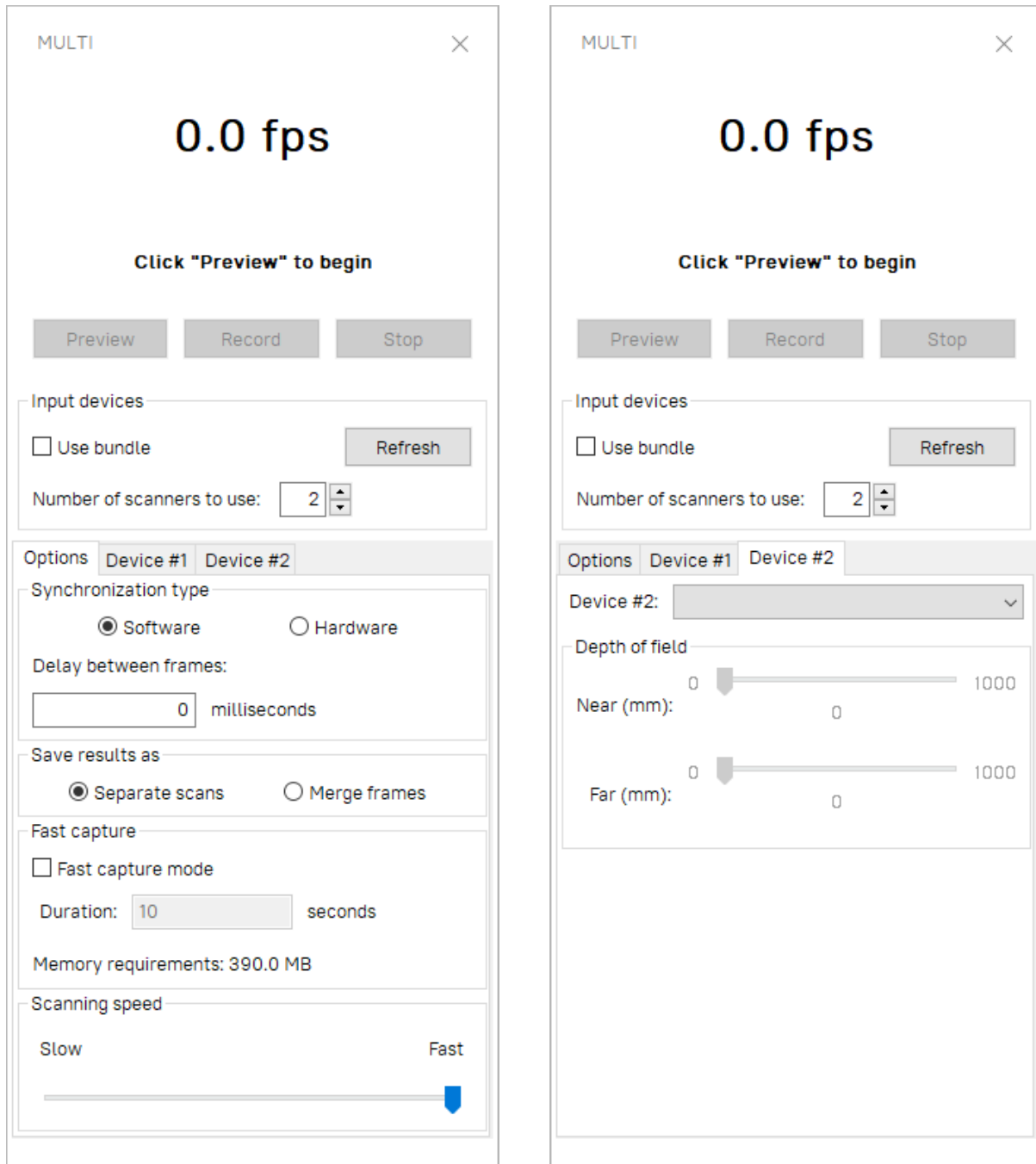


Figure 212: Multicapture panel: *Options* tab on left, *Device* tab on right.

12.1.2.1 Tweaking Multicapture Options

You can store multicapture data either as separate scans (use the *Separate scans* radio button) or as a single scan in which every frame represents an aligned union of corresponding frames from all bundled devices (use the *Merge frames* radio button).

If you need to capture frames with a certain delay between the scanners, enter the delay value in the *Delay between frames* field. Unlike the *Scan* mode, the *Multicapture* mode captures each frame independently without attempting to align each subsequent frame with the previous one, so it makes sense.

Sometimes, limiting the cameras' field of view is necessary (e.g., to cut off extraneous distant objects). Two sliders in the *Depth of field* area set the near and far scanning boundaries. The application sets work-area boundaries for each device independently in the device tabs (see [Figure 212](#), right). By default, the minimum and maximum boundary values for the corresponding device type are set to the recommended range; we encourage you to avoid changing them. However, if you're using Artec L scanners or 3D sensors, it may become necessary. To change these values manually, mark the *Override default depth range* checkbox in the *Scan* tab of the *Settings* dialog and enter the appropriate values in the fields below.

Note: For most scanner types, redefining the recommended depth range may reduce accuracy.

Fast capture mode instructs Artec Studio to store raw scanned data in memory and processes frames after completing the capture sequence. It allows to save processor time on building and rendering surfaces. And if the number of processor cores is less than doubled number of scanners in the bundle, it can also increase scanning speed.

To enable it,

1. Check the *Fast capture mode* box.
2. Enter the desired capture duration in seconds. The application will automatically recalculate and display the required amount of memory.

Artec Studio saves multicapture parameters when you exit the application and reapplies them the next time you start it.

12.2 Measurement Tools

Artec Studio offers a number of measurement tools, including

- Distance
 - Linear distance
 - Thickness
 - Geodesic distance

- Sections and Volume
- Distance map
- Section analysis

The corresponding buttons reside in the upper part of the *Measures* panel.

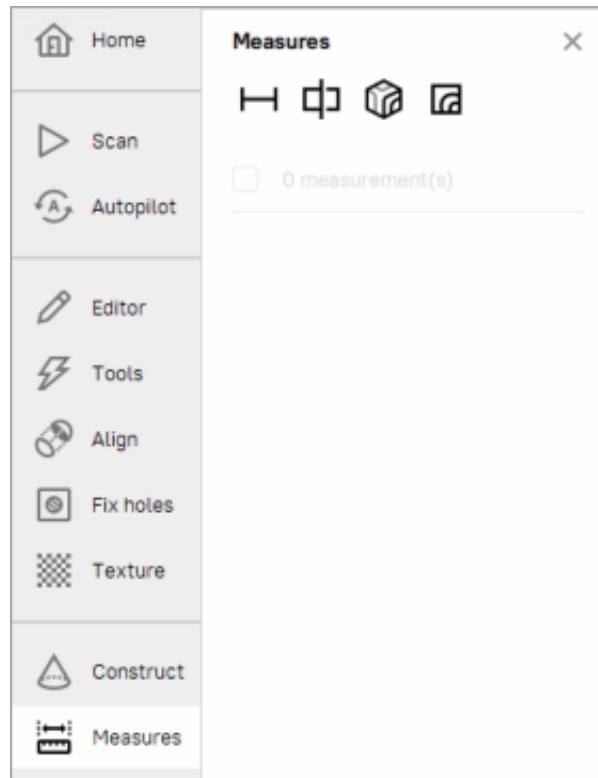


Figure 213: The *Measures* panel.


To work with these tools

1. Mark the ☒ checkboxes of each desired scan or model to display them in the *3D View* window.
2. Select the measurement tool you need and click on the object surfaces to create measurement lines, planes, etc.

The sections below takes a closer look at the different measurement tools and their features.

12.2.1 Distance

12.2.1.1 Linear Distance

When you select *Measures* → *Distance* () , the linear measurement will be used by default. Don't mark the *Geodesic* checkbox.

The linear-measurement tool allows you to measure:

- the distances between selected points
- the thickness of a model (see [Thickness measurement](#) for details)
- the total length of a polyline determined by a sequence of points

You can enter a name for the new measurement by typing it in the *Name and color* field. Click on the color circle next to the field to choose a color of the measurement projection. The application creates new measurements with default names `Linear 1`, `Linear 2` and so on.

To measure distances between points,

- Use `LMB` to sequentially set the points on the model in the *3D View* window. The application will add these points to the current point list (in the *Measures* panel), which will also display linear dimensions and point coordinates.
- When you roll the cursor over any one of these points in the *3D View* window, the point will be highlighted; you can then drag it to another location using `LMB`. When you release the mouse button, the point will fix to its new location.


Note: You can't set a point outside the object's surface; in this situation, if you release the mouse button, the point will return to its original position.

After you click *Save measurement*, the application will return to the original *Measures* panel and will display a list of all saved measurements along with editing and deletion options.

12.2.1.2 Thickness measurement

Artec Studio allows you to measure the thickness of a model. Thickness measurement uses the ability of Artec Studio to determine the shortest distance between any selected point and a plane.

To measure the thickness of a model, follow these steps:

1. In the *Construct* panel, build a plane (shown in orange in [Figure 215](#)) that fits the side surface of the model (find out in [Constructing CAD Primitives](#) how to do this).
2. In the *Workspace* panel, select the model and the plane you constructed.
3. Open the *Measures* panel and click . Leave the *Geodesic* checkbox clear.
4. Select any point on the side of the model opposite to the plane (Point 1 in [Figure 215](#), left).
5. Click the plane. To avoid mistakes, it is recommended to hide the model in the *3D View* panel before doing this.

Artec Studio will automatically construct a perpendicular to the plane, determine the point of their intersection (Point 2 in [Figure 215](#), right), and calculate the distance between the two points. This distance gives you the thickness of the model.

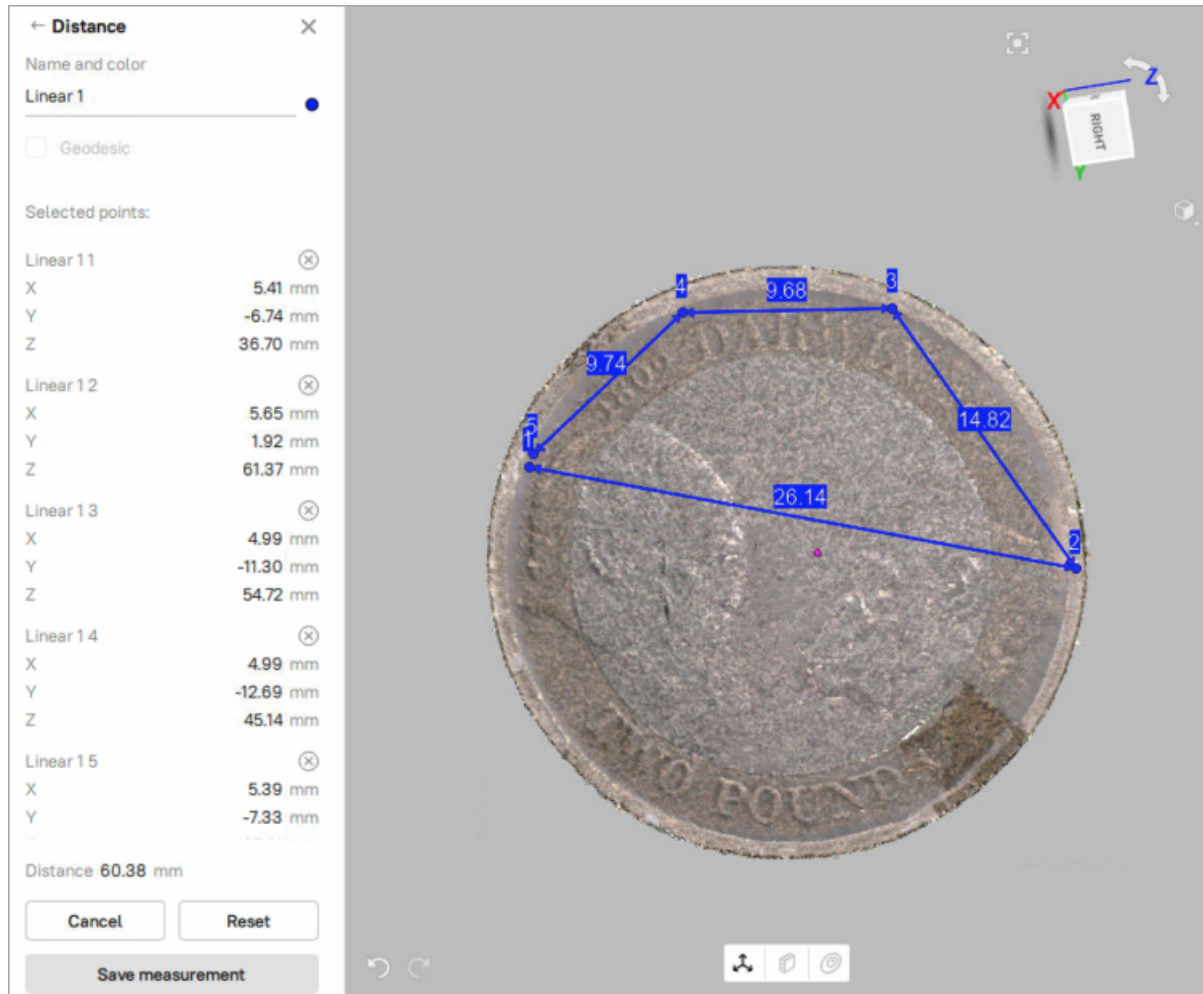


Figure 214: Linear measurement.

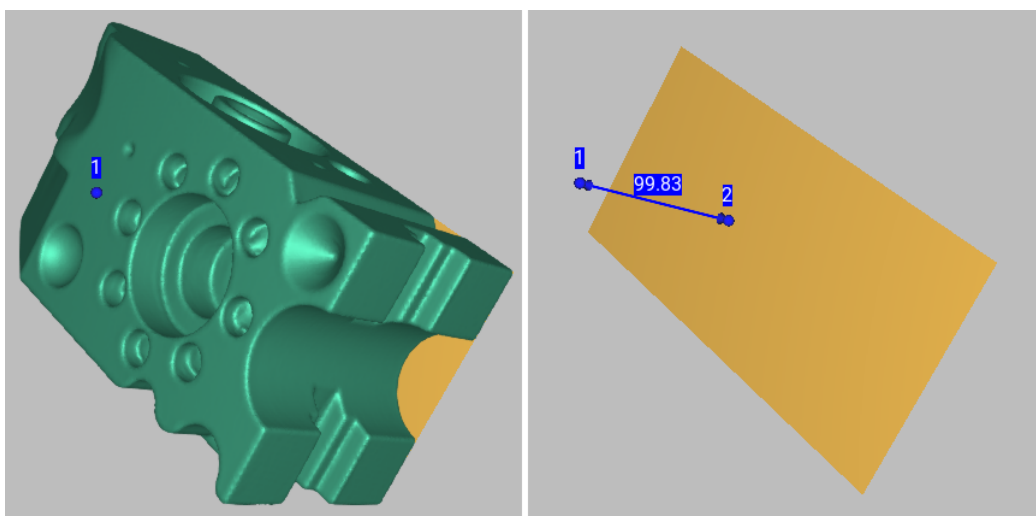


Figure 215: Thickness measurement: selecting a point on the side opposite to the plane (left), clicking the plane to determine distance to it (right).

12.2.1.3 Geodesic Distance

Geodesic distance is defined as the length of the shortest path over a surface between several given points. To activate the geodesic measurement, mark the *Geodesic* checkbox in the *Measures* → *Distance* panel and select a point cloud scan or model to start using the tool.

Working with geodesic measurements is similar to working with linear measurements (see [above](#)).

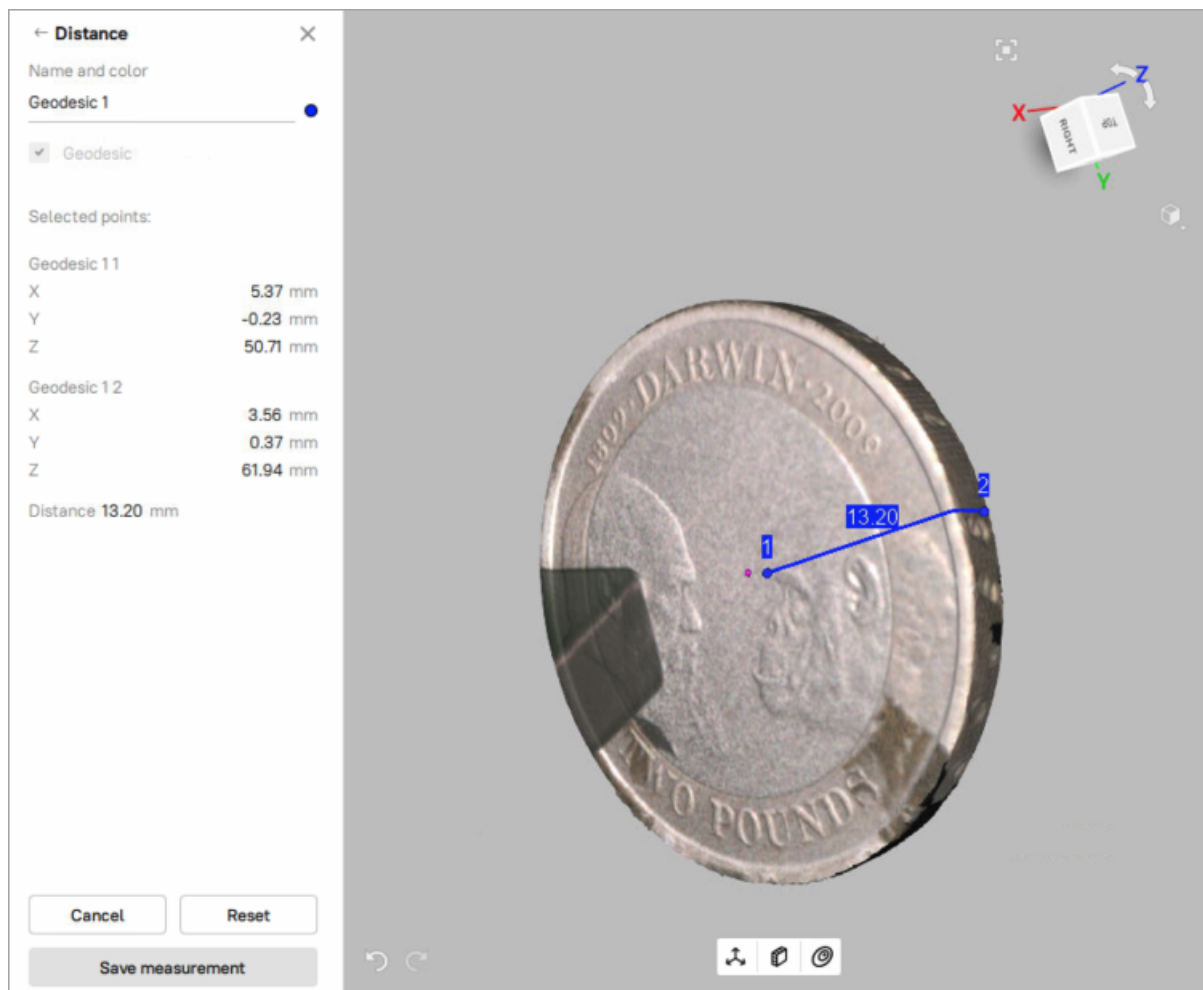


Figure 216: The Geodesic measurement.

Calculation of the shortest path is a time-consuming process that is accompanied by a progress-bar window. Also keep in mind that the shortest path between different surfaces or disconnected parts of the same surface is not defined. Therefore, the program will display an error if you select points on parts of a surface that are not connected to each other.

Note: The geodesic algorithm is complex, and computations for a large number of vertices may take a long time. Therefore, if you choose the first point on a surface containing more than 150000 points total, the software will warn you that it may be a lengthy operation. You can either use the mesh-optimization algorithm beforehand (see [Mesh](#)

[Simplification \(Tools, Mesh Optimization\)](#)) or delete the parts of the surface that you don't need.

The left panel in this mode is similar to the one for linear-measurement mode (see [Linear Distance](#)).

12.2.1.4 Exporting Linear (Geodesic) Measurements

Once you have made and saved the required measurements, you can export them. Go to the general section *Measures*, select the desired measurement(s) and click on *Export...* You can export measurements in the following formats: CSV and XML.

12.2.2 Sections and Volume

Section is the plane that splits model or scan into two parts. Once created, it can provide you with data on volumes and areas of these parts as well as area and perimeter of the contour, i.e. the line formed as an intersection of the plane with surface.

To create a section of an object, follow the steps:

1. Select one or more models or scans and click *Measures* → *Sections & Volume* (📐). Models are preferable, since they contain only one surface.
2. Change the section name in the *Name* field as necessary.
3. Select the type of restrictions to create a plane: *Unconstrained* (3 points) or *Parallel to* either plane. Alternatively, you can also construct a plane using *CAD Primitives* and then, use this constructed plane to create a section by selecting the *Use constructed plane* option.
4. Use **LMB** to mark points on the object's surface:
 - Mark only one point to specify a plane parallel to one of the coordinate planes (XOY, YOZ, XOZ).
 - Mark three points to specify the plane that passes exactly through them.

Note: You can mark more points than required, i.e. more than one point or more than three points respectively. In this case, the plane will pass through the center of mass of the specified system of points.

5. If necessary, redefine your selection of points before using *Calculate*; to do so, click the *Reset* button.
6. For the plane to intersect the entire object, check the *Scale to bounding box* option. Alternatively, to enlarge or reduce the plane, you can use the *Scale* mode (see the next step for details).

7. Change the location and orientation of the plane as necessary. Choose a mode for doing this: *Translate*, *Rotate* or *Scale*. You can either specify numerical values in the text fields (in the plane's coordinate system for the *Scale* mode or in the global coordinate system for other modes) or drag the controls (which are also called *gizmo*) in the *3D View* window.
8. You can also get a live preview of the section by dragging and moving the respective axis arrows (gizmo), for a clearer visualization.
9. Click *Calculate*.

Note: The control principles of the section gizmos are the same as for the model gizmos. See [here](#) for details.

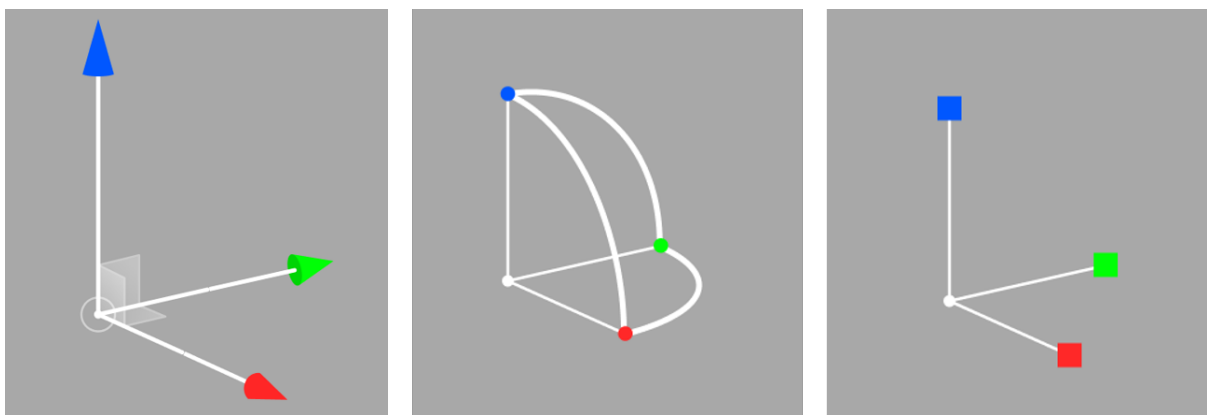


Figure 217: Gizmos for the Translate, Rotate and Scale respectively.

To measure the other side of the selected section

1. Flip the axis direction by clicking on the *Flip* button next to *Axis direction* in the panel.

To create a series of sections

1. Specify the quantity of planes you want to create by entering the value in *Planes* and define the spacing in the *Spacing* (in *mm*) field.
2. Then select from the *Direction* list one of three directions (*Positive*, *Negative* or *Both*) in which to create the new planes.
3. Click *Calculate*.

Once you have created the section(s), the *Section* panel will display its geometrical information. This information includes perimeter and area for contours as well as area and volume for parts of meshes. Besides displaying geometrical values, Artec Studio will show a list of meshes and contours that allows you to highlight them in the *3D View* window by clicking on them in the list.

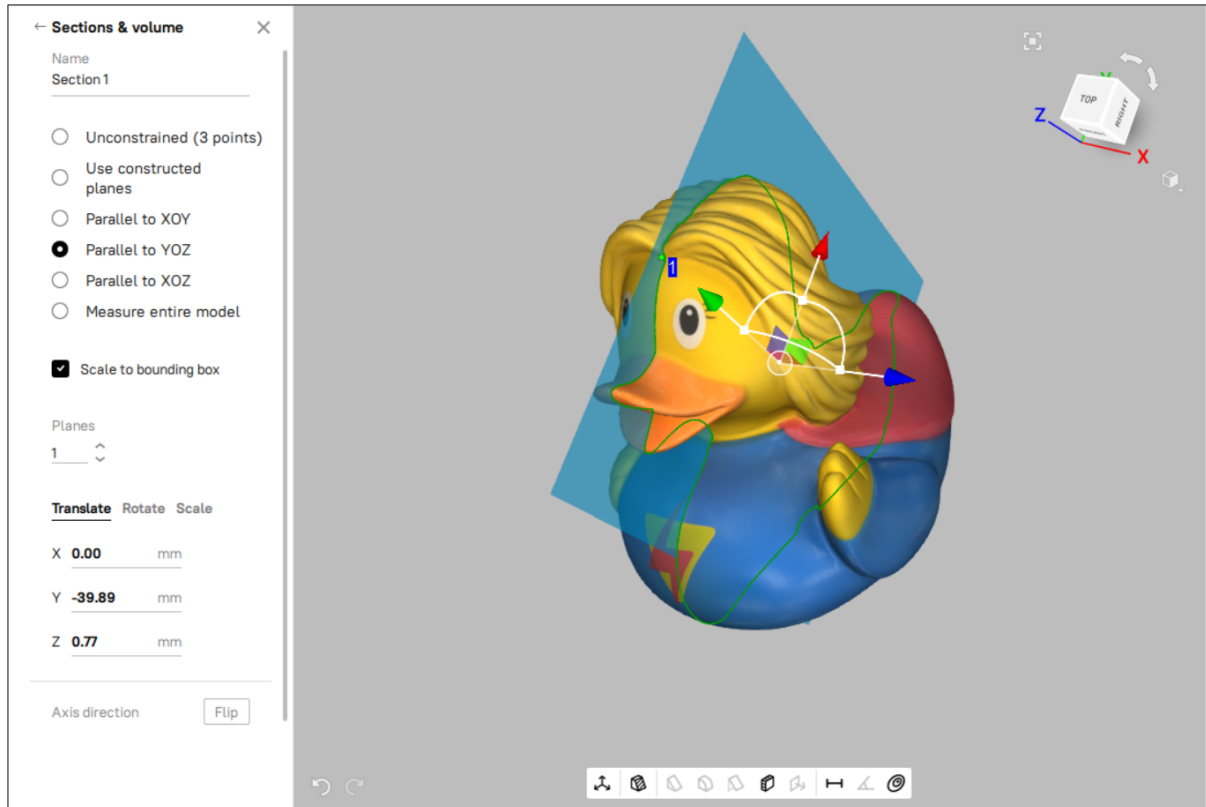


Figure 218: Change location and preview a new section by dragging the Gizmo controls.

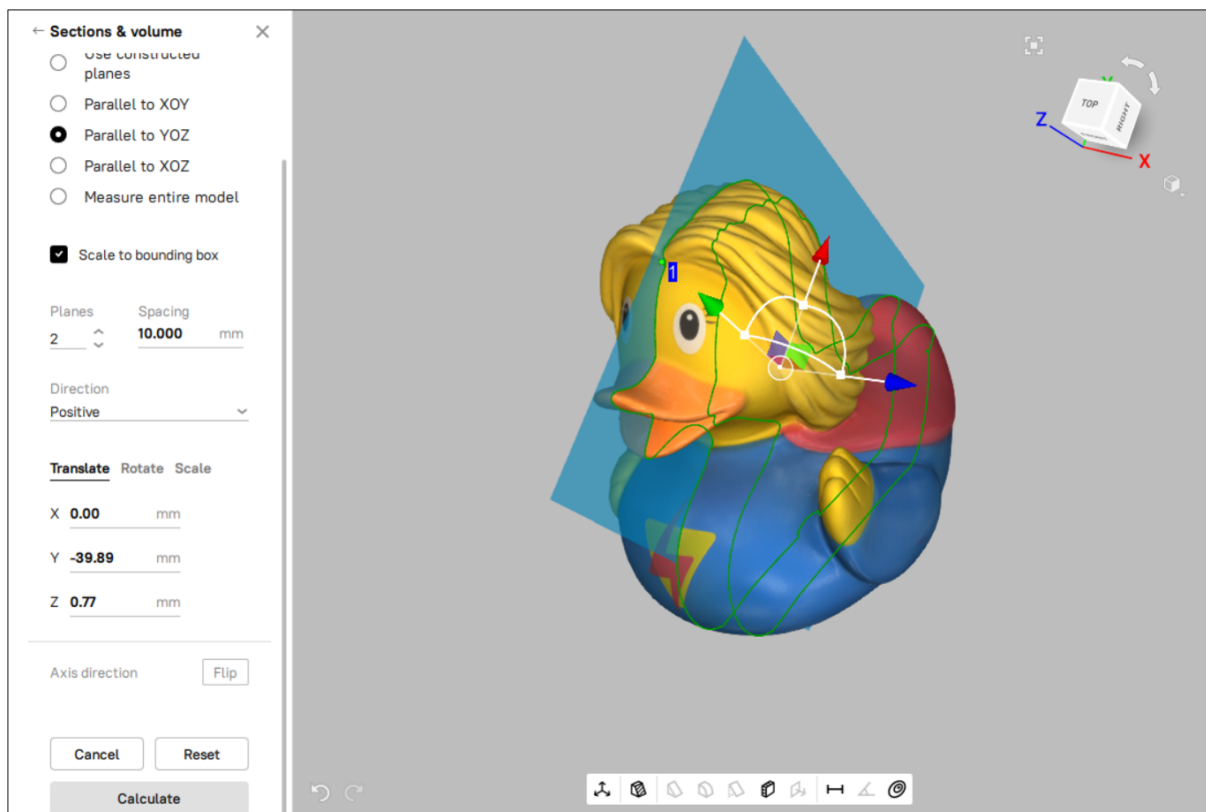


Figure 219: Calculating with two planes.

12.2.2.1 Comparing Values

The *Section* panel allows you to compare contours and mesh parts. To this end, select either two contours or two mesh parts from the list using the **Ctrl** key. Artec Studio will calculate the differences between the areas and perimeters of the contours and the difference between volumes and areas for mesh parts. These values will be available in the lower part of the *Section* panel (see [Figure 220](#)).

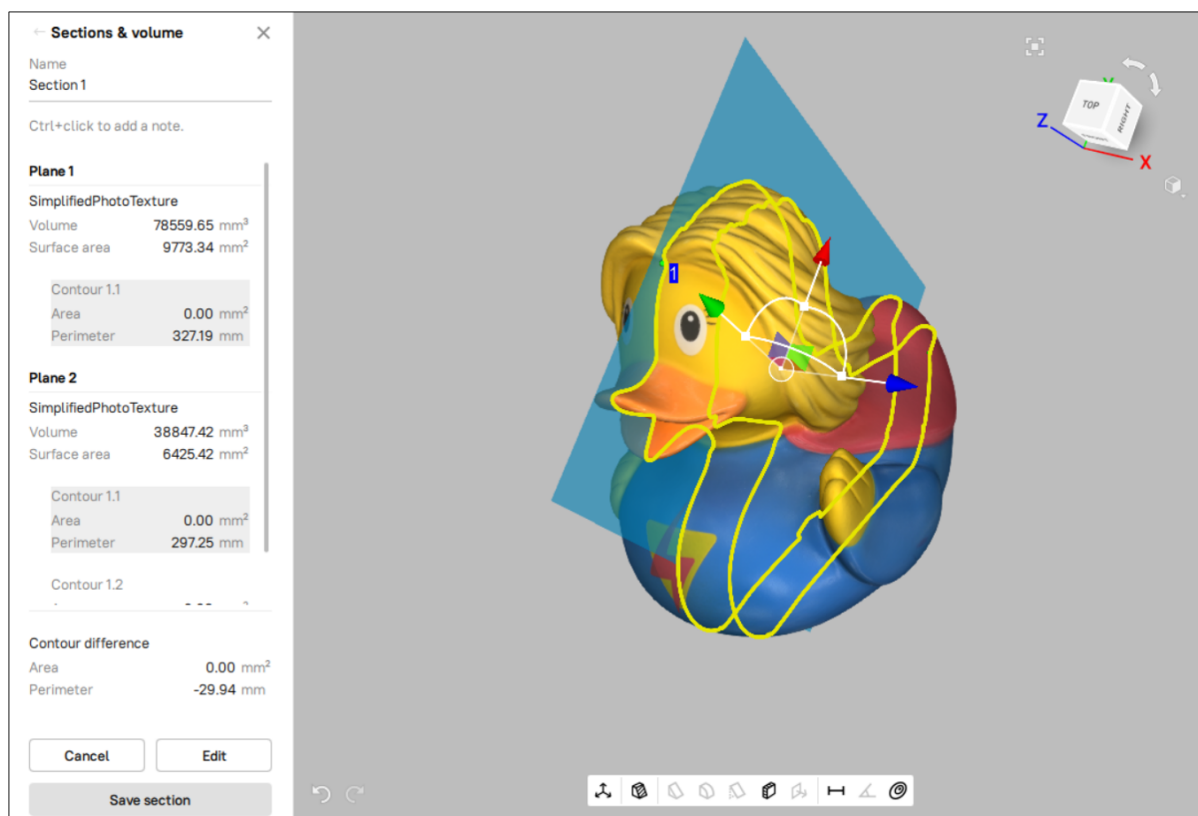


Figure 220: Calculating the contour difference.

12.2.2.2 Volume and Surface Area of Models

To calculate the entire volume and surface area

1. Select one or more models in the *Workspace* panel.
2. Check *Measure entire model* in the *Sections & Volume* panel.
3. Click *Calculate*.

Artec Studio will calculate the parameters for all the selected models.

12.2.2.3 Exporting Sections

Once you have made and saved the required measurements, you can export them. Go to the general section *Measures*, select the desired measurement(s) and click on *Export...* You can export measurements in the following formats: CSV, XML or DXF.


Also, if you have SolidWorks installed, the *Export to SolidWorks* button will be accessible.


12.2.3 Distance Maps

You may often find it necessary to compare two models and assess the deviation of their forms. For instance, quality control may require comparison of the original model with the scanned one. You can handle these tasks by using the *Distance* option in the *Distance map* feature.

Note: Artec Studio can only compare models or scans containing a single surface.

Use this tool as follows:

1. Select two *aligned* models for comparison.
2. Go to *Measures* → *Distance map* () , and select the option *Distance*.
3. If necessary, specify the name of the distance map in the *Name* field of the *Distance map* panel. By default, the application creates new distance maps under the names *Distance map 1*, *Distance map 2* and so on.

Note: The direction along the normals of the first scan is considered positive; the opposite direction is considered negative. The  button swaps scans.

4. Specify the *Search distance* value (in *mm*), a maximum range in millimeters for calculating distances between surfaces. You can adjust the actual range subject to this maximum after the calculation finishes.
5. Select a desired *Raycasting mode*. The *Raycasting* modes refer to the point-to-point projected distance between the two surfaces in comparison.
6. Click *Calculate*.

Note: Artec Studio 18 introduces two distance-projection (Raycasting) modes - *Shortest Distance* and *Along normals*.

Once the process is complete, the distance map will appear in the *3D View* window and the calculation results in the *Distance map* panel.

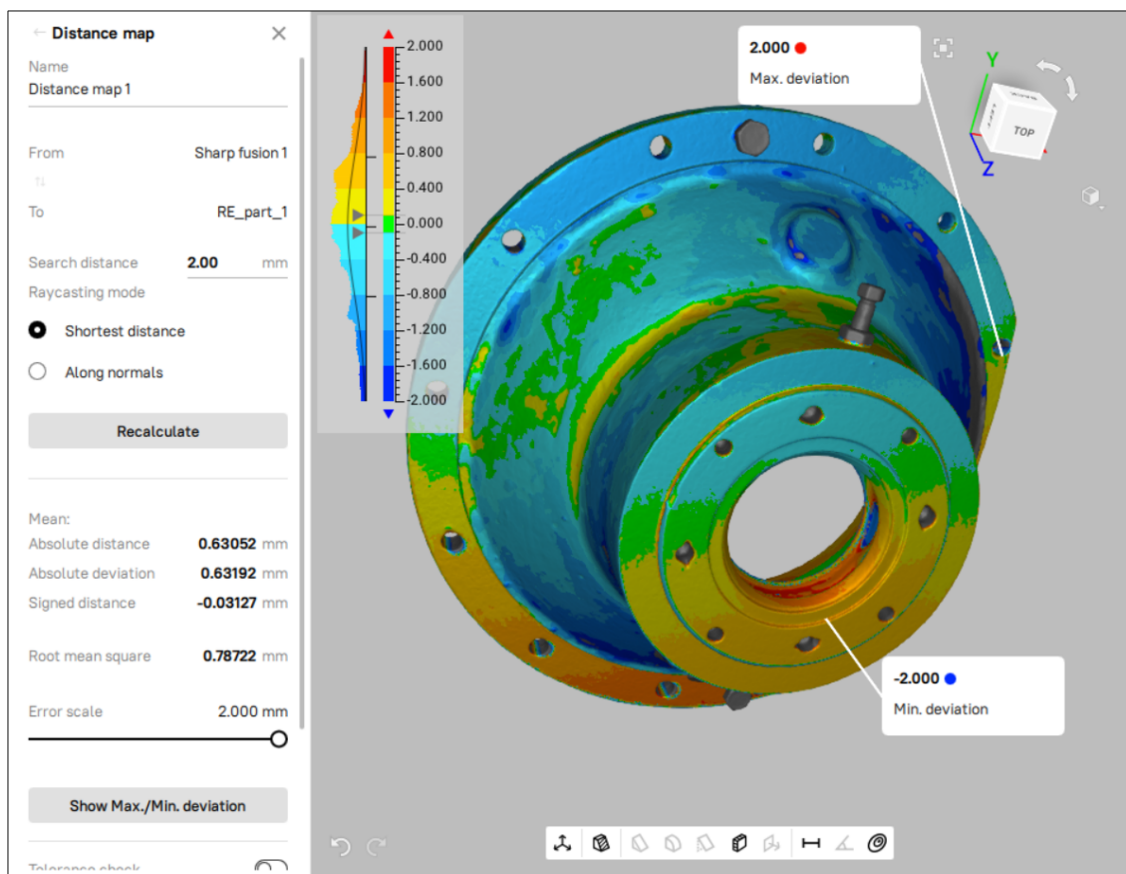








Figure 221: Surface-distance map calculated for two models.

See also:

You can also calculate a distance map in the Datum Alignment mode. See [Datum Alignment](#) for more details.

To recalculate the distance map with a new *Search distance* value, simply enter the new value in the *Search distance* field and click on the *Recalculate* button. The new distance map will be generated.

You can analyze the calculation results and the distance map:

- On the basis of the *Search distance* value you entered, Artec Studio calculates the following:
 - *Mean absolute distance*
 - *Mean absolute deviation*
 - *Mean signed distance*
 - *Root mean square (RMS)*—the square root of the arithmetic mean of the squared distances
- A distance map is a colored rendering on the particular surface regions. You can read the corresponding distance values and their distribution from the graduated scale and histogram that appear adjacent to the model. The map color changes from  blue, which corresponds to a negative distance, to  red, which corresponds to a positive distance.
 -  Green means the distance between surfaces in this region is close to zero.
 -  Gray highlights any surfaces with distances that exceed the specified *Search distance*.
 -  Orange and  bright blue correspond respectively to distances that are slightly above and below the limiting values of the scale.
- The graduated scale ranges from the positive value to the negative value of the *Error scale*. You can adjust this range using the *Error scale (mm)* slider or text box. Its maximum value cannot exceed the *Search distance*.
- If you move the mouse cursor to a particular point on the map, the exact distance will appear nearby.

Artec Studio enables you to set a tolerance value for the distance map and assess the deviation of each individual selected point against this value.

To set a tolerance value:

- Enable the *Tolerance check* toggle switch in the panel
- Enter a tolerance value (in mm), the markers for which will appear in the graduated scale adjacent to the model
- A tolerance-based 3D map is rendered and the labels at each point are marked with dots of three colors (Red, Green and Yellow).

- Green means the point is within the tolerance, Yellow means the point is very close to the tolerance value, and Red means the point is outside the tolerance limit.


If you want to identify the spots with maximum and minimum deviation, simply click on the *Show Max./Min. deviation* button in the panel. Artec Studio will automatically mark and display the objects' maximum and minimum deviation points on the *3D View* window.

To save the current distance map and quit this mode, click *Save map*.

12.2.3.1 Thickness Maps

Sometimes, it is required to assess the consistency of an object's thickness. For instance, the thickness of a sheet metal part and its uniformity. Artec Studio 18 enables you to measure an object's thickness and inspect how much it deviates from a given reference thickness value. This can be done using the *Thickness* option in the *Distance map* tool.

To use this tool:

1. Select an *aligned* model.
2. Go to *Measures* → *Distance map* () , and select the option *Thickness*.
3. If necessary, specify the name of the thickness map in the *Name* field of the panel. By default, the application creates new distance maps under the names *Thickness map 1*, *Thickness map 2* and so on.
4. Specify the *Reference thickness* value (in *mm*).
5. If needed, adjust the size of the projection-area using the *Projection angle* slider. It's recommended to increase this value when working with geometry-rich models.
6. Click *Calculate*.

Once the process is complete, the thickness map will appear in the *3D View* window and the calculation results in the panel. To recalculate the thickness map with a new Reference thickness value, simply enter the new value in the *Reference thickness* field and click on the *Recalculate* button. A new thickness map will be generated.

The graduated scale ranges from the positive value to the negative value of the Error scale. You can adjust this range using the *Error scale* (mm) slider or text box. Its maximum value cannot exceed the Reference thickness.

If you want to identify the spots with maximum and minimum deviation from the reference value, simply click on the *Show Max./Min. deviation* button in the panel. Artec Studio will automatically mark and display the object's maximum and minimum deviation points on the *3D View* window.

To set a tolerance value for the thickness map and assess the deviation of each individual selected point against this value:

- Enable the *Tolerance check* toggle switch in the panel
- Enter a tolerance value (in mm), the markers for which will appear in the graduated scale adjacent to the model

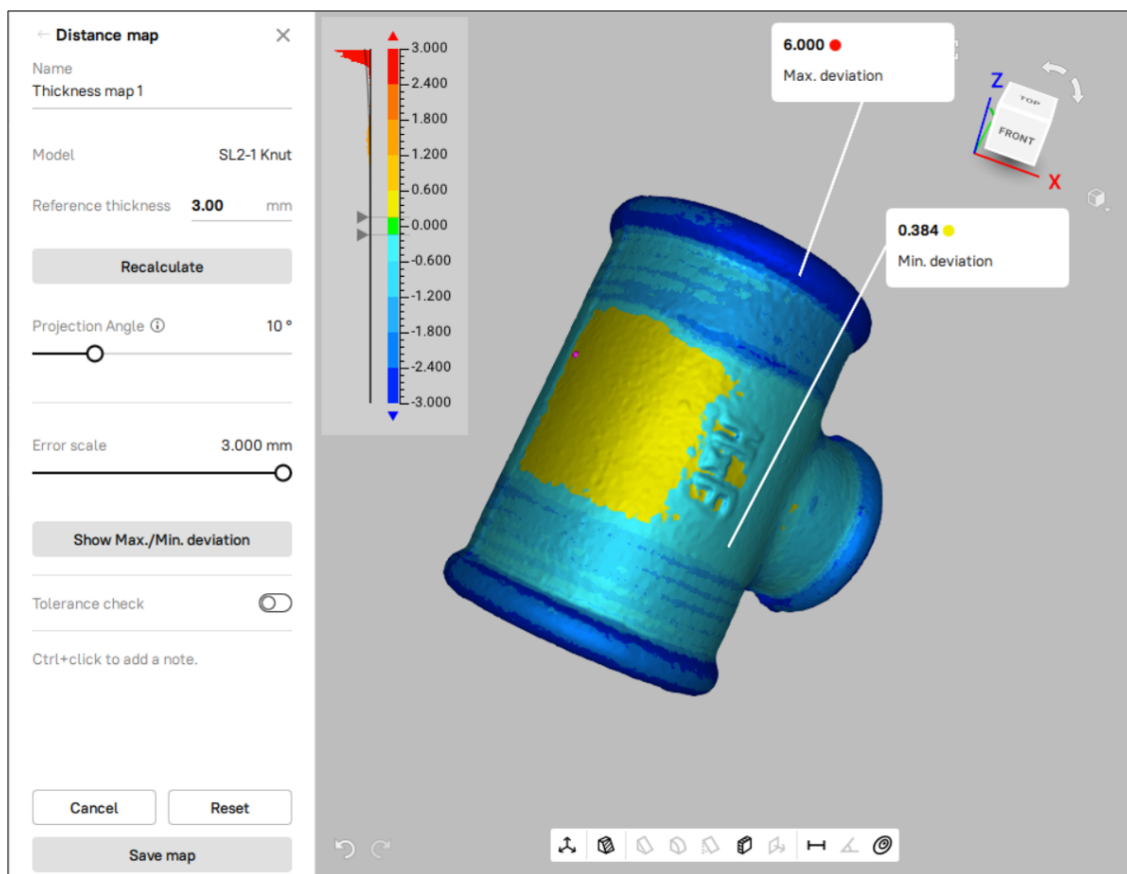


Figure 222: Thickness map calculated for a model.

- A tolerance-based 3D map is rendered and the labels at each point are marked with dots of three colors (Red, Green and Yellow).
- Green means the point is within the tolerance, Yellow means the point is very close to the tolerance value, and Red means the point is outside the tolerance limit.

To save the current thickness map and quit this mode, click *Save map*.

12.2.4 Section Analysis

Artec Studio 18 introduces another tool for inspection. You can now compare selected sections of two models and assess their deviations. This can be done using the new *Section analysis* tool in the *Measures* panel. Similar to *Distance maps*, this tool is especially for inspection of a particular surface section only.

To use this tool:

1. Go to the *Section analysis* tool in the *Measures* panel.
2. Select two aligned models, or one model or one CAD object, for instance.
3. If necessary, specify the name of the section analysis in the *Name* field. By default, the application names the analyses as *Section analysis 1*, *Section analysis 2*, and so on.
4. Select an appropriate *Raycasting mode*. This mode refers to the type of projected distance between the two models under inspection.
5. Select a coordinate plane, by clicking on one of the options under *Use a coordinate plane*.
6. To select a section on the surface, simply drag and move the respective coordinate axis gizmo that appears on the 3D View window.
7. After selecting a section, click on *Calculate*.

Once the process is complete, the section analysis will appear in the 3D View window and the deviations are displayed in the form of colored projection lines. The calculation results appear in the *Section analysis* panel.

To increase the scale of the projection lines on the 3D View Window, for a better visual evaluation of the analysis, use the *Projection line scale* slider. A higher value sizes the projection lines up, and vice versa.

Using the *Tolerance* field, you can set a tolerance value for the section analysis and assess the deviation of each individual selected point against this value.

You can also ask Artec Studio to automatically indicate the points of minimum and maximum deviation, by switching the *Show min/max deviation* toggle switch ON.

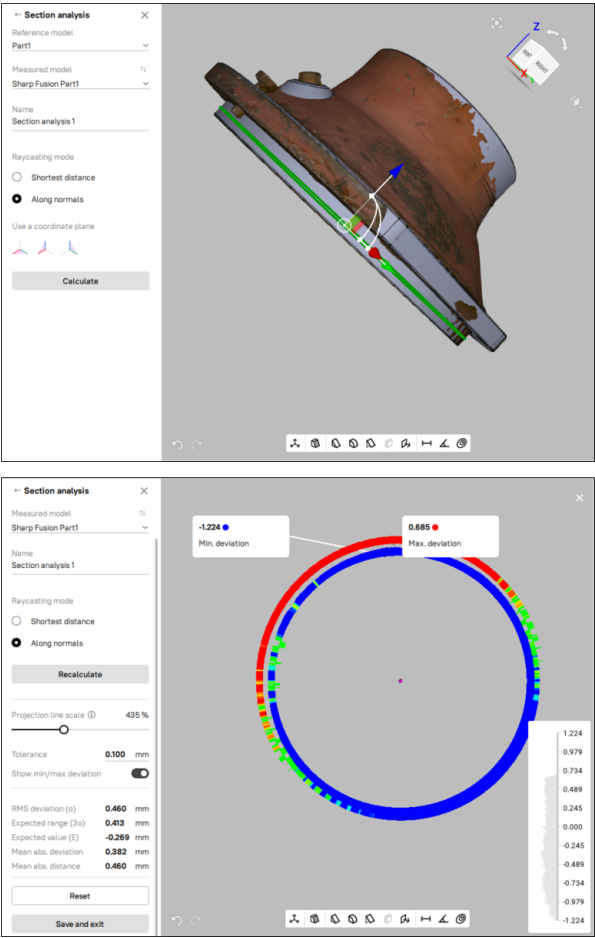


Figure 223: Result of section analysis of a model (bottom), for a selected section (top).

12.2.4.1 Exporting Measurements

Once you have made and saved the required measurements, you can export them. Go to the general section *Measures*, select the desired measurement(s) and click on *Export...* You can only export maps and analyses in CSV format.

12.2.5 Notes (Annotations)

Notes allow you to mark noteworthy points on the surface (parts of the object) and fix the calculated values on distance maps. Notes can be saved in screenshots (see [Saving Screenshots](#) for details), which is useful for making presentations or sharing your notes with colleagues. Notes are available in all the *Measures* modes.

To make a note, just click **Ctrl+LMB** on the desired surface and you will see an editable label. Type any text into this label.

For example, in the *Distance* mode:

Use the following buttons to control your notes:

- ✓ is for committing notes
- ✎ is for editing notes
- 🗑 is for removing notes

Note: To commit a note, you can also click anywhere outside the note's pop-up window.

In the *Sections & Volume* and *Distance map* modes, it works just the same. But in the *Distance map* mode, if you create the note on the colored part of the model, the note will automatically fix the calculated signed distance at that point (see the figure below).

12.2.5.1 Exporting Notes

Notes are exported with the measurements in which the notes are made. See [Exporting Linear \(Geodesic\) Measurements](#) and [Exporting Sections](#).

The export of linear measurement with notes to XML is shown below.

```
<?xml version="1.0" encoding="utf-8"?>
<Linear title="Linear">
  <Annotation>
    <coord>vector float : 3; 11.39915; -1.54995; 24.
    ↪40591</coord>
    <text>string : Hand</text>
  </Annotation>
  <Annotation>
```

(continues on next page)

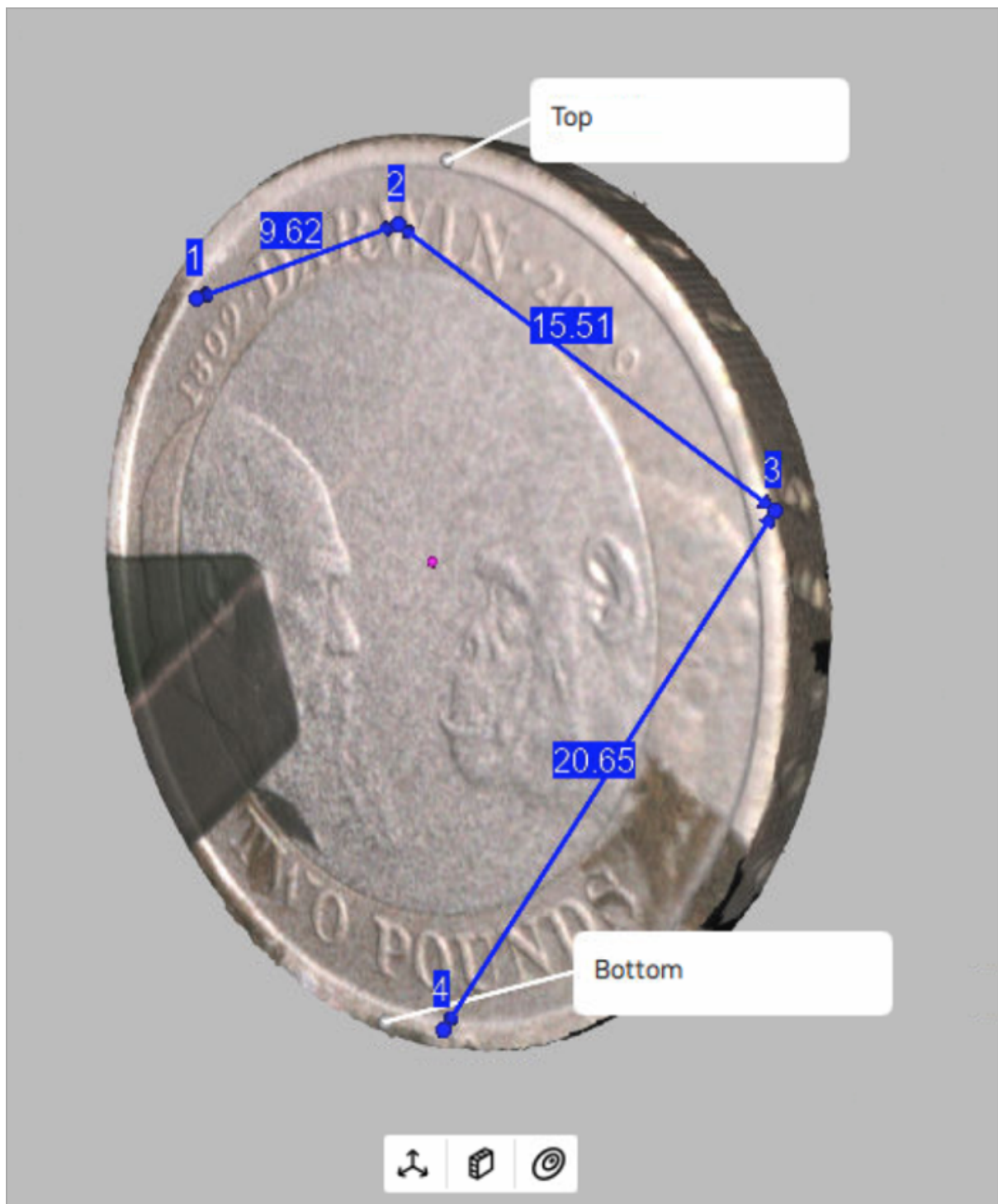


Figure 224: Notes on the model surface (Distance mode).

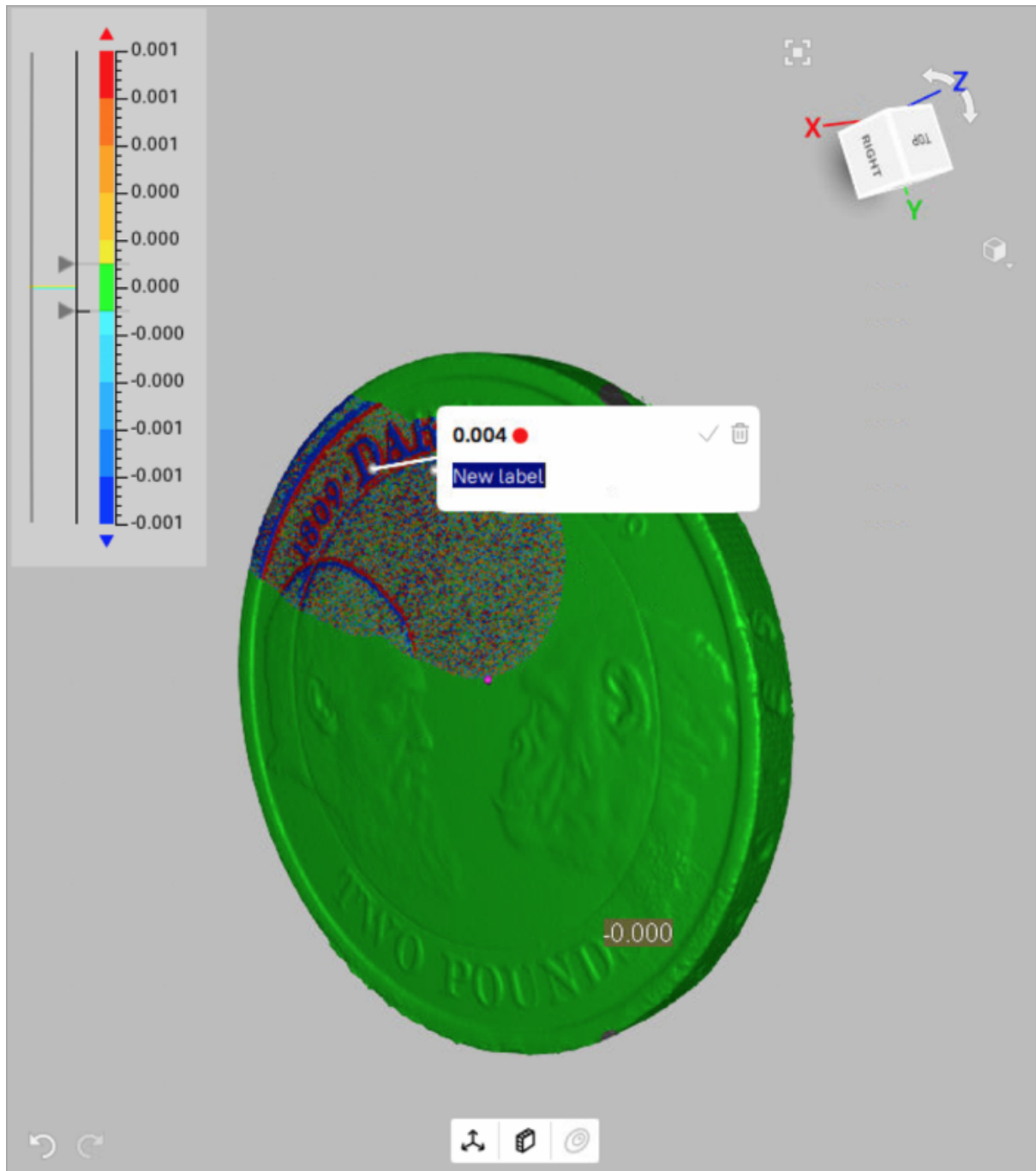


Figure 225: Note on the distance map.

(continued from previous page)

```

        <coord>vector float : 3; -2.042809; -1.170498; 39.
↪77322</coord>
        <text>string : Head</text>
    </Annotation>
    <point_0>
        <coord>vector float : 3; -1.869595; -1.218353; 39.
↪71429</coord>
        <length>float : 0</length>
    </point_0>
    <point_1>
        <coord>vector float : 3; 11.40365; -1.638699; 24.
↪64325</coord>
        <length>float : 20.0871</length>
    </point_1>
</Linear>

```

12.3 Copying Log Records

If for some reason you need to copy the log records, for example, to provide information to our support center, you can do this using the context menu of the *Log* window:

- To copy a single log record to the clipboard, first click it to highlight, then right-click this record and select *Copy*.
- To place the entire log content to the clipboard, right-click any line of the *Log* window and choose *Select all*. After all log records are highlighted, right-click any of them and select *Copy*.

12.4 Feedback Form

We're always here to help, and we welcome constructive input from our customers. If you have a question, comment or suggestion about an Artec product, the feedback form is a quick and easy way to get in touch with us. Simply provide a valid email address (or use default MyArtec email) and type in your question or comment, and we'll direct it to the proper staff members. If appropriate, we'll respond with an answer to your question or a request for further information so we can better assist you. To use the feedback form, you must agree to our terms of service.

SETTINGS

This chapter describes Artec Studio settings that you can change through the *Settings* dialog. To display this dialog, select *Settings...* from the *File* menu or hit the F10 key.

The user-adjustable settings are divided into categories under separate tabs. These categories include the following:

- General
- Performance
- Scan
- UI
- Miscellaneous

13.1 General

The *General* tab contains basic Artec Studio settings and includes the following options (see [Figure 226](#)):

- *Project-storage folder*
- *Temporary folder*
- *Import/export options*
- *Default import units* and *Default export units*
- *View control* settings
- *Legacy* section

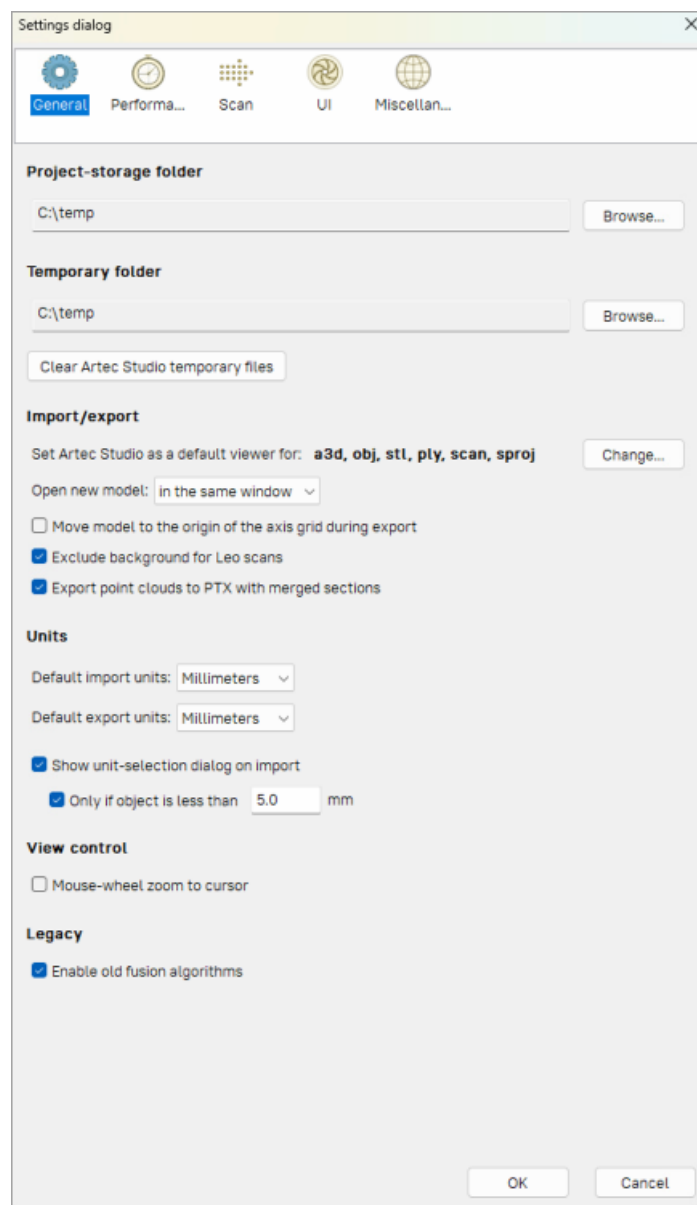


Figure 226: General settings tab.

13.1.1 Project-Storage Path

Project-storage path is a default path which Artec Studio will use in the project saving dialog ([Saving Project](#)). The default location is Windows user's `Documents` folder. You can alter this path by editing the field content or clicking *Browse...* and afterwards specifying the required folder.

13.1.2 Temporary Folder

A newly created and yet unsaved project is stored at the location specified in the *Temporary folder* field. The default path is the Windows temporary folder. To change this folder, use the *Browse...* button or enter a new path in the field. Artec Studio does not delete a new project and all the actions unless you save it manually in another location.

You can access Windows temporary folder and remove the unwanted projects later as necessary.

1. Open the *Explorer* window.
2. Type `%temp%` in the address bar and hit `Enter`.
3. Locate folders that have GUID names in braces { }.

13.1.3 Clear Artec Studio temporary files

Whenever you encounter a shortage of free space on your system, do not hesitate to clear up some room by clicking the *Clear Artec Studio temporary files* button in the General tab.

13.1.4 Registering Artec Studio as Default Viewer

Artec Studio supports various file formats. To make it the default application for supported formats, click *Change...* and select the formats you want the application to open by default (see [Figure 227](#)):

<code>*.a3d</code>	Project files for Artec Studio
<code>*.scan</code>	Single-scan export/import format
<code>*.ply</code>	Format for saving polygonal models obtained using 3D scanners
<code>*.stl</code>	3D-model export format for fast-prototyping equipment
<code>*.wrl</code>	Virtual-reality files in VRML 1.0 and VRML 2.0 format
<code>*.obj</code>	Texturized 3D models; Wavefront OBJ format

For more information on importing and exporting files, see [Exporting Models, Scans, and Point Clouds](#) and [Importing Models and Scans](#).

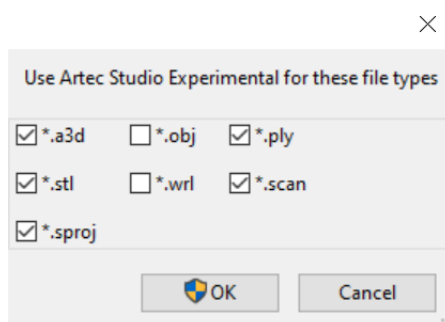


Figure 227: Making Artec Studio the default application for various file types.

13.1.5 Opening Files

Artec Studio can serve as the default viewer for A3D, SCAN, PLY, STL, OBJ and VRML (*.wrl) formats. To open each subsequent file in a new application window, select *Open new model in a new window*. If the *Open new model in the same window* option is selected, Artec Studio will use existing windows to display subsequent files.

13.1.6 Surface-Consistency Detection During Import

The *Surface-consistency detection during import* option instructs Artec Studio to examine imported files for defects. Select one of the following parameters:

Do not detect. Disable automatic surface-consistency detection.

Detect & ask. Enable automatic surface-consistency detection; Artec Studio will prompt you to start defect correction.

Always detect & fix. Enable automatic surface-consistency detection and correction.

13.1.7 Model Placement

When exporting, the application can automatically center scans and models on the origin of the axis grid. To enable this option, select the *Move model to origin of the axis grid during export* checkbox. If the checkbox is cleared, the application will save the model's current placement on the axis grid when exporting surfaces.

13.1.8 Base Removal for Leo Scans

The *Enable automatic base removal* option in the *Scan* panel only works for scans from Eva and Spider and other handheld scanners connected to computer. To enable automatic base removal for scans from Leo, select the *Launch base removal for Leo scans* checkbox. The algorithm will start after the application *imports that project*.

13.1.9 Point-Cloud Export

The *Export point clouds to PTX with merged sections* ensures a successful import of the exported files in third-party software products. See [Export Settings for Point Clouds](#).

13.1.10 Units

In Artec Studio, all software operations use millimeters as the default measurement unit. If you need to export a model in other units, change the corresponding setting using the *Default export units* dropdown list. Artec Studio supports the following units for exporting models: millimeters, centimeters, inches and meters.

When exporting point cloud scans (Artec point cloud and Leica PTX), application will ignore the specified units. See [Exporting Point Clouds](#) for details.

13.1.11 View-Control Settings

Artec Studio allows you to use `Scroll wheel` to zoom in on the model in the *3D View* window. You can take advantage of this capability in two ways:

- Clear the *Mouse-wheel zoom to cursor* checkbox to enable zooming to the center of the screen. In this case, you must keep the target area in the screen center and readjust its position from time to time.
- Select the *Mouse-wheel zoom to cursor* checkbox to enable interactive zooming to the mouse-cursor position. In this mode, you need only keep the cursor on the target area while spinning `Scroll wheel` forward and backward.

13.2 Performance

The following parameters are user adjustable by way of the *Performance* tab (see [Figure 228](#)) multithreading, memory usage, command-history storage, compression levels for stored data, texture-recording mode and *Real-time fusion* setting.

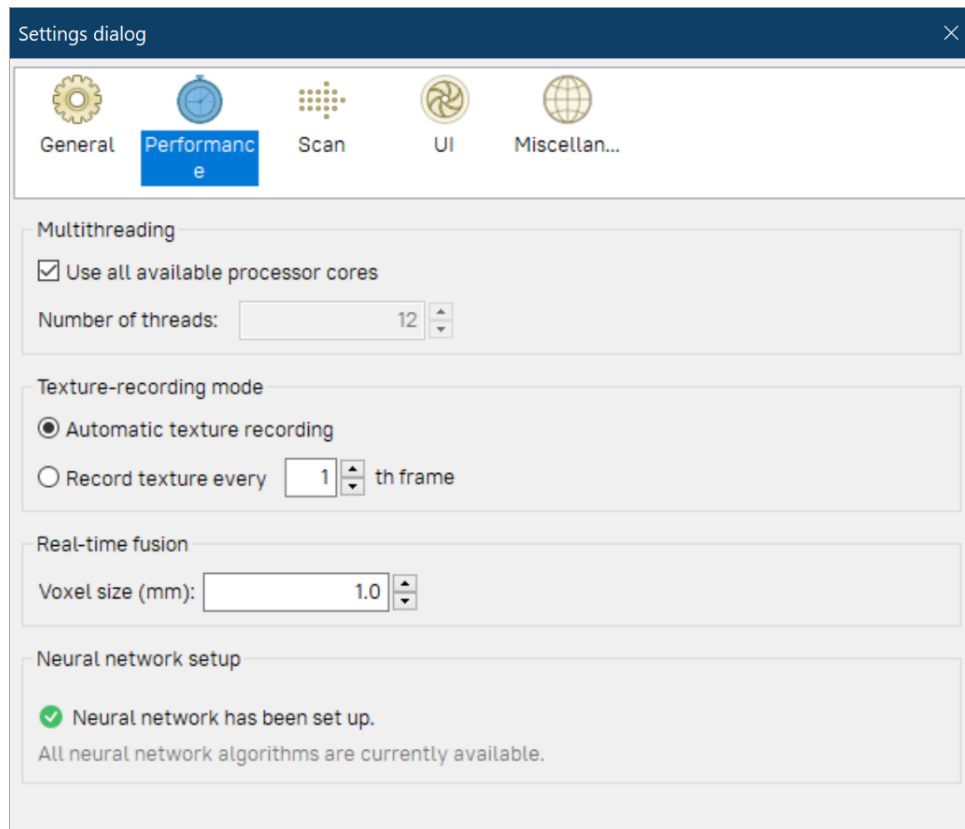


Figure 228: Performance settings tab.

13.2.1 Multithreading

On computers that feature multicore processors, Artec Studio uses all cores by default. If you would like to limit the number of cores the application employs, clear the *Use all available processor cores* checkbox and enter the number of concurrent threads manually.

13.2.2 Texture-Recording Mode

By default (*Automatic texture recording* enabled), Artec Studio doesn't capture texture for every frame. You can, however, manually specify the frequency for capturing texture frames by using the spinner in the *Record texture every __th frame* option.

13.2.3 Real-Time Fusion Setting

Real-time fusion offers an optional setting (see [Scanning With Real-Time Fusion](#)):

Voxel size (mm). The fusion resolution. It affects the algorithm's performance and quality. The lower the value, the sharper the shape of the model. Note that specifying low values may produce noisy surfaces.

13.2.4 Scan Reconstruction

In order to achieve the fastest possible reconstruction, Artec Studio has an in-built benchmark test that checks your GPU type, the driver version, and automatically adjusts the internal reconstruction settings. The test is optional, but is highly recommended as it considerably speeds up the algorithm performance. You will only need to rerun the test when you change GPU or update the adapter drivers.

The first time you open Artec Studio in your system, a pop-up message prompts you to run the GPU test. You can opt to skip it for the time being, and run it later. In order to run the test, go to Settings → Performance → Scan Reconstruction section. This section also displays the result of the test after it is run once.

13.3 Scan

The *Scan* tab allows you to edit the parameters that the application uses both while scanning and while postprocessing the results (see [Figure 229](#)).

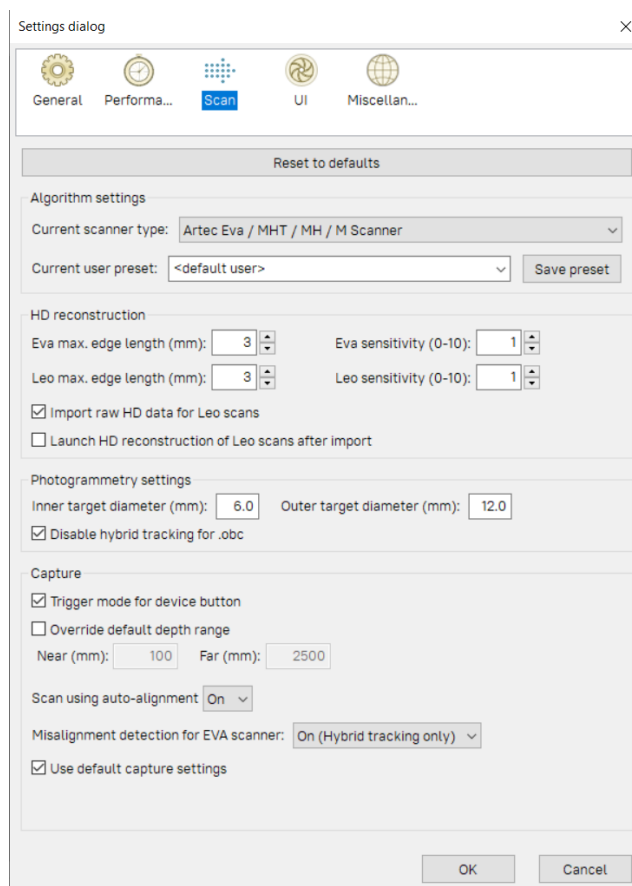


Figure 229: Scan settings tab.

13.3.1 Algorithm Settings

Artec Studio automatically selects and displays settings for each scanner type in the *Current scanner type* dropdown of the *Settings* dialog and in the *Preset* dropdown of the *Tools* panel. If it fails to correctly identify your scanner type or you process scans from different scanners, select the appropriate scanner type manually. To reset all settings to their default values, click *Reset to defaults*.

Current user preset allows you to save the current parameter values in the *Tools* panel. By selecting a saved preset, you can change all settings at once. Note that this option applies only to the selected device type.

13.3.2 HD Reconstruction

When using Artec Eva or Artec Leo in the HD mode, you can adjust the following parameters that influence the results of the HD reconstruction:

- The maximum edge length (in mm) of the polygons used for the HD reconstruction
 - *Eva max. edge length (mm)*
 - *Leo max. edge length (mm)*
- Sensitivity
 - *Eva sensitivity (0.0-1.0)*
 - *Leo sensitivity (0.0-1.0)*

Higher sensitivity results in more detailed reconstruction of scanned surfaces, on the one hand, and in higher noise level, on the other:

- sensitivity of 0.0 means maximum noise filtering
- sensitivity of 1.0 means no noise filtering

You can vary the sensitivity with the step of 0.01.

You can also instruct Artec Studio to import the HD raw data for all Leo scans, or to launch HD reconstruction for all Leo scans immediately after import. There are two respective checkboxes for this.

13.3.3 Photogrammetry Settings

Photogrammetry settings allow you to define the target size. *Inner target diameter (mm)* corresponds to the diameter of the white circle in the middle of the target; *Outer target diameter (mm)* corresponds to the outer diameter of the target's black ring. The most popular targets have diameters of 6 mm and 12 mm; the values 5 mm and 10 mm correspond to the *Scan Reference* target. See [Target-Assisted Scanning](#) for details.

The *Disable hybrid tracking for .obc* checkbox ensures that tracking is purely based on targets. Select the checkbox if you don't want the texture and geometry features to assist target scanning ([Photogrammetry Solution](#)).

13.3.4 Capture

The *Capture* section covers settings related to the trigger button for the Artec MHT scanner, as well as the scanning-depth range and individual frames acquired during the scan.

The first option is the *Trigger mode for device button* checkbox, which changes the button behavior on the Artec MH and Artec MHT scanners. For details regarding these buttons, see [Scanner Buttons and Capture Modes](#).

The scanner has a defined depth range. If it's too close to the object, it may fail to capture all or part of the object. On the other hand, if the scanner is too far away, various

types of 3D “noise” will appear in the scene, complicating the postprocessing effort and affecting the final results. Therefore, you should position the scanner as close as possible to the object without crossing the cutoff plane. Default settings for each 3D scanner contain minimum and maximum limits within which you can position the cutoff planes. The scanner model determines these values. If you are using an Artec L scanner or 3D-sensor and high accuracy is of lesser importance, however, you can adjust the depth boundaries manually, allowing you to scan closer to or further from the object than the recommended distances indicate. To this end, mark the *Override default depth range* checkbox and enter new range values.

Warning: Redefining the depth range may reduce accuracy.

13.3.4.1 Scan Using Auto-Alignment

The *Scan using auto-alignment* option is enabled by default and is covered in the [Resuming Scan After Lost Tracking](#) and [Auto-align new scans with those marked in Workspace](#) sections. The application’s behavior varies depending on this option’s value, as [Table 19](#) shows.

Table 19: Application behavior with option enabled and disabled.

Scan Using Auto-Alignment	<i>On</i>	<i>Off</i>
Tracking Mode	Geometry + Texture	Geometry or Geometry + Texture
Audio Notification?	Yes (see Audio Notification)	Yes
Message in <i>3D View</i>	Searching for position: Point 3D Scanner at the object to continue	Tracking lost: Repeat scan using slower motions or additional features
Instructions	Direct the scanner at any already captured region with sufficient texture, maintaining the original scanner orientation relative to the object	Direct the scanner at the last captured region
Data Recording	Handled in a newly created scan	Handled in the same scan

13.3.5 Misalignment Detection

In some cases, Artec Studio may incorrectly determine relative frame positions, resulting in misalignment. When this error occurs, you must restart the scanning session and remove the misaligned scans. Alternatively, you can attempt to fix the misalignment by breaking the scan into several segments. Further information about addressing this problem by dividing scans is available in [Separating Scans](#). To prevent possible misalignment and improve your scanning experience, Artec Studio features a *Misalignment detection for EVA scanner* setting that functions during the scanning process. However, if you have difficulty maintaining the tracking when scanning particular objects, you can disable this

setting.

Options are as follows:

- *On (Hybrid tracking only)*. The default value, option works for *Geometry + Texture tracking* mode.
- *On*. The option works for all tracking modes, including *Geometry*.
- *Off*. The option is turned off for all trackers.

13.3.5.1 Default Capture Settings

Artec Studio allows you to change the characteristics of single-frame surfaces as the scanner captures them. To change the default parameters, clear the *Use default capture settings* checkbox and change the settings manually in the displayed window. The options below are user adjustable:

Important: We recommend using default settings. Poorly chosen settings may reduce data quality.

Triangles step. Point density for a frame mesh.

Minimum object size. The smallest object scanned, by number of polygons.

Length filter threshold. Triangle-filtration threshold by edge length (maximum possible size in mm).

Interpolate. Use interpolation for parts of surface that are missing data.

Max interpolated length. Maximum size of areas to be interpolated (in mm).

Max angle. Triangle-filtration threshold by maximum angle (in degrees) between the triangle's normal and the camera's sight vector.

Geometry registration threshold. The higher the threshold, the stricter the quality requirements for the geometry being scanned. Therefore, determining the proper geometry in the scene is more difficult in such cases. Subsequently, Artec Studio runs geometry registration less frequently, making way for texture registration. Works with *Geometry + Texture tracking* only, values are between 0 and 1.

13.4 UI

The *UI* page allows you to edit user-interface settings (see [Figure 230](#)) and covers the following categories:

- Audio notification
- Workspace colors
- Warnings
- Surfaces that Artec Studio displays during a scan

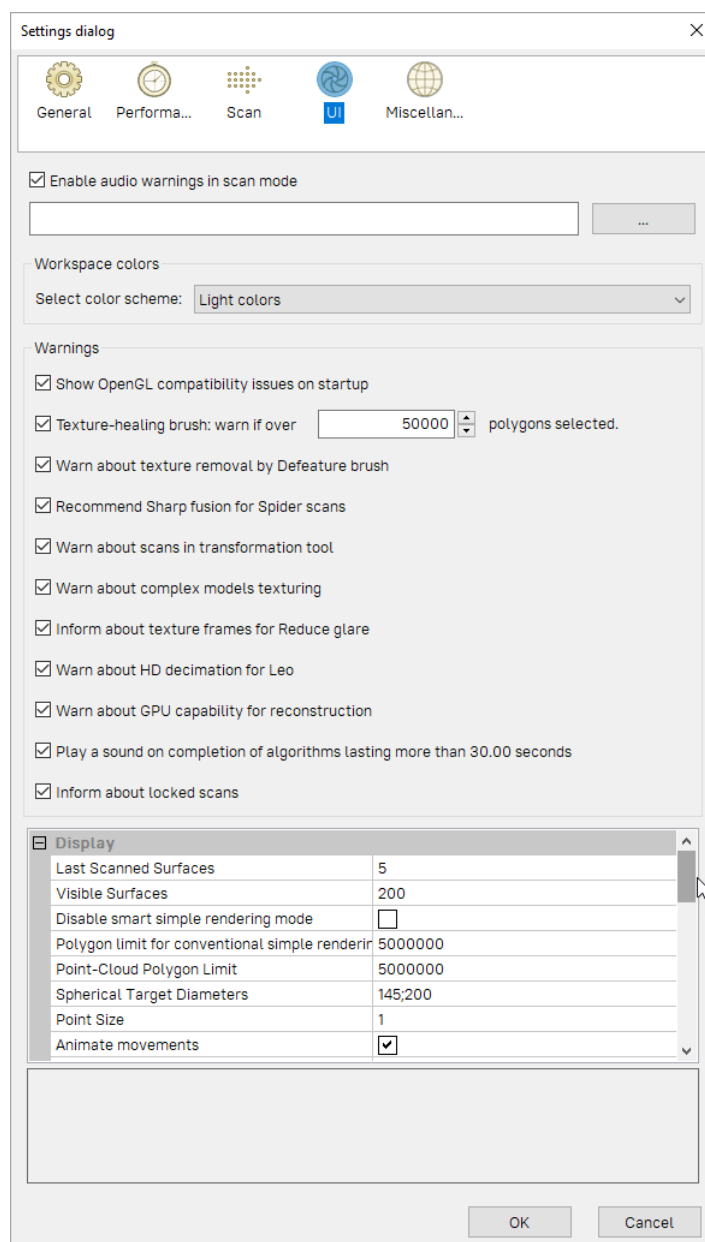


Figure 230: Interface settings tab.

13.4.1 Audio Notification

Sometimes, automatic alignment in real time is impossible during the scanning process, and the program is unable to align the previous frame with the current one (see [Resuming Scan After Lost Tracking](#)). When this situation occurs, Artec Studio issues an audio warning that stops once you reposition the scanner and the software again finds its location in 3D. To enable or disable this feature, use the *Enable audio warnings in scan mode* checkbox. A standard “beep-sound” is the application’s default sound. You can choose any WAV file as the warning sound. To this end, click the ... and specify a file path.

See also:

[Warnings in Tools and Editor](#).

13.4.2 Workspace Colors

Artec Studio automatically chooses display colors for newly created scans. You can select any of the standard palettes:

- Full palette
- Light colors
- Web-safe colors
- Random colors
- Monochrome

13.4.3 Warnings

The *Warnings* options allow you to toggle certain notifications. They include the following:

13.4.3.1 Startup Checks

Show OpenGL compatibility issues on startup. Artec Studio requires *OpenGL* version 2.0 and some *OpenGL* extensions to function properly; your PC may or may not currently support these capabilities. Selecting this option activates a display window on startup containing information regarding possible missing extensions.

13.4.3.2 Warnings in Tools and Editor

If you are familiar with these algorithm peculiarities, you may disable these notifications.

Texture-healing brush: warn if over __ polygons selected. This checkbox instructs the application to display a warning if you exceed the maximum number of polygons to be inpainted at one time. This limit reduces the potential for the computer to hang up. Specify a suitable value for your system, or clear this checkbox if you require no warnings of this kind.

Warn about texture removal by Defeature brush. Be ready that *Defeature brush* won't preserve texture in the corrected areas, so the application notifies you of this.

Warn about complex models texturing. If you are attempting to texture a high polygonal model, Artec Studio will suggest that you simplify it first.

Warn about scans in transformation tool. We advise that you refrain from repositioning source scans as it may result in the incorrect texture application. The message may remind you about it.



Warn about HD decimation for Leo. Enabling this option instructs Artec Studio to display a warning if both of the following conditions are met:

- You launch HD reconstruction on raw data from Artec Leo with [HD frames frequency](#) less than 1.
- The raw data has already been decimated during scanning with Artec Leo.

Double decimation can lead to poor results, for example, some parts of the scanned surface may be lost, and the resulting HD scan may have holes.

Warn about GPU capability for reconstruction. With this option enabled, Artec Studio will warn you in case the installed GPU/hardware is not suitable for data reconstruction. Due to a weak GPU/hardware, Artec Studio may take forever to complete the reconstruction process successfully.

Play a sound on completion of algorithm lasting more than 30 seconds. This setting allows you to get distracted while the application is busy running algorithms and performing commands. Once the application finishes any of these processes, it chimes.

Inform about locked scans. Artec Studio will remind you that some of the scans selected for [Global registration](#) have  or  marks (see [Workspace Panel](#)). This message allows you to unlock them or run the algorithm without changing scans' status.

13.4.4 Displaying in 3D View Window

You can change the way you see surfaces and points during the scanning process, adjust their colors as well as the background color, and specify the mode for frame playback. To these ends, use the settings below:

13.4.4.1 Display

Last scanned surfaces. Number of visible surfaces most recently captured that will appear in *3D View* during scan.

Visible surfaces. Total number of visible surfaces displayed during scan (equal to the number of most recently scanned surfaces plus the number of key frames to display).

Disable smart simple rendering mode. Smart simple rendering mode ensures that 3D content is rendered without simplification if computer resources allow it. Once the system experiences lags, it automatically turns on simplification.

Polygon limit for conventional simple rendering mode. Maximum number of polygons in the viewport beyond which Artec Studio will switch to simple rendering mode during 3D navigation.

Point-cloud polygon limit. If the polygon count of a point cloud surface exceeds the specified value, Artec Studio will render a simplified copy of this surface having no more than specified polygons.

Spherical target diameters. List of diameters of the target spheres used during scanning with Ray. Use semicolon ; as a delimiter between values in millimeters in the field.

Point size. Number of pixels for rendering each point when using the *Points* or the *Points and solid* rendering mode.

Animate movements. It shows movement of the 3D data when Artec Studio repositions or reorients it. Disable this option on slow computers.

Highlight objects. Enable this option for Artec Studio to highlight the outlines of an object displayed in the *3D view* window when you hover the mouse cursor over its name in the *Workspace* panel.

13.4.4.2 Colors

Last. Color of last scanned surfaces.

Registered. Color of correctly aligned surfaces.

Preview. Color of surfaces in preview mode.

Dropped. Color of unaligned (and thus dropped) surfaces.

Key frames. Color of key frames (surfaces).

13.4.4.3 Screenshots

You can specify the default screenshot size in pixels (see [Saving Screenshots](#)):

- *Width*
- *Height*

If your system configuration is incompatible with the specified settings, Artec Studio will save a screenshot of the maximum possible size.

13.4.4.4 Playback

See also:

[Selecting Scans and Models](#)

Repeat. Continuously loop the frame sequence in the surface-view mode of the *Workspace* panel.

FPS. Speed (in frames per second) at which frames appear during playback.

13.4.4.5 Background

Color. Background color; the application may automatically alter this color in certain modes, such as [X-ray](#).

Dropped color. Background color when misalignment occurs while scanning.

Texture. Display patterned ([chessboard pattern](#)) or plain background.

Gradient. Gradient or monochrome background color.

Background for screenshots. Application will use this background color when [saving screenshots](#), the actual background color will remain unaltered.

13.4.4.6 Welcome Screen

Don't show. Disable the welcome screen.

13.4.4.7 Autopilot

Don't show greeting screen. Disable the *Autopilot* screen showing the steps to pass in this mode



Figure 231: Example of altered background.

13.5 Miscellaneous

13.5.1 Usage Information

You can help us improve the quality and performance of Artec Studio by allowing us to collect and send usage information to Artec Group. This information will not be used to identify you, and it excludes your project data, 3D surfaces, textures and any other data that you obtain and process using Artec Studio. By default, the *Collect and send anonymous usage data to Artec* checkbox is selected. We recommend leaving this checkbox marked so we can better improve the application.

When installing Artec Studio, you can decide whether you want it to collect and send usage data. The same checkbox described above also appears in the final installation dialog (see [Figure 38](#)).

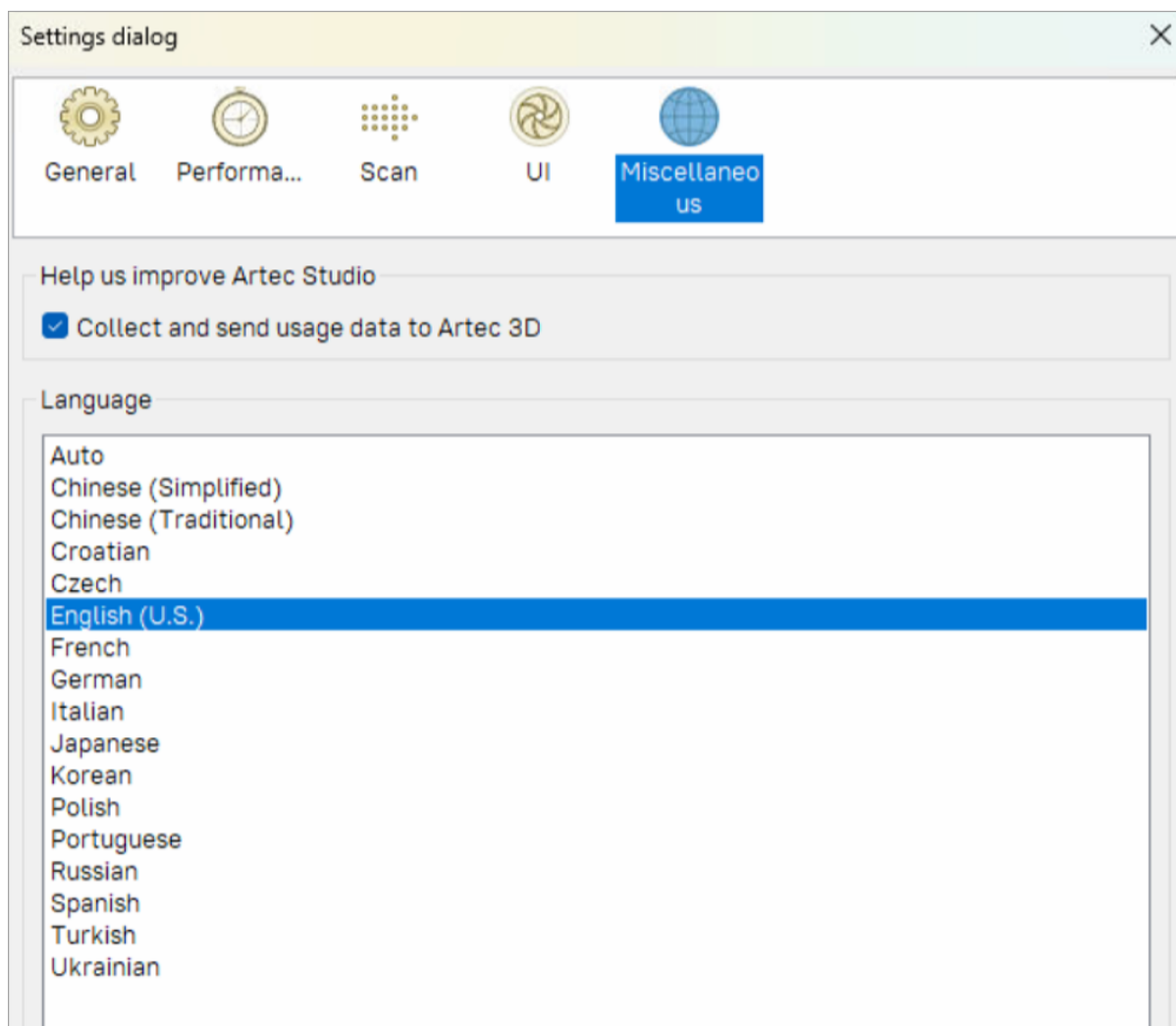


Figure 232: Miscellaneous settings tab.

13.5.2 Language

The Artec Studio interface supports several languages:

- *Auto*—automatic language selection on the basis of system settings
- *Chinese (Simplified)*
- *Chinese (Traditional)*
- *Croatian*
- *Czech*
- *English (U.S.)*
- *French*
- *German*
- *Italian*
- *Japanese*
- *Korean*
- *Polish*
- *Portuguese*
- *Russian*
- *Spanish*
- *Turkish*
- *Ukrainian*

To switch between languages, choose the one you want and click *OK*. The program will then prompt you to restart. If you agree, the application will restart automatically using the newly selected interface language. If you choose not to restart, the changes will take effect the next time you start the application.

Note: To change the language, Artec Studio must restart.

SCANNER CALIBRATION AND CORRECTION

In some cases, owing to careless handling or transportation (jolts, accidental drops or some other reason), the scanner may fail to capture surfaces properly. The scanned surfaces may only be partially reconstructed or may contain holes. You can resolve these issues by correcting or calibrating the scanner.

In Artec Studio, you can calibrate your scanner and correct its existing calibration. Calibration generally involves verifying and adjusting a scanner's measurements by comparing them with standard (etalon) values. Every Artec scanner is delivered pre-calibrated.

Depending on the scanner model, calibration or correction can be performed directly in Artec Studio (e.g., Artec Point, Artec Spider II) or by using a standalone application called Calibration tool (e.g., Artec Spider, Artec Eva).

14.1 Calibration Tool

Calibration Tool can operate in one of the two working modes:

- Correction for Artec Eva scanner
- Calibration of Artec Spider scanner

14.1.1 Suggestions for Use

Correction differs from calibration, in that it preserves the current calibration: it only changes the correction ratio so as to enable good reconstruction. Application of the correction does not guarantee that captured geometric shapes and linear measurements will be accurate. Use this procedure as a temporary measure until calibration is performed.

Table 20: Correction versus calibration.

Mode	Characteristics	Speed	For Spider	For Eva
Correction	Inexact	Fast	No	Yes
Calibration	Exact	Prep required	Yes	No

Important: Calibration is available for Artec Spider scanners only. Calibration of Artec Eva can only be carried out at the Artec production office.

14.1.2 Launching Calibration Tool

To launch the Calibration Tool, first ensure that the scanner you intend to calibrate appears in Artec Installation Center as either *On loan* or *Activated*. You can launch the tool either through the *Start* menu by clicking *Start* → *All Programs* → *Artec Group* → *Artec Studio* → *Calibration Tool* or in Artec Studio by selecting the *Run Calibration Tool* command from the *File* menu.

Connect the scanner. If you have several scanners connected, select the appropriate one from the dropdown list.

Note: The new Calibration Tool has the ability to detect USB types, and automatically make adjustments for compatibility. This makes it possible to connect scanners using USB 3.1 cables, without external adapters.

14.1.3 Field of View Correction for Eva

Important: Apply correction sparingly, as a temporary measure until calibration is performed. If correction fails, please contact the Artec support.

The Artec Eva scanner only allows you to correct their current calibration data on field of view.

1. Launch the Calibration Tool as [Launching Calibration Tool](#) describes.
2. If multiple scanners are connected, select the scanner you want to correct. Otherwise, continue with the connected scanner.
3. On the main window, click on the *Start* button, and the scanner will start the preview.
4. Direct the scanner at the right angle to a flat, light (but not shiny) monochrome surface (e.g., a wall or floor) from a distance of 650–700 mm.
5. The *Correction* window will indicate whether the distance is optimal, and start rendering the surface.
6. Click *Next*, to perform the correction.
7. The *Evaluation* window, will then display the result of the correction. If the correction result meets your expectations, click on *Save correction*. Otherwise, click on *Recorrect*, and repeat the process.

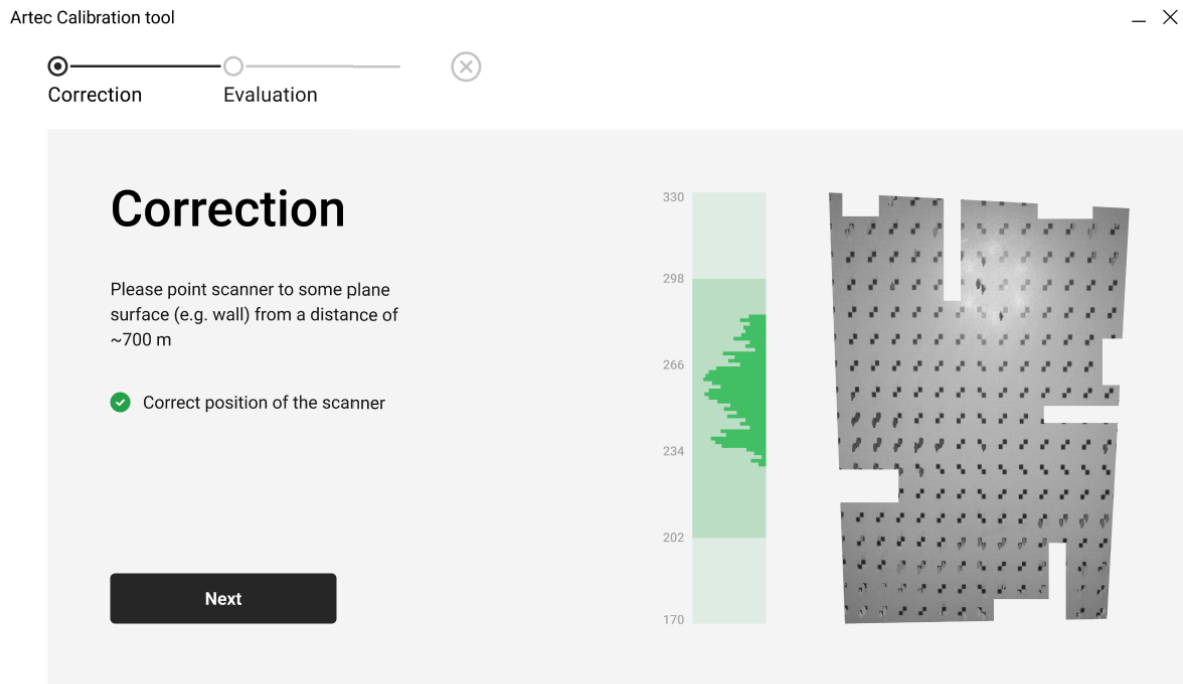


Figure 233: Artec Eva correction window

14.1.4 Calibration for Spider

To carry out the calibration, you will need the following additional equipment: a calibration rig, a scanner stand and a positioning sheet. Assembly instructions for the scanner stand and calibration rig are given in [Assembling the Scanner Stand](#) and [Assembling the Calibration Rig](#), respectively.

Step 1: Set up board

1. Unfold the positioning sheet and place it on a desk or any hard, planar surface.
2. Align the scanner stand with the rectangle marked on the sheet, paying close attention to the orientation of the slots in the stand cover (see [Figure 234](#)).
3. Place the scanner on the scanner stand, making sure that you insert the three scanner stems in the three slots of the stand cover (see [Figure 235](#)).
4. Set the calibration rig on the positioning sheet, turning its marker side towards the scanner as [Figure 236](#) shows.
1. Now, launch the Calibration Tool as [Launching Calibration Tool](#) describes.
2. If there are multiple scanners connected, then select you scanner on the *Calibration tool* main window, and click on *Start*.
3. Enter the serial number of your calibration rig, and click *Next*.

Step 2: Warm up scanner

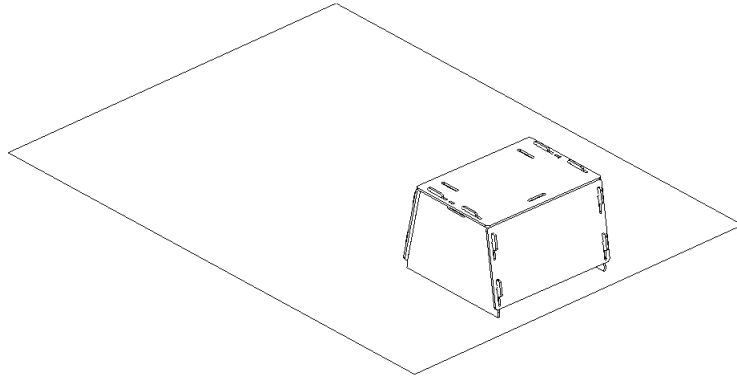


Figure 234: Scanner stand resting on the sheet.

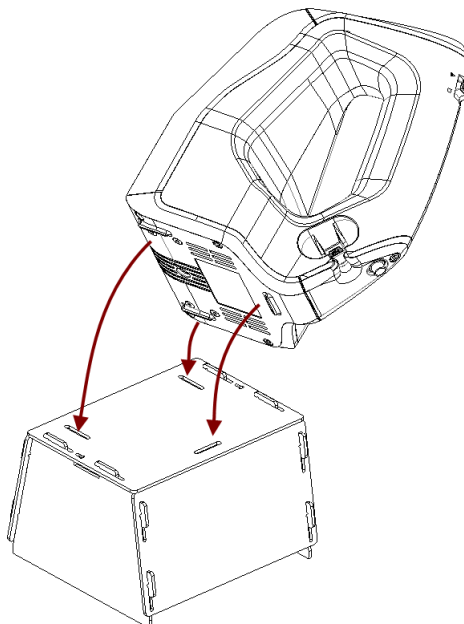


Figure 235: Placing Artec Spider on the stand

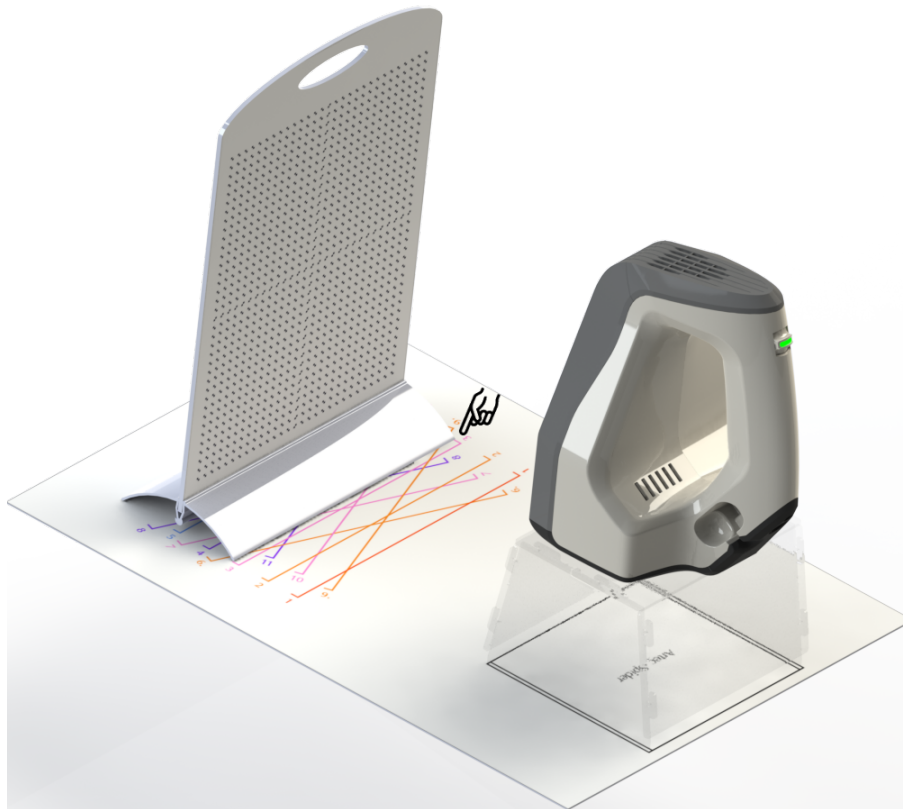


Figure 236: Calibration rig, positioning sheet and scanner stand with Artec Spider.

1. If the scanner temperature is outside the optimal range—for example, you just connected the device to a power outlet—the tool will notify you to warm the scanner up.
2. The warm-up time will depend on the actual temperature of the scanner. In any case, we advise against clicking *Skip* and instead recommend waiting for the Artec Spider to reach its optimal temperature.

Note: It is important to warm up the scanner to its optimal working temperature before carrying out calibration. For precise results, do not skip this step.

Step 3: Calibration

1. After scanner reaches its optimal temperature, click *Start* to start calibrating Artec Spider.
2. Place the rig in its initial position such that the front edge of its base coincides with the color line numbered 1 on the sheet. As you do so, keep an eye on the *Calibration* window for the position plane to turn green plane. Once the plane turns green, stop moving the rig and wait for the scanner to capture the plane.
3. Wait for the tool to instruct you to move the rig to the next position on the pattern; the number for that position will appear on the screen. Move the rig and again wait for the scanner to capture the plane.

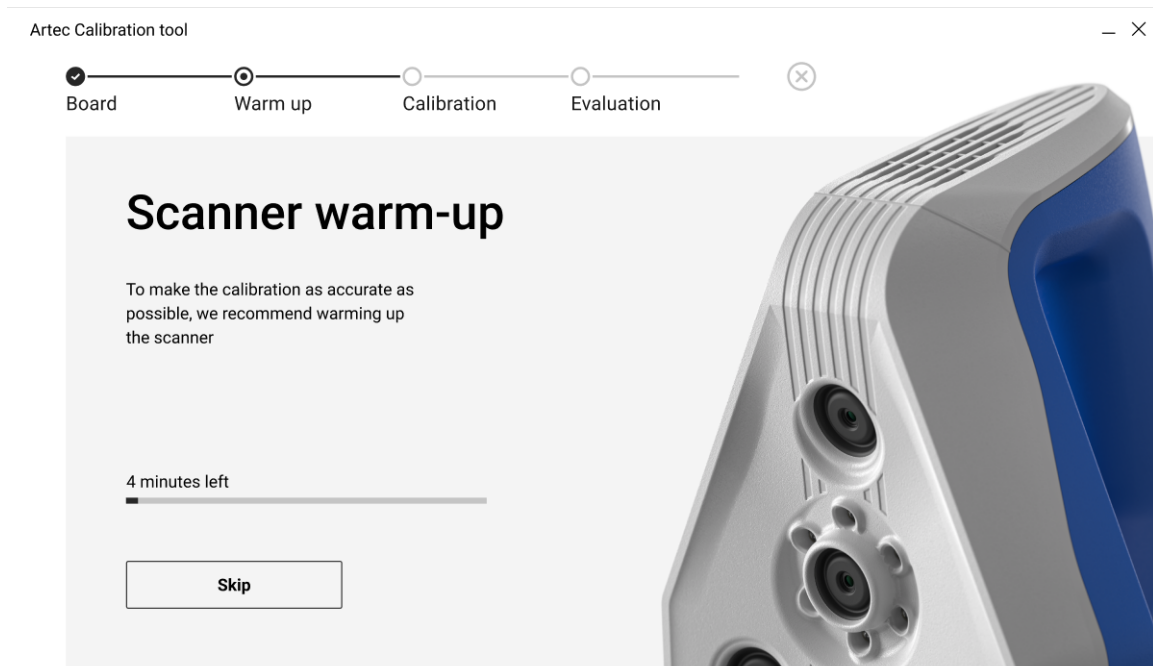


Figure 237: Warming up the scanner

4. Repeat the preceding step for the remaining positions sequentially. Depending on the version of your calibration kit, the positioning sheet will have 11 to 15 positions.

Step 4: Evaluation

1. Once you have captured the last position and the calculations have concluded, the *Evaluation* window will display the the quality of the calibration and accuracy.
2. If it indicates that the scanner is well calibrated, you can go ahead and click on *Save Calibration* .
3. Alternatively, direct the scanner at a flat, nonglossy surface (e.g., a piece of paper) from a distance of about 200 mm. Assess the quality of the reconstructed surface and check for any holes. If no holes appear on the surface and you are satisfied with the reconstruction results, go ahead and *Save Calibration*.
4. In case of discrepancies or dissatisfactory results, click on *Recalibrate*, and repeat the calibration process.

14.1.5 Notes Regarding Scanner-Calibration Files

Calibration and correction results reside in files that you can access as follows. Their location is

```
C:\Users\%name%\AppData\Roaming\Artec\Artec Installation Center
\Devices\SP.00.00000000.
```

Here, %name% is the current user folder and SP.00.00000000 is the folder corresponding to the scanner serial number. Note the following information regarding calibration

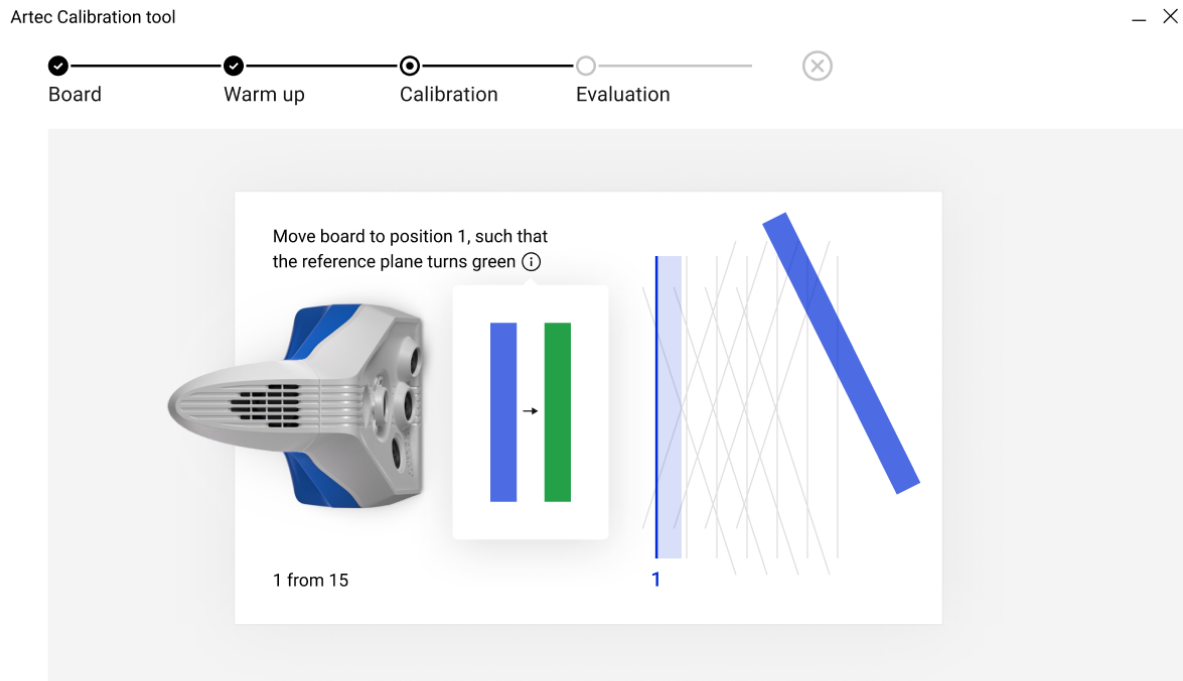


Figure 238: Moving calibration rig to position number 1

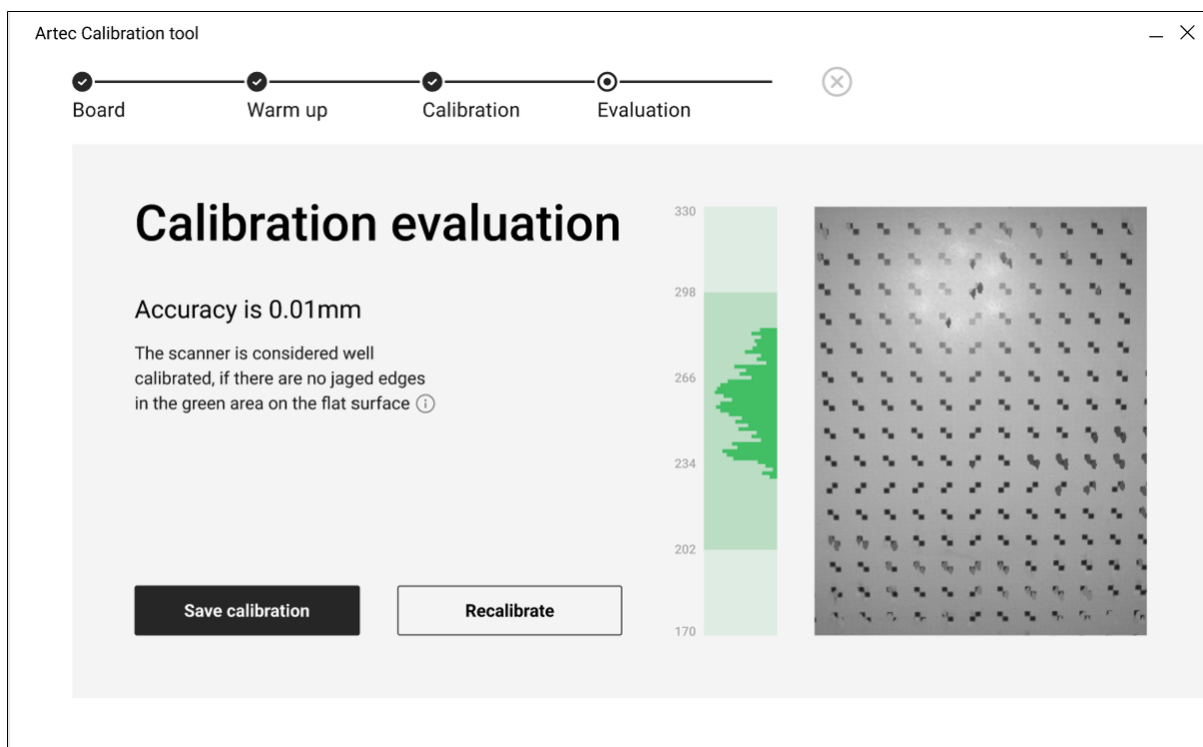


Figure 239: Evaluating calibration results

and correction.

- Once you apply correction results, the software will create an ACD file.
- Once you apply calibration results, the software will create ACD and CORR files.
- All newly created files have names of the form YYYYMMDD-HHMMSS, with the characters corresponding to the date and time of the file's creation.
- Original ADD and CORR file names are based on the scanner serial number and have the form SP.00.00000000.

Note: You can restore the initial calibration by removing the ACD and CORR files whose names have the form 20131121_101010.

Note: If you use the scanner on several computers, you need not recalibrate it on every one. Simply copying the ACD and CORR files to the above-mentioned folder on each computer may be sufficient.

14.1.6 Assembling the Scanner Stand

The scanner stand comes unassembled with Artec Spider and consists of five parts (see [Figure 240](#)): two side walls, one front and one back wall (these parts are identical, however), and a cover. Before beginning assembly, lay them all out as [Figure 240](#) shows. Then follow these steps:

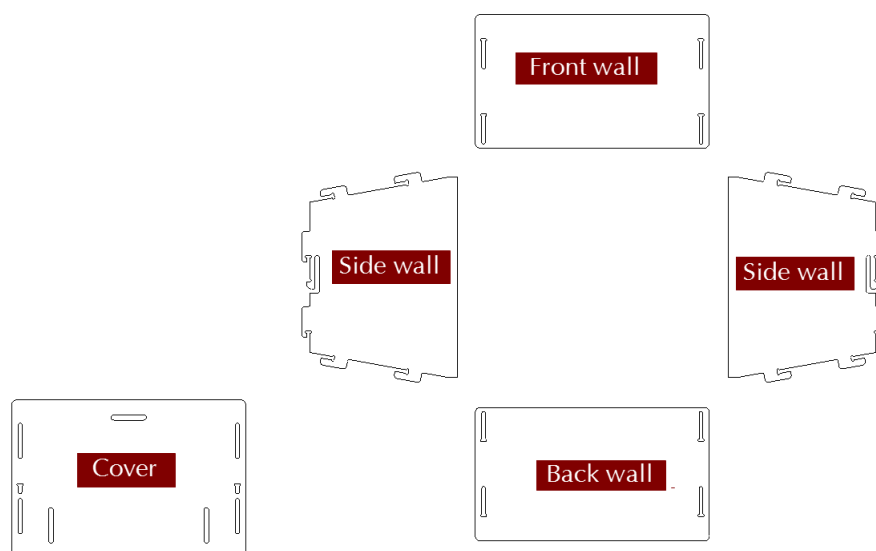


Figure 240: Parts of the scanner stand.

1. Raise the two side walls to the upright position, as [Figure 241](#) shows. Noting carefully the orientation of the T-shaped slot, install the front wall to the side walls

using the two pairs of hooks. Press the front wall and slide it down against the stop. Make sure the three walls are properly aligned with each other.

2. Install the back wall in the same way (see [Figure 242](#)).
3. Paying attention to orientation of the slots, install the cover using the upper hooks of the side walls (see [Figure 243](#)).
4. Press your thumbs against the T-shaped holes on the cover and shift it toward the back wall until you hear a click (see [Figure 244](#)).

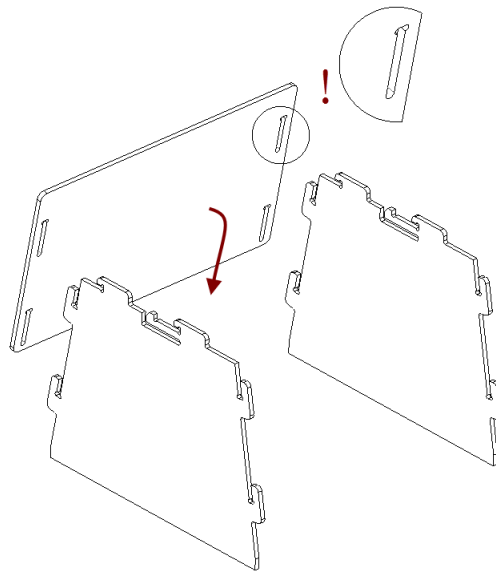


Figure 241: Assembling the front wall.

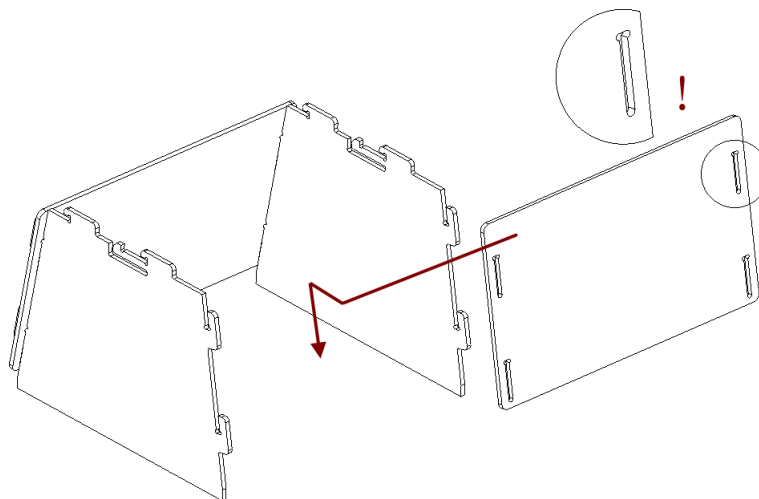


Figure 242: Assembling the back wall.

The scanner stand is now ready to use.

Note: To disassemble the stand, release the detents in the cover's T-shaped slots (see [Figure 240](#)) using a thin object like a ballpoint pen. Repeat the assembly steps in reverse

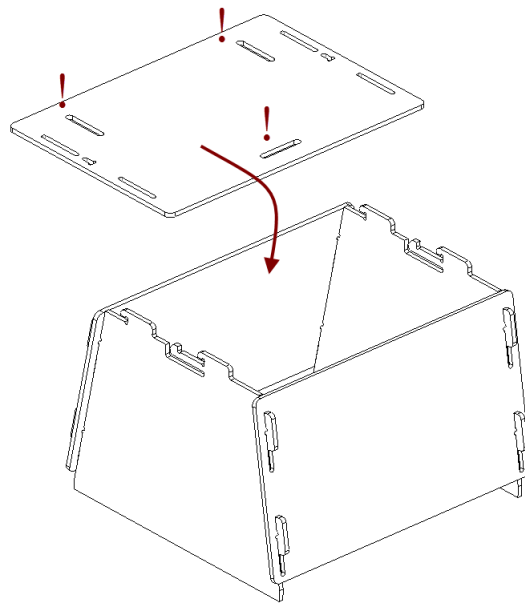


Figure 243: Mounting the cover.

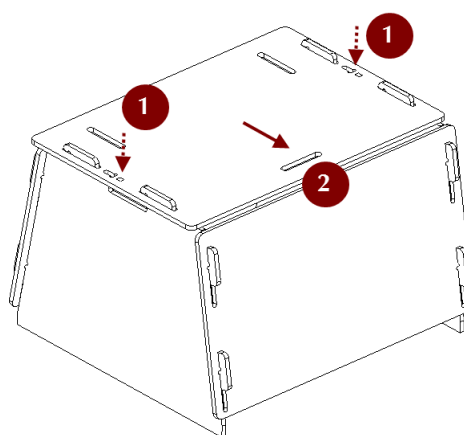


Figure 244: Latching the cover.

order (from [Figure 244](#) to [Figure 241](#)), moving the parts in the opposite directions.

14.1.7 Assembling the Calibration Rig

The calibration rig comes only with Artec Spider and consists of the base and the board. To assemble the rig, follow these instructions:

1. Press the hinge of the base against your forefingers.
2. Unfold the bent leaves of the base, pressing on their edges with your thumbs.
3. Insert the board into the slot, as [Figure 245](#) shows.

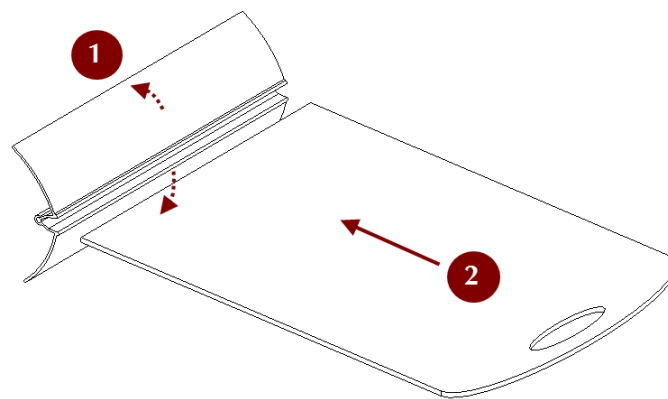


Figure 245: Assembling the rig.

14.2 Embedded Calibration in Artec Studio

As of Artec Studio 19, you can calibrate Artec Spider II or Artec Point directly in Artec Studio. The process is generally very simple and takes no longer than 5 minutes.

First, make sure the scanner is connected to your computer. Next, prepare the calibration board, and follow the steps:

14.2.1 Artec Spider II

1. Open the *Scan* panel
2. Click the *Start* button.
3. Scan the QR code in the upper-left corner of the calibration board.
4. Once the QR is code scanned, the warming-up process will begin. This is an optional step, but we highly recommend warming up the scanner for better results. However, you can proceed to the next step by clicking the *Skip* button.

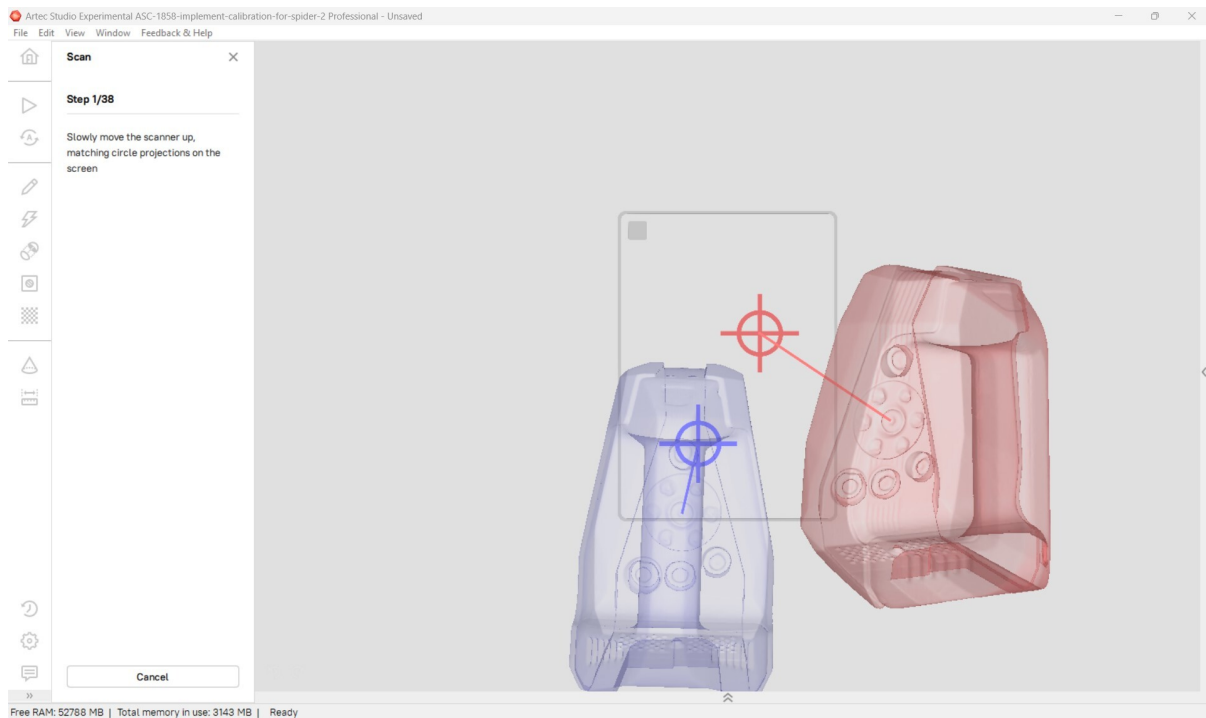


Figure 246: Artec Spider II calibration

5. Follow the calibration process instructions displayed in the 3D scene.

Once the process is complete, Artec Studio will automatically calculate the results. You are now ready to start scanning.

14.2.2 Artec Point

1. Open the *Scan* panel
2. Click the *Start* button.
3. Follow the calibration process instructions displayed in the 3D scene.

Once the process is complete, Artec Studio will automatically calculate the results. You are now ready to start scanning.

Note: To gain the best results, we recommend calibrating Artec Point before each scanning session.

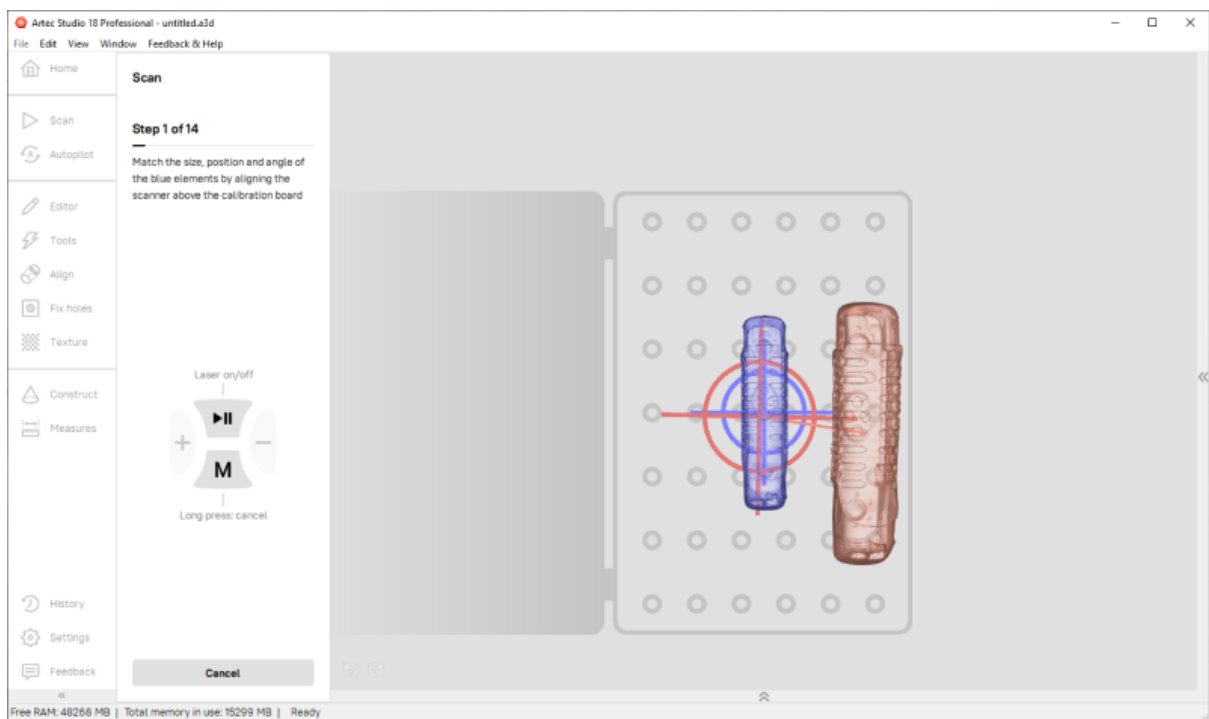


Figure 247: Artec Point calibration

SWITCHING FROM ARTEC STUDIO 14

Since version 15, Artec Studio has more comprehensible names for the algorithm parameters (*Tools* panel). The glossary below lists these new names in alphabetical order and provides their former names used in version 14. Links lead to the corresponding sections covering these parameters.

3D resolution resolution; everywhere: in Fusion, Outlier removal.

3D-noise level Either [std_dev_mul_threshold](#) in Outlier Removal, or [minDistBetweenDescriptors](#) in Global registration for point cloud scans.

Adaptive (distance-aware) [Adaptive](#); in Ray scan triangulation.

All (watertight) [Watertight](#); in Fusion.

All except largest [Leave_biggest_object](#); in Mesh optimization (Small-object filter).

Decimation ratio [decimationStep](#); in Ray scan triangulation.

Distance from scanner [effective_dist_from_scanner](#); in Global registration for point cloud scans.

Distinct colors for sections [SectionColor](#); in Ray scan triangulation.

Feature voxel [voxelSide](#); in Global registration for point cloud scans.

Features registration_algorithm; in registration algorithms.

Fill holes [Fill_holes](#); in Fusion.

Focus on geometry First introduced in version 15.

Geometry Geometry (unchanged); in registration algorithms.

Geometry and texture Geometry_and_Texture; in registration algorithms.

Geometry Ray [Geometry_Ray](#); in Global registration for point cloud scans.

Hole perimeter (max) [max_hole_len](#); in Mesh optimization (Hole filling).

Hole radius (max) [max_hole_radius](#); threshold radius in Fusion.

Incidence angle (max) [maxIncidenceAngle](#); in Ray scan triangulation.

Incidence angle between vertices (max) [maxTriangleAngularSize](#); in Ray scan triangulation.

Keep edges *keep_boundary*; in Mesh optimization (simplification).

Keep texture *UV_Triangle_quantity*; in Mesh optimization (simplification).

Key frame ratio *key_frame_ratio*; in Global registration

Later, manually *Manually*; one of the options in Fusion.

Maximum shape deviation *error*; in Mesh optimization (simplification)

Mode *method*; in Ray scan triangulation.

No targets (Geometry alignment) *Geometry_alignment*; in Global registration for point cloud scans.

None *Skip*; one of the options in Fusion.

Nonstrict polygon count *force_constraints*; in Mesh optimization (fast simplification).

One random color *None*; in Ray scan triangulation.

Polygon angle (min) *minTriangleAngle*; in Ray scan triangulation.

Polygon count *tri_num* or *Triangle_quantity*; in Mesh optimization (simplification).

Polygon count (max) *threshold*; in Mesh optimization (Small-object filter).

Polygon edge length (max) Either *maxEdgeLength* in Ray scan triangulation, or *remesh_edge_thr* in Mesh simplification.

Remove small polygons *Remesh*; in Mesh optimization (simplification)

Remove surfaces *mode*; in Mesh optimization (Small-object filter).

Render mesh based on *colorMode*; in Ray scan triangulation.

Search features within *feature_search_radius*; in Global registration.

Shape deviation *Accuracy*; in Mesh optimization (simplification).

Simple *Simple* (unchanged); in Ray scan triangulation.

Smaller than specified *Filter_by_threshold*; in Mesh optimization (Small-object filter).

Steps *steps*; in Mesh smoothing (*Tools*).

Target when simplifying *stop_condition*; in Mesh optimization (regular simplification).

Targets *Targets* (unchanged); in Global registration for point cloud scans.

Targets and geometry *Targets_Geometry*; in Global registration for point cloud scans.

Targets removal *remove_targets*; in Fusion.

Vertex colors *SourceColor*; in Ray scan triangulation.

With radius smaller... *By_radius*; determines which holes to fill in Fusion.

HOT KEYS

16.1 Scanning

Open <i>Scan</i> panel	F7	Anywhere exc. modal dialog
Toggle between <i>Preview</i> and <i>Record</i> modes	Space	<i>Scan</i> panel
Open <i>Multicapture</i> panel	F8	Anywhere exc. modal dialog

16.2 Workspace

Select one scan and deselect the rest	Ctrl+Alt+LMB	<i>Workspace</i> panel
Select one scan and deselect the rest	Ctrl+LMB	<i>Workspace</i> panel, first column
Select all scans/models or frames	Ctrl+A	<i>Workspace</i> panel
Deselect all scans/models or frames	Ctrl+D	<i>Workspace</i> panel
Select/deselect the highlighted scan	Space	<i>Workspace</i> panel
Select and display a single frame	Alt+LMB	<i>3D View</i> window
Select only key frames	Ctrl+K	<i>Workspace</i> panel → Surface list
Select only textured frames	Ctrl+J	<i>Workspace</i> panel → Surface list
Rename scan/model	F2	<i>Workspace</i> panel
Group objects	Ctrl+G	<i>Workspace</i> panel
Start/stop playback scan frames	Ctrl+P	<i>Workspace</i> panel → Surface list
Delete selected frames/scans	Del	<i>Workspace</i> panel (including surface list)

16.3 Save, Export and Import

Create new project	Ctrl+N	Anywhere exc. modal dialog
Save project	Ctrl+S	Anywhere exc. modal dialog
Open existing project	Ctrl+O	Anywhere exc. modal dialog
Import 3D files	Ctrl+I	Anywhere exc. modal dialog
Export meshes	Ctrl+Shift+E	Anywhere exc. modal dialog
Clear command history	Ctrl+Alt+H	Anywhere exc. modal dialog
Save screenshot of <i>3D View</i> window	Ctrl+Shift+S	Anywhere

16.4 Viewing 3D Content

Fit to view	F	3D View window
Place coordinate origin to the viewpoint center (Home)	H	3D View window
Display/hide coordinate axis grid	G	3D View window
Set rotation center to the origin of axis grid	Ctrl+Shift+C	3D View window
Set rotation center to the object's center of mass	Ctrl+Shift+M	3D View window
Change rendering mode to <i>Texture</i>	Ctrl+Alt+1	3D View window
Change rendering mode to <i>Scan color</i>	Ctrl+Alt+2	3D View window
Change rendering mode to <i>Frame color</i>	Ctrl+Alt+3	3D View window
Change rendering mode to <i>Max error</i>	Ctrl+Alt+4	3D View window
Change rendering mode to <i>X-Ray</i>	Ctrl+Alt+5	3D View window
Turn on/off lighting	L	3D View window
Display/hide normals	N	3D View window
Display/hide boundaries	B	3D View window
Display/hide texture boundaries	Shift+B	3D View window
Toggle between perspective and orthogonal views	5 (numpad) or Ctrl+5	3D View window
Turn on/off <i>Show CAD constraints</i> mode	Shift+C	3D View window

16.4.1 Switching Viewpoint

To front	1 (numpad) or Ctrl+Shift+1	3D View window
To back	Ctrl+1	3D View window
To left	Ctrl+3	3D View window
To right	3 (numpad) or Ctrl+Shift+3	3D View window
To top	7 (numpad) or Ctrl+Shift+7	3D View window
To bottom	Ctrl+7	3D View window

16.5 Editor

Activate <i>2D selection</i> mode	Shift+Alt+1	<i>Editor</i> → <i>Eraser</i>
Activate <i>3D selection</i> mode	Shift+Alt+2	<i>Editor</i> → <i>Eraser</i>
Activate <i>Rectangular selection</i> mode	Shift+Alt+3	<i>Editor</i> → <i>Eraser</i>
Activate <i>Lasso selection</i> mode	Shift+Alt+4	<i>Editor</i> → <i>Eraser</i>
Activate <i>Cutoff-plane selection</i> mode	Shift+Alt+5	<i>Editor</i> → <i>Eraser</i>
Activate <i>Base selection</i> mode	Shift+Alt+6	<i>Editor</i> → <i>Eraser</i>
Display control for adjusting cutoff plane	Alt	<i>Eraser/Defeature brush</i> → <i>Cutoff-plane selection</i>
Move cutoff plane	Ctrl+Shift+Scroll	<i>Eraser/Defeature brush</i> → <i>Cutoff-plane selection</i>
Change tool size	Ctrl+[and Ctrl+] or Scroll Wheel	<i>Editor</i> panel → any tool
Select the entire surface below the cutoff plane	Ctrl+Q	<i>Eraser/Defeature brush</i> → <i>Cutoff-plane selection</i>
Clear selection of 3D regions	Ctrl+Alt+LMB	<i>Editor</i>
Invert selection	I	<i>Editor</i> panel → any tool → <i>3D View</i>
Delete selected region	Delete	<i>Editor</i> → <i>Eraser</i>

16.6 Aligning Scans

Display aligned scans/models	1	<i>Align</i> panel
Display unaligned scans/models	2	<i>Align</i> panel
Display all scans selected for alignment	3	<i>Align</i> panel
Manually align scans	Shift	<i>Align</i> panel
Switch between point sets/pairs	Space and Backspace	<i>Align</i> panel → points
Confirm creation of point set	Space	<i>Align</i> panel → <i>Complex</i>

16.7 Starting Tools, Modes and Dialogs

Open <i>Autopilot</i>	F9	Anywhere exc. modal dialog
Open the <i>Tools</i> panel	Ctrl+T	Anywhere exc. modal dialog
Open the <i>Align</i> panel	Ctrl+L	Anywhere exc. modal dialog
Open the <i>Fix holes</i> panel	Ctrl+B	Anywhere exc. modal dialog
Open the <i>Repair</i> panel	Ctrl+R	Anywhere exc. modal dialog
Open the <i>Measures</i> panel	Ctrl+M	Anywhere exc. modal dialog
Open the <i>Texture</i> panel	Ctrl+U	Anywhere exc. modal dialog
Open the <i>Editor</i> panel	Ctrl+E	Anywhere exc. modal dialog
Start <i>Eraser</i> tool	E	<i>Editor</i> panel
Start <i>Defeature brush</i>	D	<i>Editor</i> panel
Start <i>Positioning</i> tool	P	<i>Editor</i> panel
Start <i>Transformation</i> tool	T	<i>Editor</i> panel
Start <i>Smoothing brush</i>	S	<i>Editor</i> panel
Start automatic processing (don't confuse with <i>Autopilot</i>)	Ctrl+G	<i>Tools</i> → Auto
Open web manual	F1	Anywhere
Open local User Guide file	Ctrl+F1	Anywhere
Call <i>Settings</i> dialog	F10	Anywhere exc. modal dialog
Show/hide the <i>Workspace</i> panel	F11	Anywhere exc. modal dialog
Show/hide <i>Log</i> window	Ctrl+Alt+L	Anywhere exc. modal dialog

CONVENTIONS AND ACRONYMS

Portions of this user guide are highlighted to draw your attention. For example,

Note: Important information appears in specially formatted paragraphs.

The following examples illustrate our conventions:

- Panel and element names that appear in the application window use italics: e.g., *Workspace*, *File* and *Texture*
- Buttons, checkboxes and elements of dropdown lists in panels and application menus are italicized and underscored: *Invert*, *Apply* and so on
- Shortcuts, individual keys and hardware buttons use gray highlighting: e.g., `Ctrl+A`
- Characters that appear in a field, file extension, or directory or file path employ the following style: `Scan 1`, `A3D`, `SPROJ`, `C:\Program Files`, and so on.

Note the following abbreviations and icons:

- LMB—left mouse button
- RMB—right mouse button
- ►—*Play/Pause* button on the scanner body

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