



User manual







Congratulations on your purchase of the latest professional 3D scanner Calibry!

The device uses the latest developments in structured light scanning and even enables the capture of complex surfaces.

This guide provides information on how to install and use Calibry software, how to operate the scanner, and recommendations for the scanning process itself.

When using the device, keep in mind that the 3D scanner is a high-precision optical device that requires careful attention. Careful use and compliance with the rules of use will ensure a long life for the scanner.

Scanner hardware device

Front panel



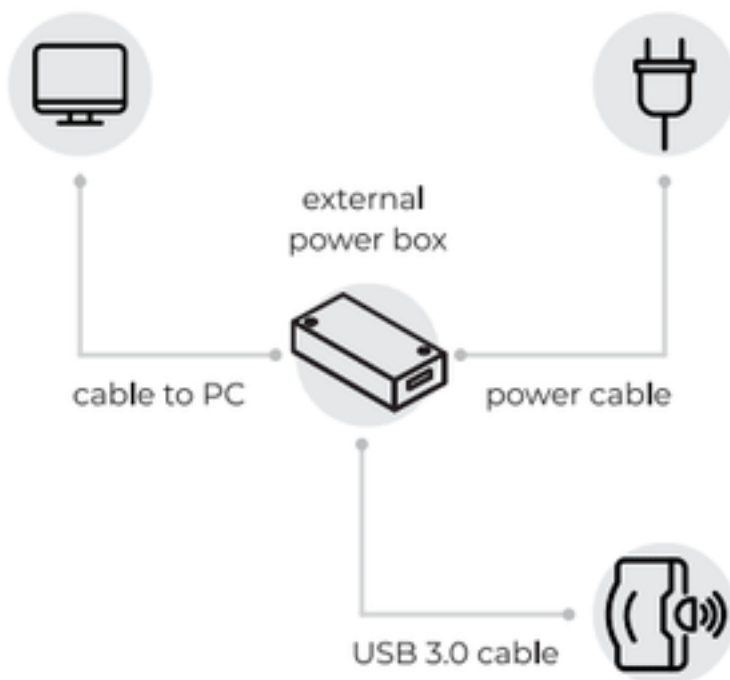
Scanner hardware device

Rear panel



Pre-starting procedure

Connect the scanner to a computer with the Calibry Nest software installed.

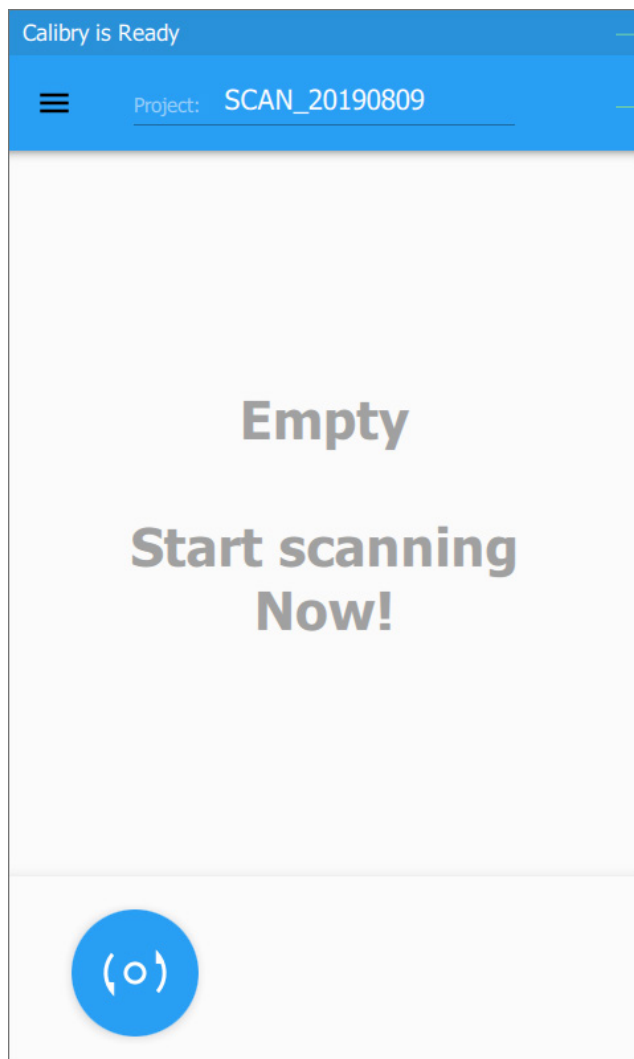


- Strictly follow the connection sequence. Make all connections when the power supply unit is disconnected. Connect the power supply unit when all other connections have been made. Otherwise, the equipment may be damaged, and this case will not be covered under the warranty. When the scanner is powered on, it turns on automatically.
- When you first connect the scanner to the computer, we recommend that you connect the computer to the Internet. In this case, the software will automatically download the scanner calibration file, and the scanner will be ready for use. Otherwise, you can manually download the calibration file. The calibration file can be requested from the supplier of the scanner.

Scanner operation

Main screen elements

After the scanner is loaded, the main screen is displayed



Status bar

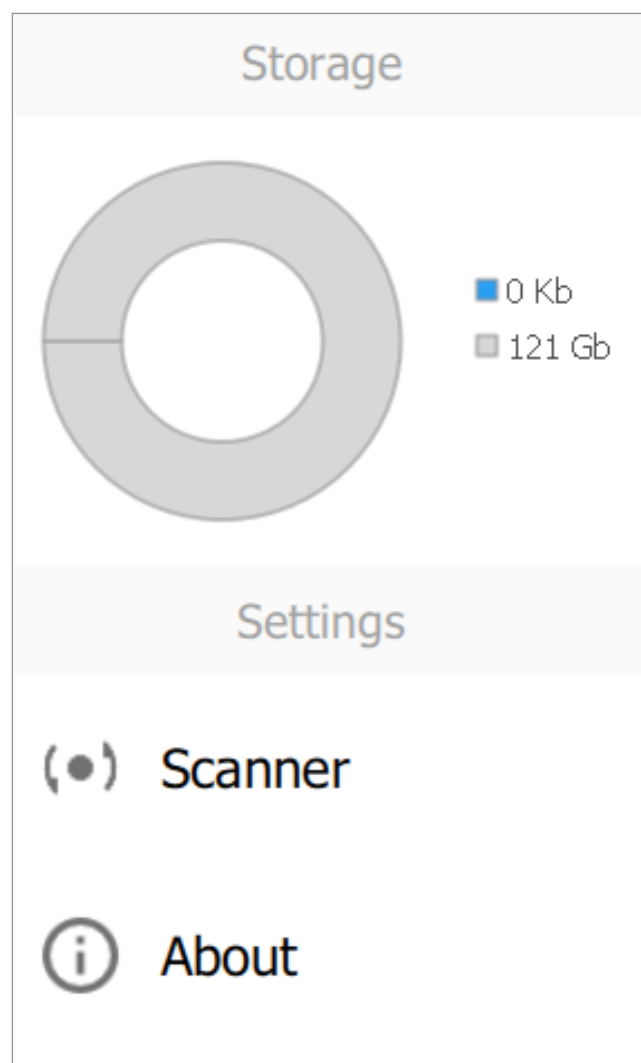
The status bar shows the status of the scanner

Control panel

The control panel is used to display the sidebar. Here you can also specify the name of the current project (the object being scanned) by clicking on the title in the centre. All scanned parts of the object will be placed in the folder with this name. If the project name is not specified or is empty, a standard name indicating the full scan date will be applied, for example, «SCAN_ 20200101».

Scanner operation

List of scans

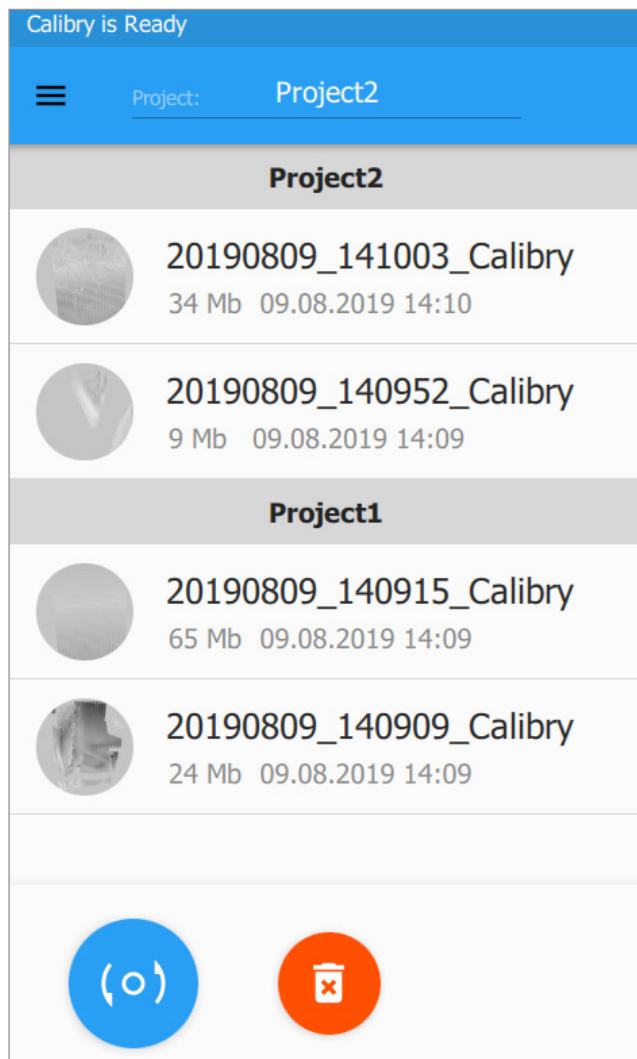


The sidebar

presents information on the available and occupied space on the hard disk of the computer, to which the scanner is connected, as well as buttons for scanner settings and the scanner data.

Scanner operation

List of scans

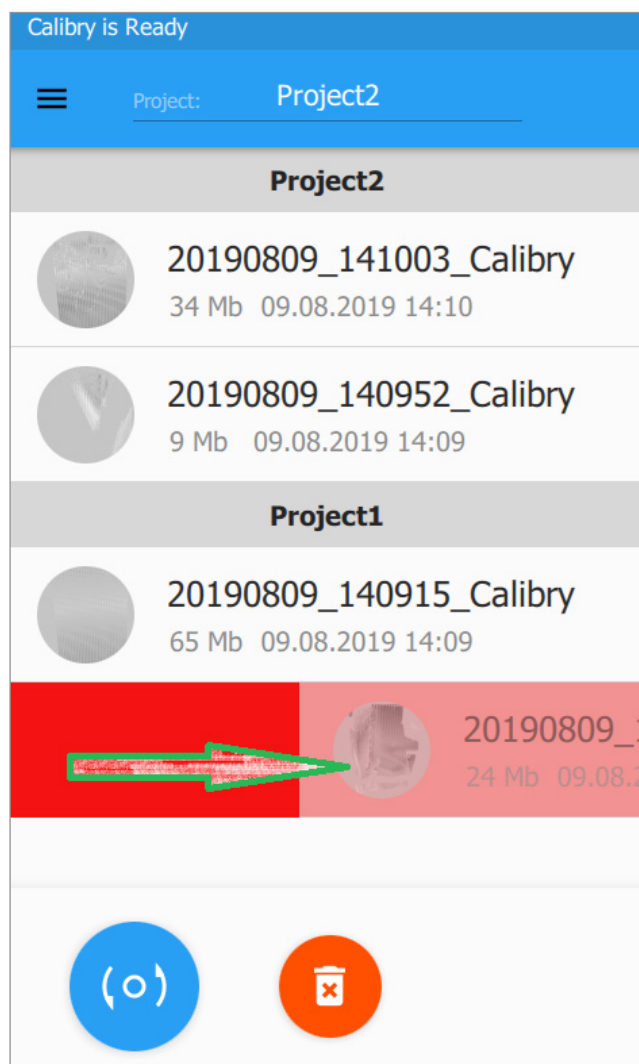


The list of scans

During the scanning process, the list of all scans carried out will be placed on the main screen. The scans are sorted by creation date: the newer, the higher. Scans can also be grouped in their respective project sections. At any time, you can switch to another project by clicking on the section bar, or create a new project by typing its name in the title. All scans carried out are saved to the hard disk of the computer to which the scanner is connected.

Scanner operation

List of scans



Any scan in the project can be deleted by simply swiping the item in the list sideways.



You can cancel the deletion within 5 seconds by clicking the «**Cancel**» button.



You can delete all scans by clicking the «**Delete All Scans**» button

Scanner operation

Preview Mode

The preview mode allows you to select the correct scan angle, to determine the optimal distance, to assess the nature of the surface, to set up the scan parameters, and to determine the adequacy of the number of markers applied.



To enter the mode, press the button, on the main screen of the scanner. For convenience, you can also use the mechanical button located under the screen.



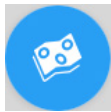
To exit the main screen, press the button, at the bottom of the screen. For convenience, you can also use the mechanical button located under the screen.



In the preview mode, additional buttons appear on the screen allowing you to adjust the scan settings.



**With tracking
by geometry**



**With tracking
by markers**



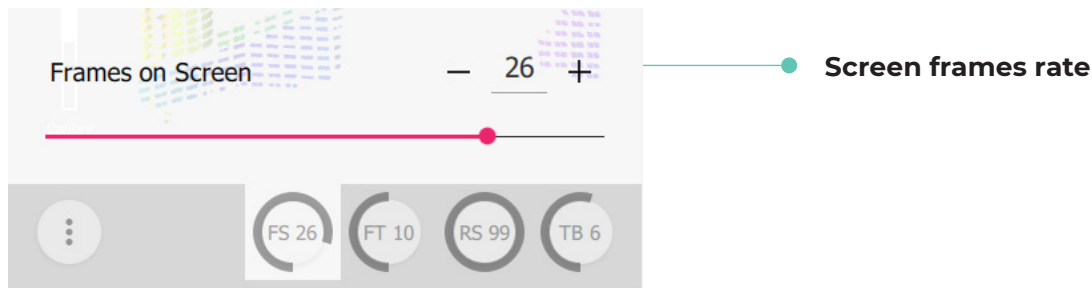
**With tracking
by texture**

Scan mode selection
button

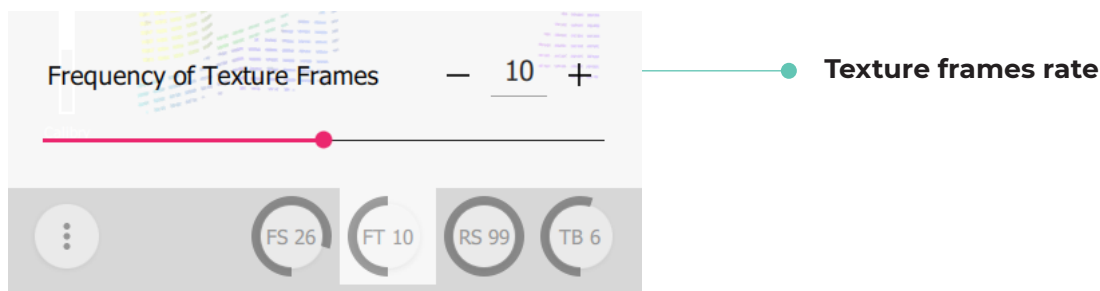
Selection of scanning modes with tracking by geometry, markers and texture, respectively. Depending on the mode selected data visualization on the scanner screen in the preview and scan modes has its own specific features.

Scanner operation

Preview Mode



This parameter determines the frame update rates on the scanner screen during preview and scan modes. Increase the setting value to improve the picture quality displayed on the scanner screen. If increasing the value slows down the scanning, decrease it back.



This parameter determines the rate of recording frames by the texture camera, necessary for building a textured model. For example, if the value of this parameter is 10, then every 10th frame taken during shooting is used to scan texture.

Recommended value for shooting with texture 20.

Decrease the setting value to increase the number of texture frames in the project. In some cases, this can improve texturing.

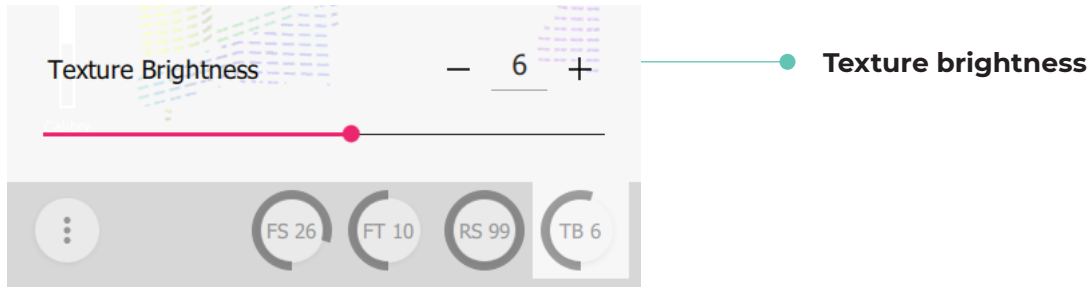
Increase the setting value to decrease the number of texture frames in the project. In some cases, this can improve texturing as well. And in any case, this will reduce the project volume and post-processing time.



The parameter does not affect tracking by markers and texture.

Scanner operation

Preview Mode



This parameter determines the frame texture brightness.

If you change the value of this parameter, the image from the texture camera is displayed on the scanner screen, so you can visually assess the texture quality in advance.

Set the parameter value so that the texture is displayed in the best quality. Before scanning, in preview mode analyze the texture image in different parts of the scanned surface. In case of glare, the corresponding surface areas will be tinted in red.

Scanner operation

Preview Mode



Set this parameter to one of the following values.

To select the maximum, average or minimum projector capacity, respectively.

As a rule, the maximum capacity mode is used to scan dark objects. The minimum capacity mode is recommended for scanning shiny objects. The default mode is average capacity.



Set this parameter to one of the following values.

To select the maximum, average or minimum texture flash capacity, respectively. Setting the parameter is done visually, similar to the setting «Texture brightness»



● The setting is available in geometry tracking mode only.

Scanner operation

Scan mode



To start the scan session in the preview mode, press the button at the bottom of the screen.

For convenience, you can also use the mechanical button located under the screen.



To finish the scan session, click the button at the bottom of the screen.

For convenience, you can also use the mechanical button located under the screen.

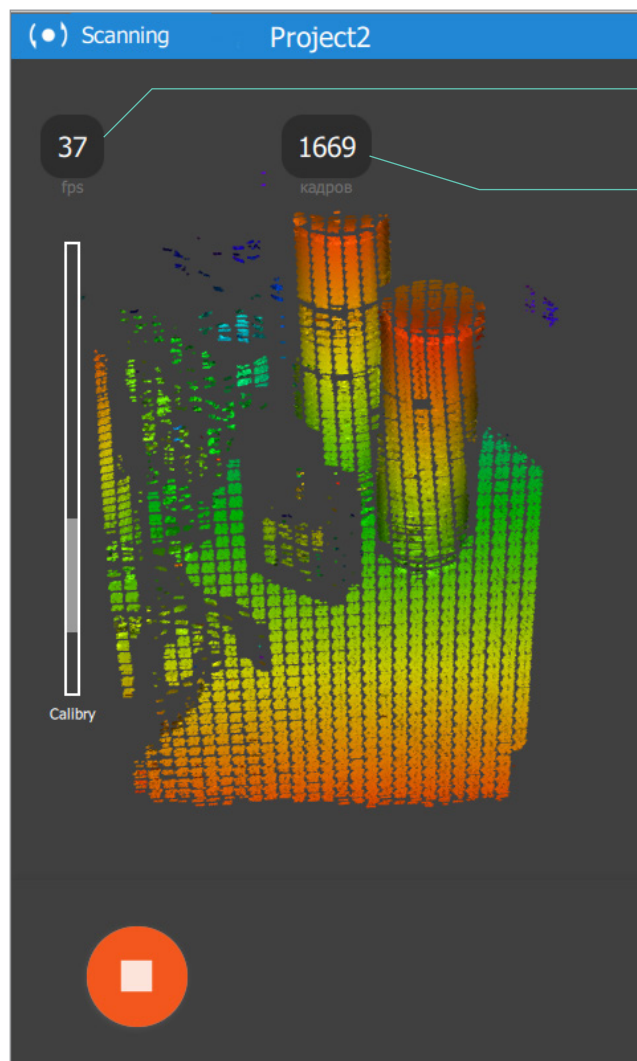


Upon finishing the scan session, the scanner shifts to the preview mode.

Scanner operation

Scanning in geometry tracking mode

Use the geometry tracking mode when capturing objects with distinct geometry and without many flat parts.



Scan rate

(frames per second)

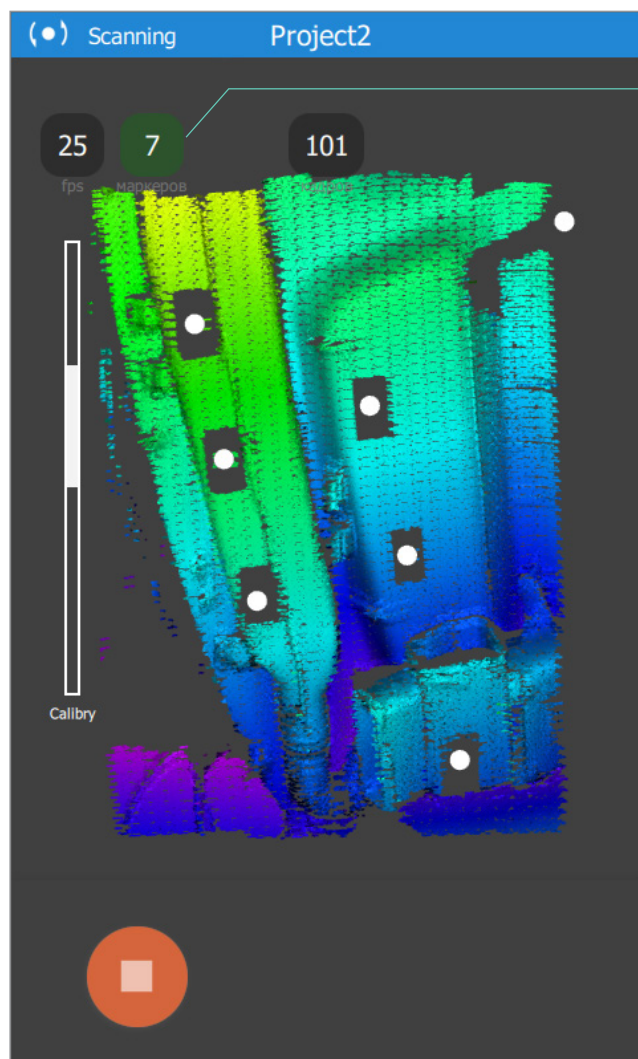
Number of frames shot

During scanning, it is important to keep the optimal distance between the scanner and the object being scanned. For convenience, and depending on the distance, the scanned surface is tinted with a certain colour. The colour from the middle part of the spectrum (green) indicates that the scanning distance is close to optimal. If the scanning distance is too small, the object is tinted with the colours from the lower part of the spectrum (yellow – orange – red). If the scanning distance is too large, the object is tinted with the colours from the upper part of the spectrum (light blue – blue – purple). It is recommended that as much of the object as possible is tinted with the green colour during scanning.

Scanner operation

Scanning in marker tracking mode

Scan in marker tracking mode if the object does not have characteristic features of geometry or texture, as well as if these features make up a periodically repeating pattern.



● Number of markers in the frame

When scanning by markers, it is important that each frame shot contains at least 3 markers (this is a critical value), optimally at least 5 markers. The indicator changing the colour depending on the fixed number of markers in the last frame helps to control the number of markers:

- If it is 4 or less, the indicator is red (critically)
- If it is 5, the indicator is yellow (warning)
- If it is more than 5, the indicator is green (good)

If there are not enough markers in the frame (less than three), the scanning will automatically stop, and the scanner will return to the preview mode. Then you should find a more comfortable position to scan and start again.

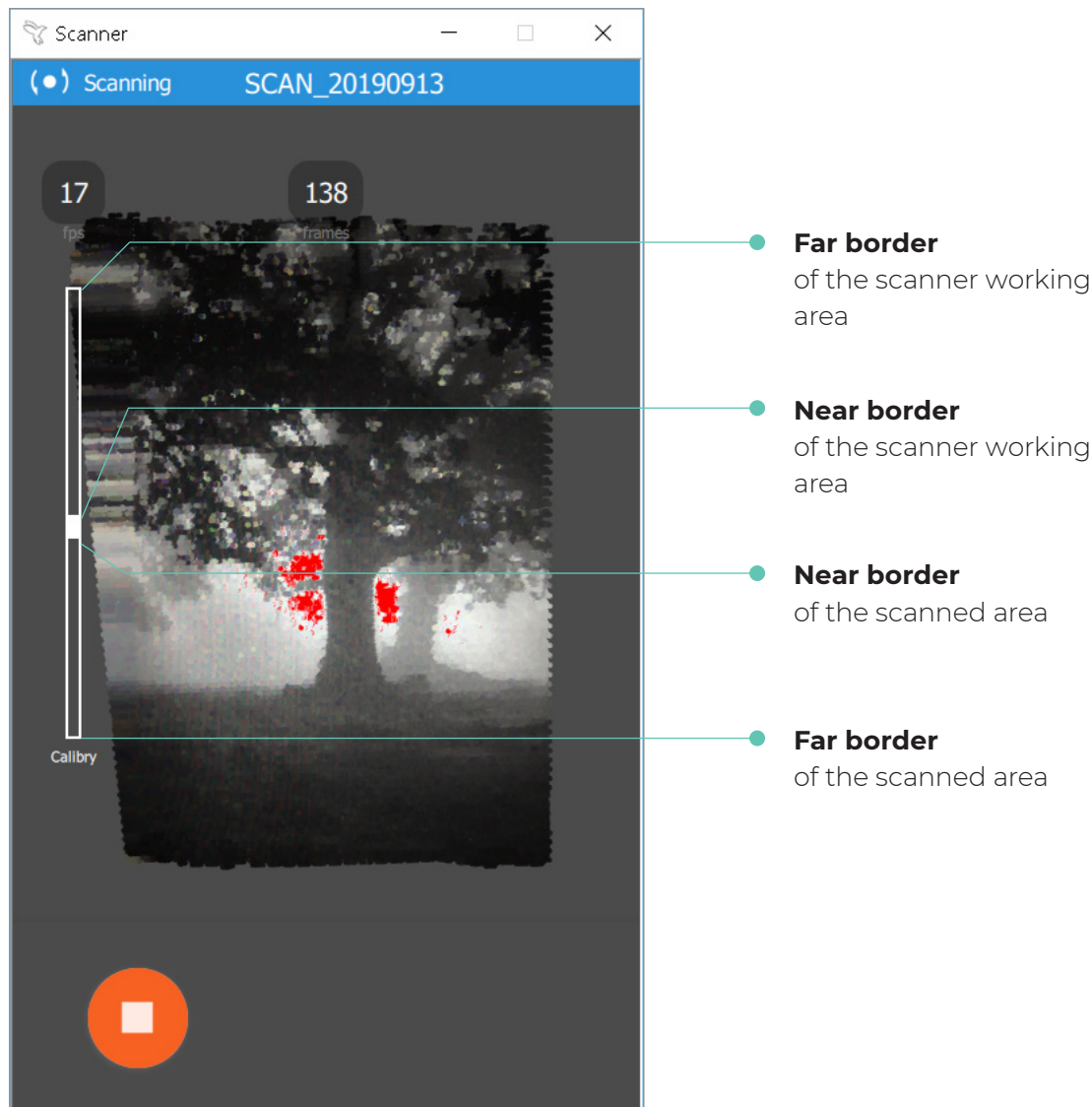


Sometimes, the object you are scanning is small enough that it fits comfortably into a single frame. In this case, you can place the markers around the object (on the table or the floor), instead of adding them directly onto the object.

Scanner operation

Scanning in texture tracking mode

Scan in texture tracking mode if the object has characteristic texture features, while scanning in geometry or marker tracking mode is not possible.



When scanning in texture tracking mode, a textured image is displayed on the scanner screen. To maintain the correct scanning distance, use the scale on the left. If the correct distance to the object is not maintained during scanning, the image on the screen will «crumble». Red areas on the scanned surface indicate glare. If they appear, decrease the value of the Texture Brightness parameter and / or change the scanning angle.

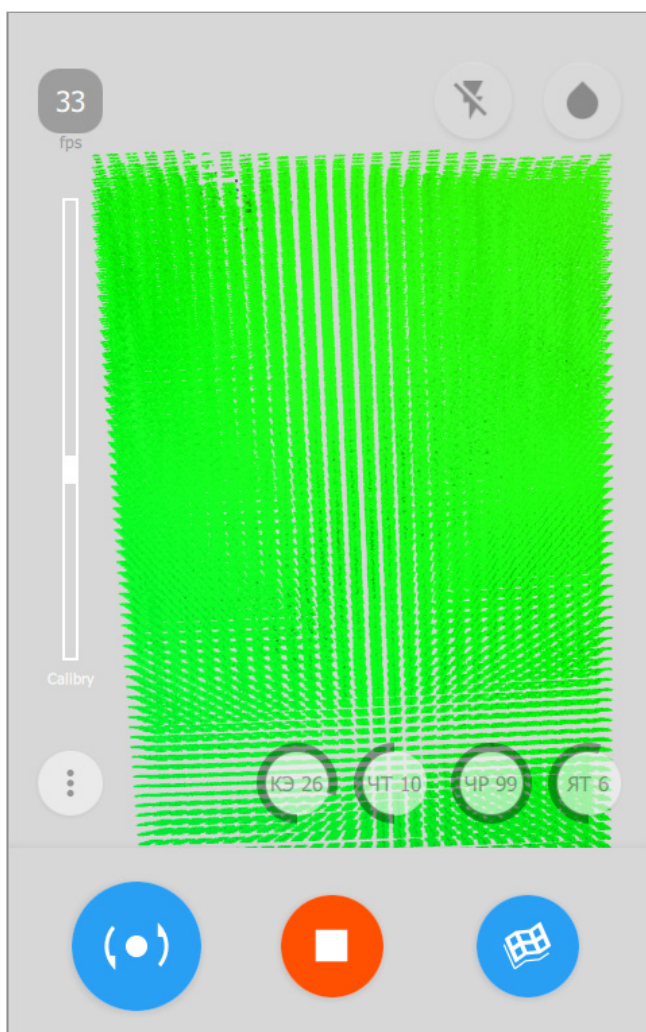
Scanner operation

Calibration of the scanner

The Calibry scanner is an accurate measuring tool that is factory calibrated. In order to ensure high scanning accuracy, Calibry has the option of custom calibration.

A simple test is sufficient to detect if the scanner needs to be calibrated. In geometry tracking mode, try to «look» at a flat object, such as a floor or a wall, by means of the scanner. The flatness should be seen without «holes» and distortions.

However, even with the correct restoration of the flatness, it is recommended to calibrate the scanner from time to time. The frequency of calibration depends on the intensity of use of the scanner. For daily use, it is recommended to calibrate the scanner twice a week.



Scanner operation

Calibration of the scanner

To prepare for calibration, assemble the calibration stand.

For easy assembly, it is recommended to screw the top panel of the stand to the scanner in advance.

Place the scanner about 50 cm away from the calibration stand.

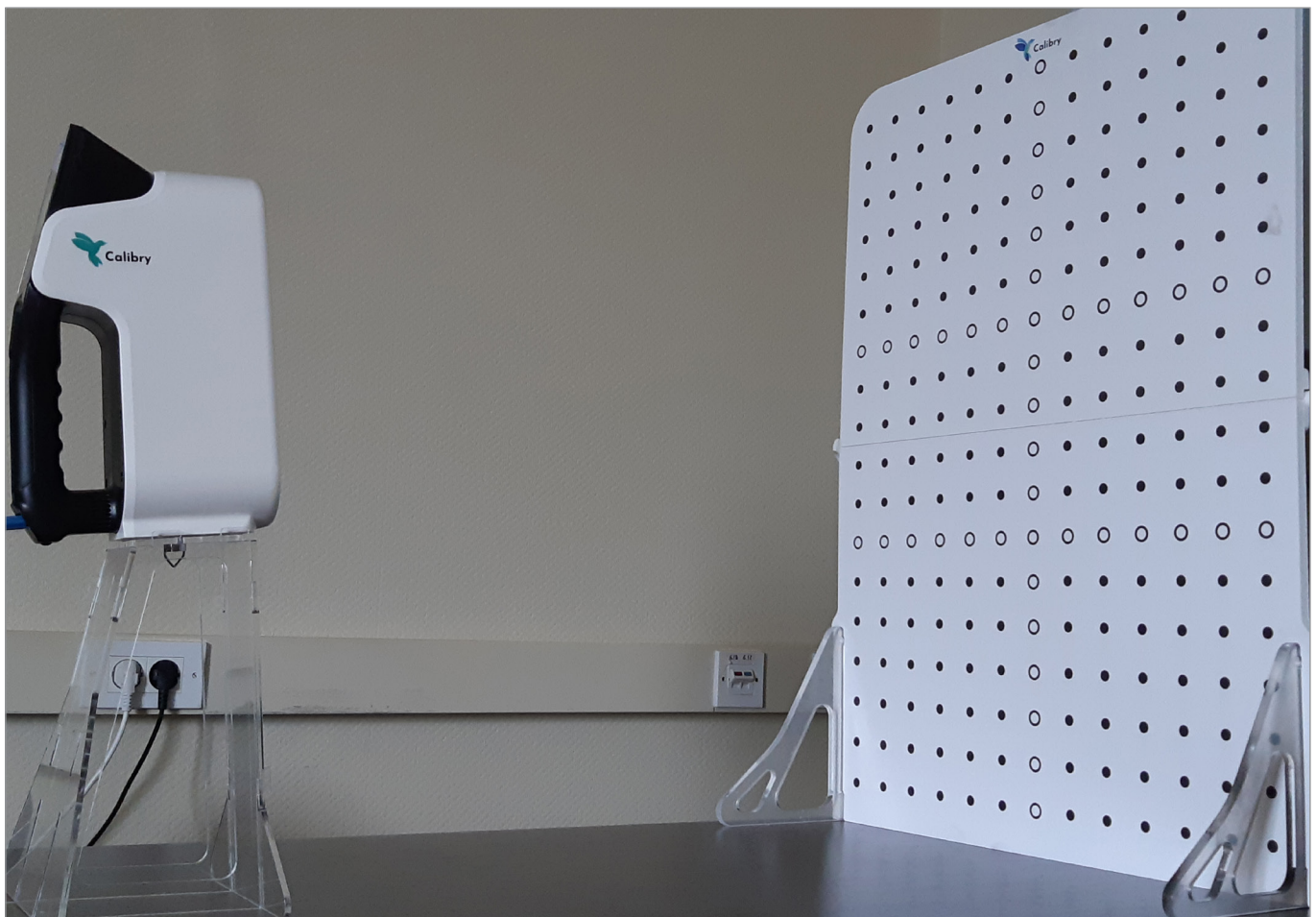


Scanner operation

Calibration of the scanner

Everything is ready for calibration. To start the calibration procedure, turn on the scanner and go to the side panel.

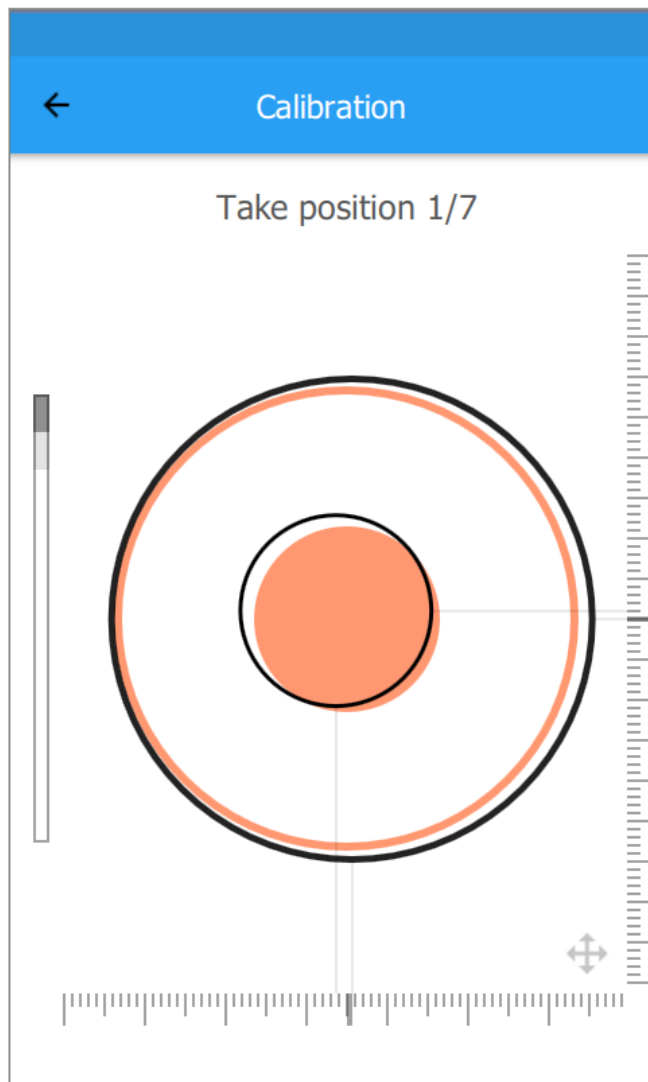
- Select «Scanner» and «Calibration»
- Click «START»



The device will start scanning, and the message will appear on the screen asking you to move the scanner to the first position. Follow the on-screen prompts to place the scanner in the first position.

Scanner operation

Calibration of the scanner



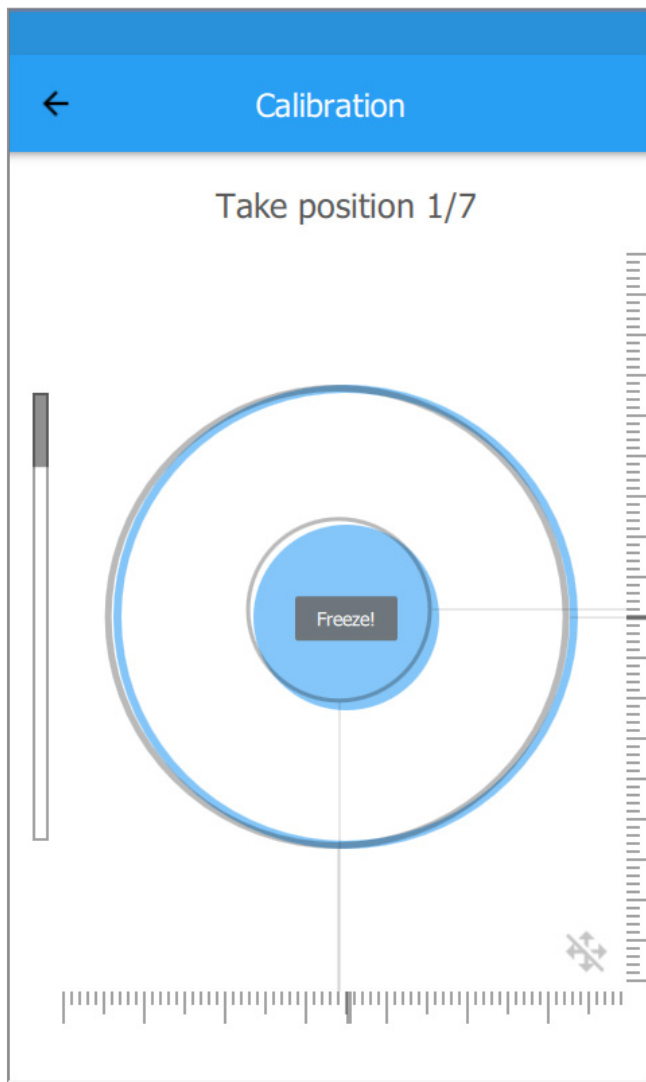
The scanner needs to be aligned in three directions:

1. Find a suitable distance to the calibration board by moving the scanner stand towards it or away from it. The indicator on the left side of the screen shows when the device is at the required distance.
2. Rotate the scanner a few degrees left and right until the smaller of the two red circles aligns with the black circle of the same size.
3. Move the scanner stand slightly to the left and right until the large red circle aligns with the black circle of the same size.

As soon as the desired position is found, the scanner will display the message «Freeze», and the red circles will become blue. Do not move the scanner during this time. It will take 2–3 seconds. Once the position is recorded, the screen will display the message about transition in the second position.

Scanner operation

Calibration of the scanner



Slowly move the scanner away from the calibration board. The indicator on the left side of the screen lets you know how much the scanner should be moved. As soon as the software finishes the calibration in the second position, it will move to the third one, the fourth one, etc. There are seven positions in total.

Once the scanner is calibrated in all seven positions, you will be prompted to restart the scanner software and the device will be ready for use.





Software manual

Introduction

Calibry software is designed for scanning process control, saving data acquired during scanning and subsequently processing the acquired data. The software (SW) includes several modules.

Calibry Tray Manager. This module is designed to provide the scanning process and to acquire raw data.

Calibry Nest. This module is designed for raw data postprocessing and saving of the obtained 3D model in a conventional format.

Additionally, SW components include a **Visual C++ Redistributable 2015 x64** package and **FTD3XX Driver** as part of the installation package.

System Requirements

Operating system – Windows 8.1, 10

Processor – Intel Core i5 or faster


Graphics card – NVIDIA GeForce 400 series or higher (with memory size of 2048Mb)

RAM size – 16 GB minimum

USB 3.0

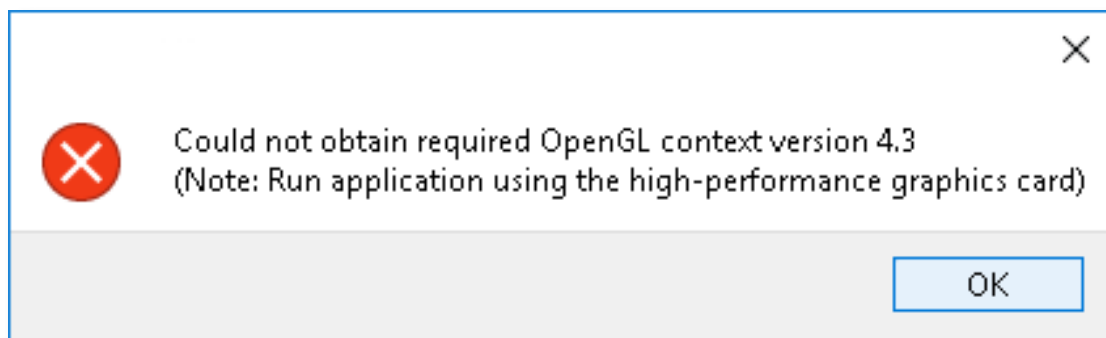
Installation and First Startup

To install the software onto your laptop or computer, launch the .msi file included with your scanner, and follow the instructions.

 **If there is more than one graphics card in your computer (e.g., both Intel and NVIDIA) make sure that Calibry software always uses the more high-performance graphics card by default. We do not recommend that you use screens with 4K resolution.**

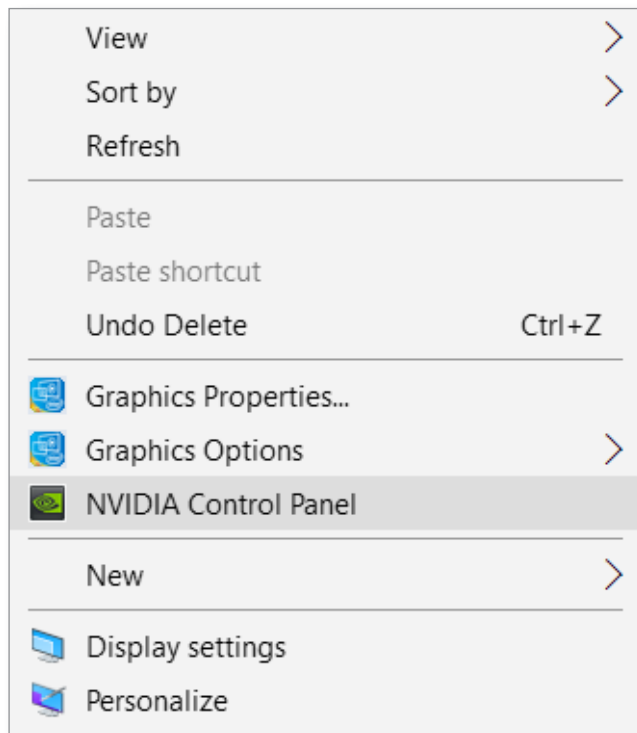
To start, double-click the Calibry Nest icon.

If the following error message is displayed during startup:



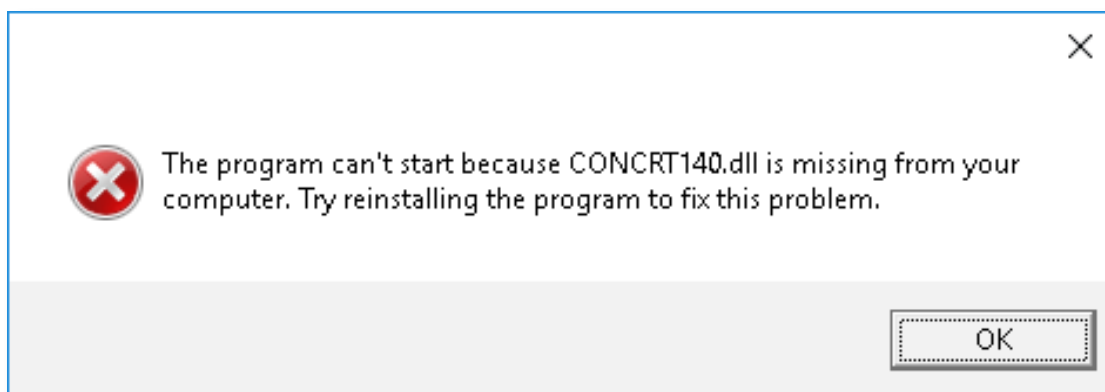
Then, most likely, a minimum recommended graphics card supporting OpenGL 4.3 is not installed on your computer. Alternatively, if you have two graphics cards, the software may be using the weaker graphics card for start-up by default.

In order to switch the default graphics card, follow the instructions below:



Right-click on desktop menu
Select **NVIDIA Control Panel**.
Enter the **Manage 3D Settings** menu
and open **Program Settings**.
Click **Add** and select the **nest.exe**
program from the list. If there is no such
program in the list click **Browse...**, select
the folder with the program and click on
nest.exe
Try to restart the program. If the error
persists, you will have to upgrade your
graphics card by replacing it with a
newer one.

If during startup this error message is displayed:



Then your laptop or computer does not have the Visual C++ Redistributable 2015 x64 package with the necessary vc_redist_x64.exe file. This can be easily corrected by downloading the necessary file from the Microsoft web site and installing it yourself:

<https://www.microsoft.com/en-us/download/details.aspx?id=48145>

On successful startup, the Calibry Nest window will open, and in the notification area in the right-bottom corner the **Calibry Tray Manager** icon will appear.

Preparing to Work with Calibry Scanner

Connecting a Scanner

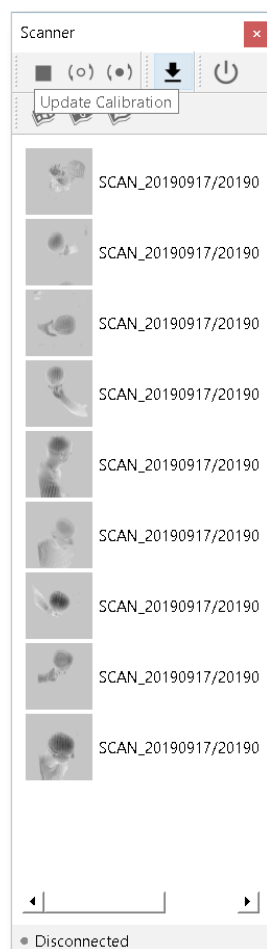
After Calibry software has been successfully launched, the scanner can be connected to the computer. Always follow the scanner operation instructions. Connect power to the scanner after all other connections have been made. Otherwise, the scanner could be damaged, and in this instance a defect is not considered under warranty.

Calibration File

Each Calibry scanner is supplied with a calibration file containing its individual settings. If necessary, a calibration file can be requested from distributor.

To interact with the scanner its calibration file should be loaded to Calibry Nest. If you plan to connect several scanners to one computer then calibration files should be loaded for each one of them.

When the scanner is connected for the first time it is recommended to connect the computer running Calibry Nest to Internet. The software will then automatically download its calibration file from the Internet, and the scanner will be ready to use. When there is no Internet connection the calibration file can be loaded manually.

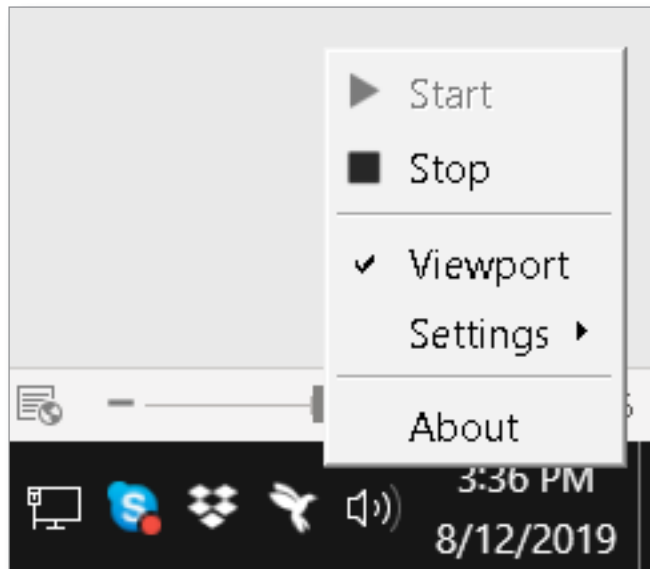


Click **Update Calibration** in the toolbar of the Scanner window or select a similar option in the **Help menu**. In the standard dialog box specify the calibration file.

If the scanner is connected correctly and its calibration file is loaded to **Calibry Nest** then everything is ready for scanning. This is signaled by the Ready message in the status bar located at the bottom of the **Scanner** window.

Calibry Tray Manager – Scanning

Interaction with the Calibry scanner is provided by the Calibry Tray Manager module. This component operates in background mode. Its work is indicated by the corresponding icon in the toolbar. By right-clicking the icon some actions can be performed.



Start/Stop – start up or stop the module.

Viewport – duplicate the scanner screen on your PC.

Settings – module settings:

- **Start by Connect** – automatic module startup when scanner connection is detected;
- **Start by Button** – automatic module startup when the Start button is pressed on the scanner;
- **Startup with System** – automatic module startup when the computer is booted up.

About – module version.

The Scanner window is provided for the scanner to work in Calibry Nest.

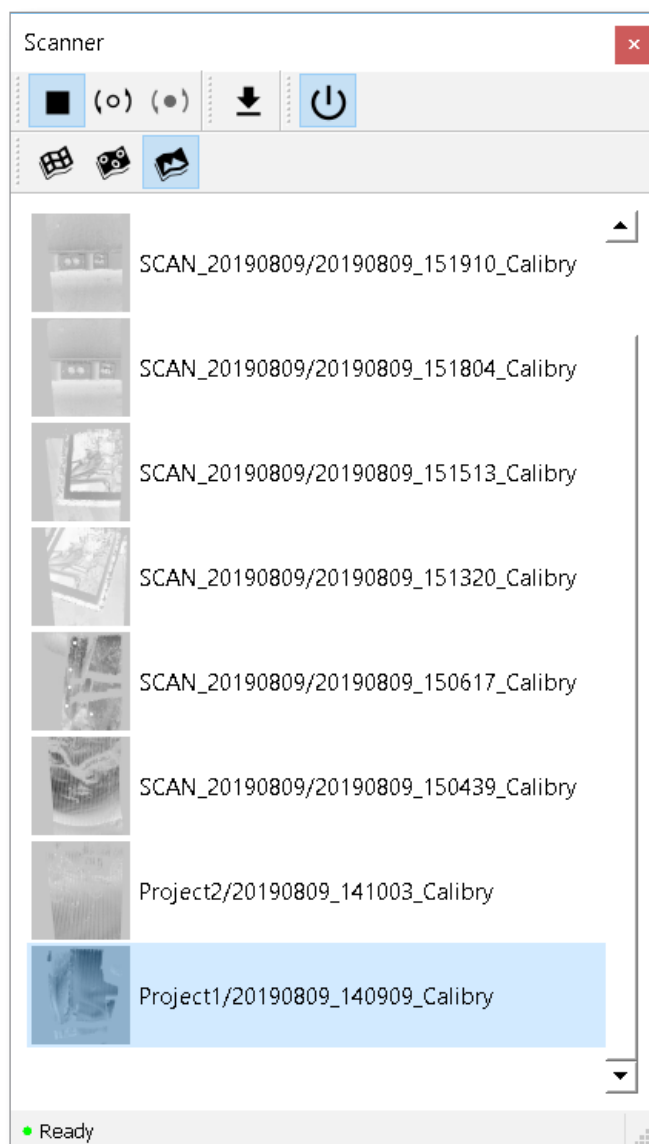
Scanner control buttons are located at the top of the window:

- | | |
|--|---|
| | • Exit from preview/scanning mode; |
| | • Start Preview mode; |
| | • Start Scanning mode; |
| | • Load Calibration file; |
| | • Switch scanner ON/OFF; |
| | • Select Scanning mode
(tracking by geometry/markers/texture). |

The scan list is located under the control button. To begin working with a scan, double-click the respective line, and raw data will be opened for postprocessing. Right-click the scan list to activate the pop-up menu:

- **Open folder** – click to select a folder where scans will be saved;
- **Refresh** – update the scan list.

A status bar is located at the bottom of the Scanner window, where the current status of the scanner connected to computer is displayed.

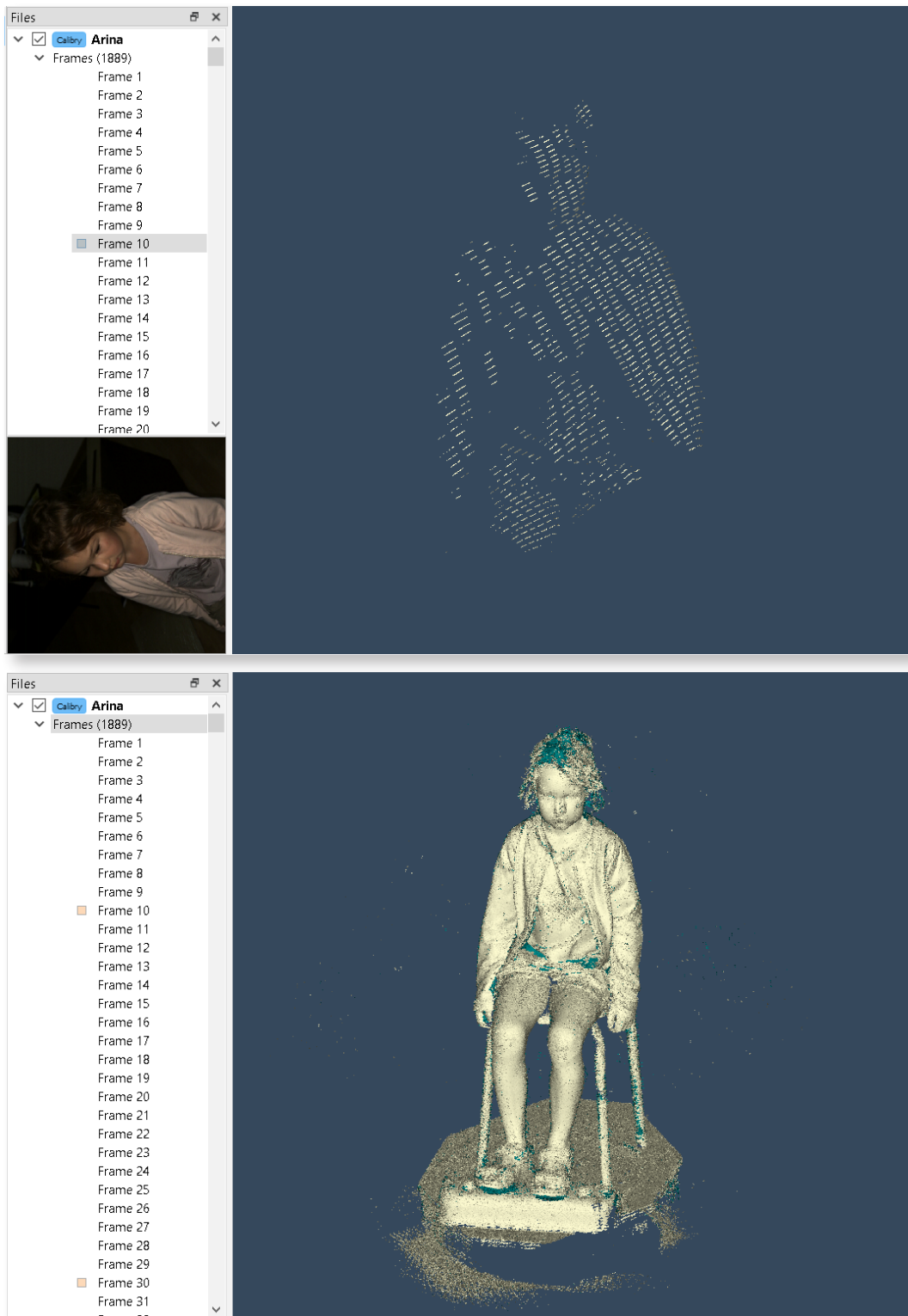


Calibry SW – Postprocessing

Raw Data

Raw data from scanning represents a set of frames captured by the scanner and used for 3D model building.

Most of the frames are geometrical. Each geometric frame contains a certain number of points on the surface of the object being scanned. Raw data may also contain texture frames used for textured model building.



All of the geometric frames create a cloud of points from which the 3D model will be created.

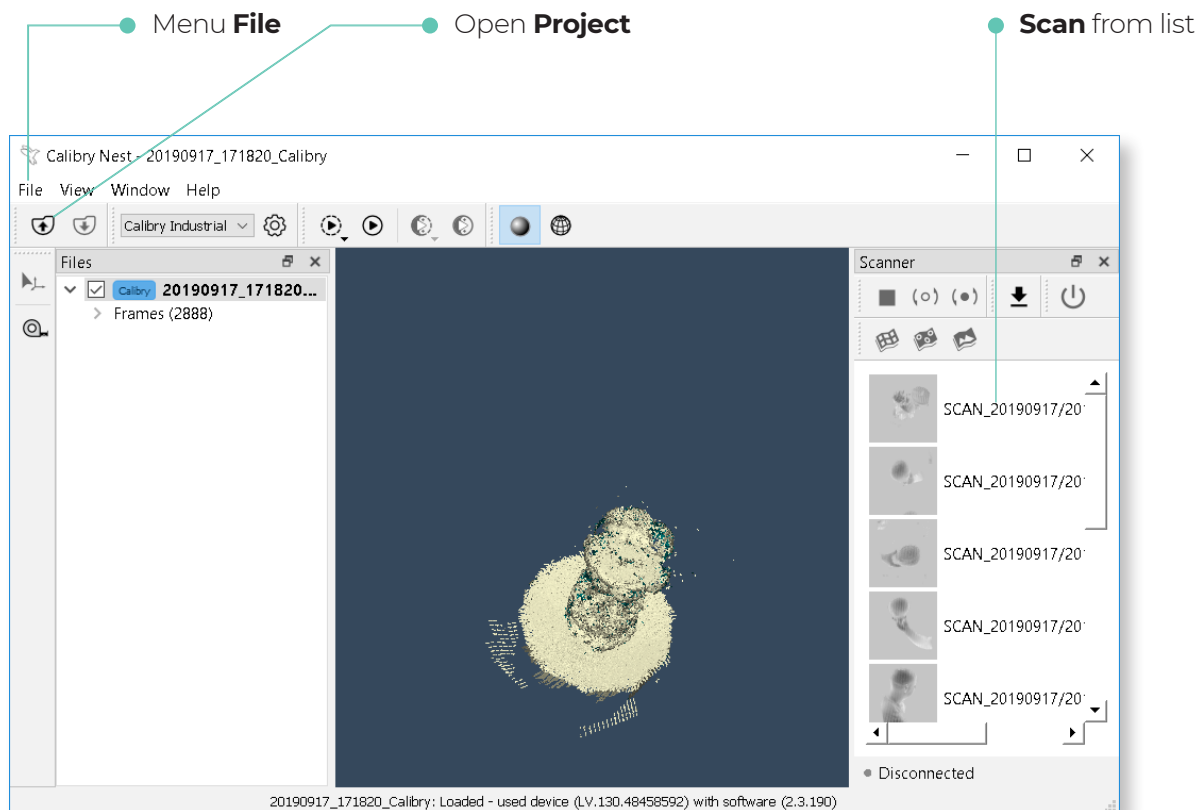
Apart from frames, raw data contain several files with additional information. The data set described above is written into a file with .ascan extension, also called a project file.

Opening a Project File

To begin working with a project you should open it using one of the following methods:

1. Click Open project in the toolbar and select «project file» in the standard dialog box
2. File -> Open menu;
3. Double-click the scan from the list in the Scanner window.

A project tree will be displayed in the Files window.



Data Visualization

A visualization window is used to view scanned data and the results of its processing. When working with data, a user can view:

- A cloud of points formed by one frame. Select the required geometric frame in the project tree;
- A cloud of points formed by several frames. Select the respective geometric frames in the project tree using Shift or Ctrl keys;
- A cloud of points formed by all frames. Click the Frames line located under the heading line of the project with its name;
- Texture frames separately. Select the respective texture frame in the project tree. Texture frames are marked in the project tree by beige boxes;
- 3D models obtained as a result of postprocessing.

! When you click a project heading line with its name, the visualization window displays a cloud of points formed by one in ten frames from the project. To visualize a full cloud of points, click the Frames line located under the heading line.

The 3D model in the visualization window can be moved, rotated and zoomed out/in.

Moving – move the mouse cursor onto the model and hold both buttons simultaneously to relocate the model.

Rotating – move the mouse cursor onto the model and hold the left button to rotate the model.

Zooming in and out – press and hold the right button and move the mouse. Move it to the right or down to enlarge the model, to the left or up to shrink it. Zooming in and out also can be executed using the mouse wheel.

There are two types of 3D model display – as a texture or in the form of a polygon mesh. To make a selection, click one of the buttons in the View panel.



Simple Postprocessing

Simple postprocessing is the name for data postprocessing when only one project file is used for 3D model creation. This means that to obtain the model only one scanning session was launched, i.e., the entire object has been scanned once as a whole.

As a rule, simple postprocessing is used for scanning simple objects. Also, simple postprocessing can be sufficient when an object can be scanned from all directions without changing its position. Scanning a human being is a typical example of this.

In general, simple postprocessing includes three stages:

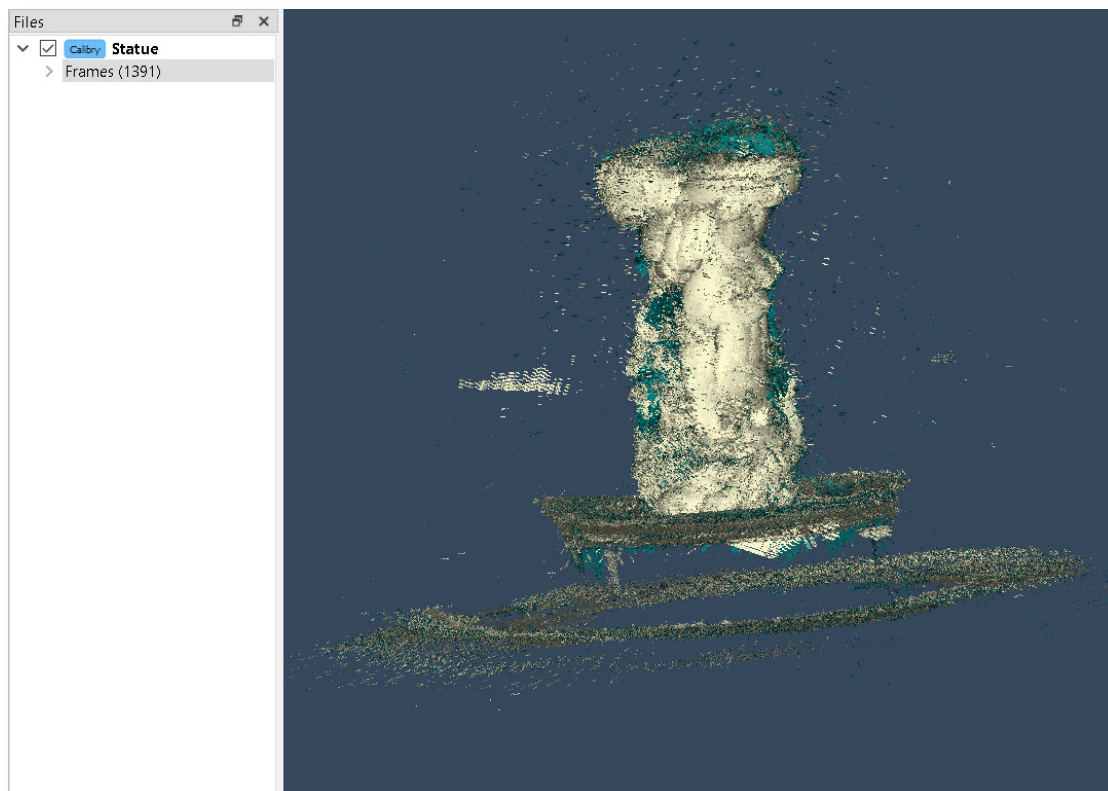
1. Registration;
2. Finalization;
3. Texture mapping.

Let's consider each one of these three stages separately.

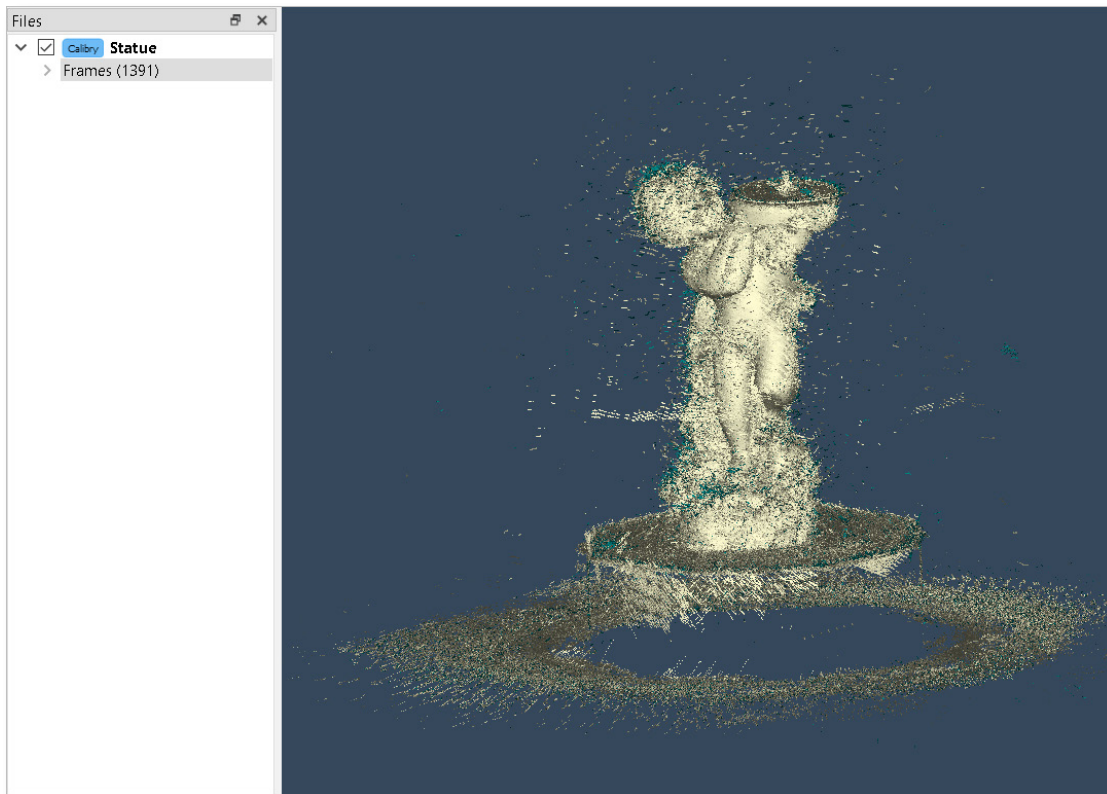
Registration

At the registration stage, raw data is processed by several algorithms which orient geometric frames relative to each other.

As a result, the complete cloud of points proves to be the closest to real surface of the object being scanned.

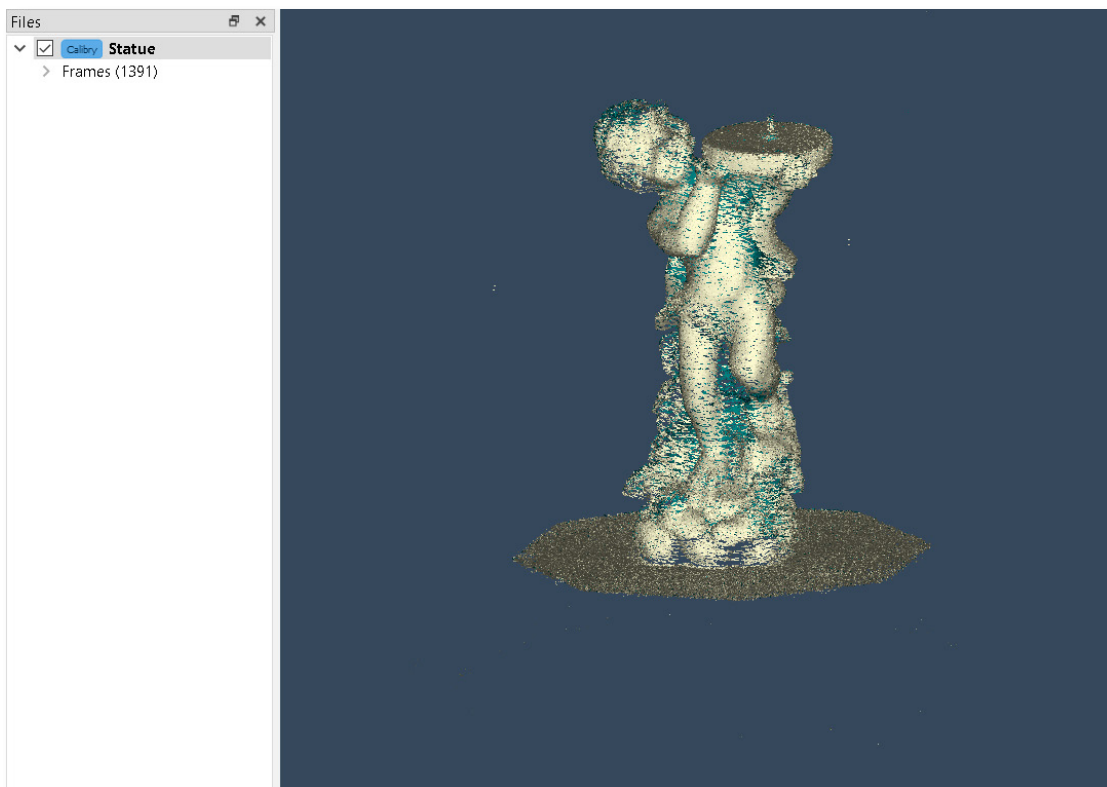


Before registration



After registration

At the registration stage, a preliminary cleaning procedure can be executed by specifying the corresponding setting. This procedure will automatically remove those points from the cloud that will be determined by the algorithm as noise or other data not relevant to the object being scanned.

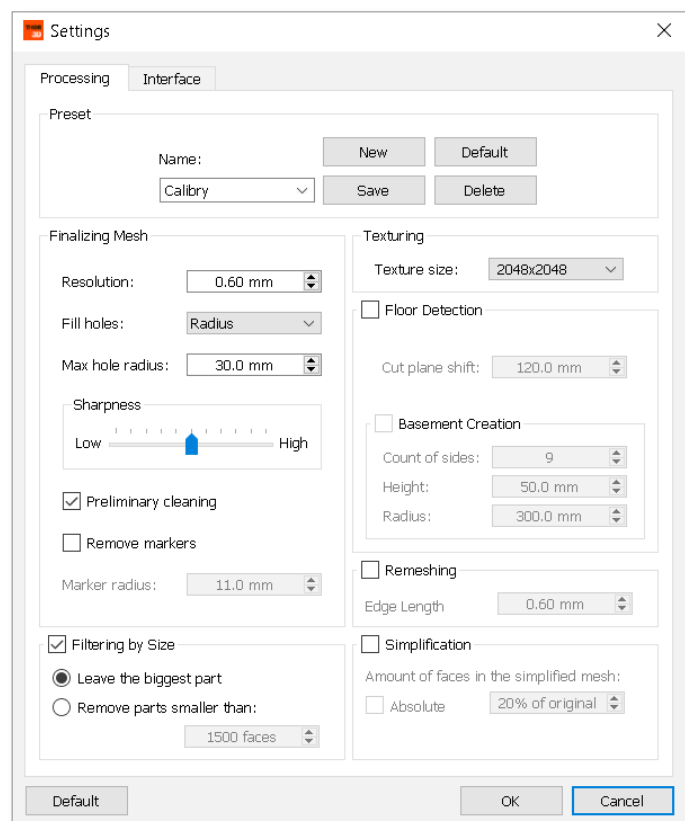


After preliminary cleaning

Finalization

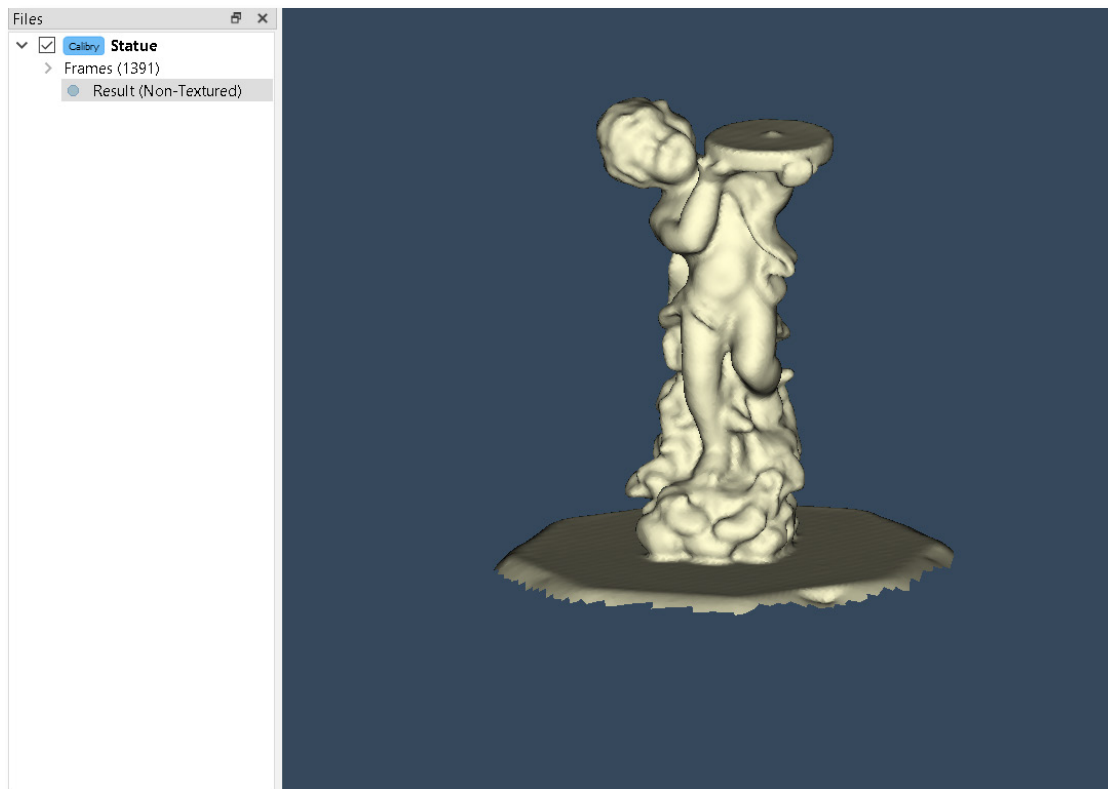
At the finalization stage, the cloud of points is converted into a polygonal model. In this case, it is necessary to specify certain algorithm settings.

In the top of the window you can select an array of preset settings depending on the scanner model and the scanned object. You can also create your own array of the most frequently used settings.

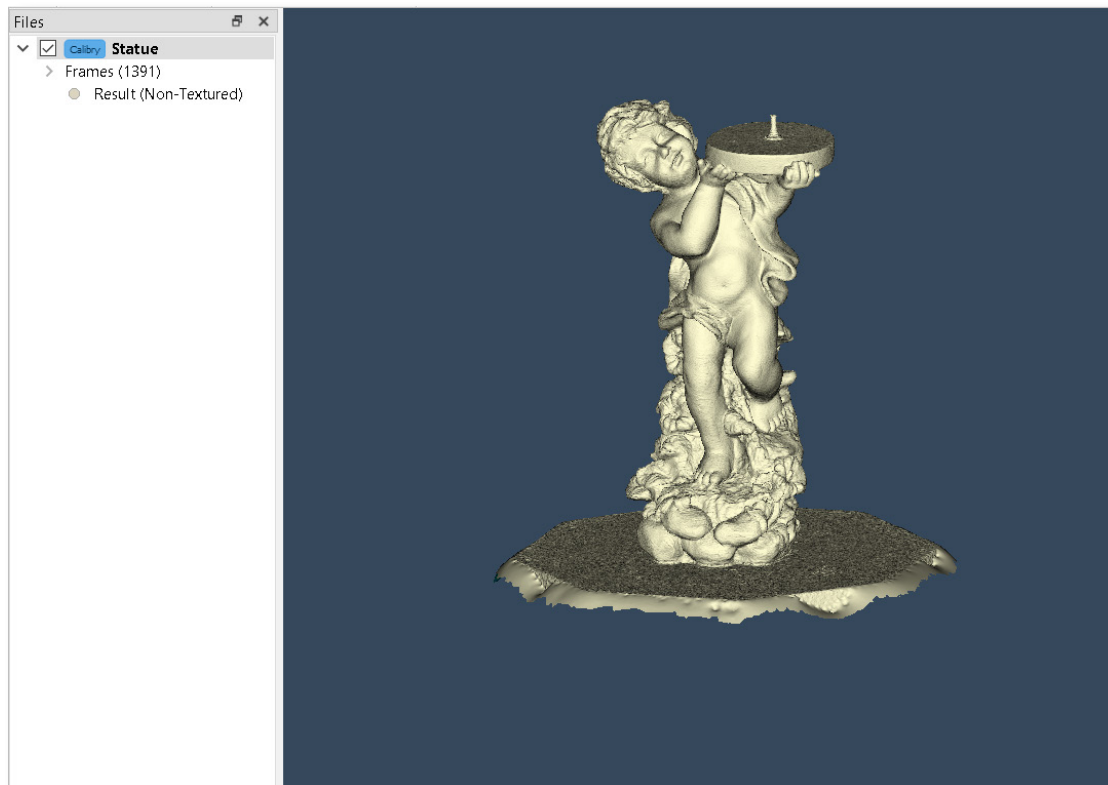


Resolution. This parameter determines the size of the face of elementary polygons (triangles) which will constitute a polygonal model. The smaller the size of an elementary polygon, the more detailed a model is. However, increasing the level of detail results in an increase of algorithm run time.

When Resolution parameter values are equal to or less than 1mm an algorithm requires more raw data which is achieved by increasing the period of object scanning time. If there is not enough raw data, this can lead to paradoxical results. Despite the specified high level of detail and long algorithm run time, the obtained surface will be uneven.



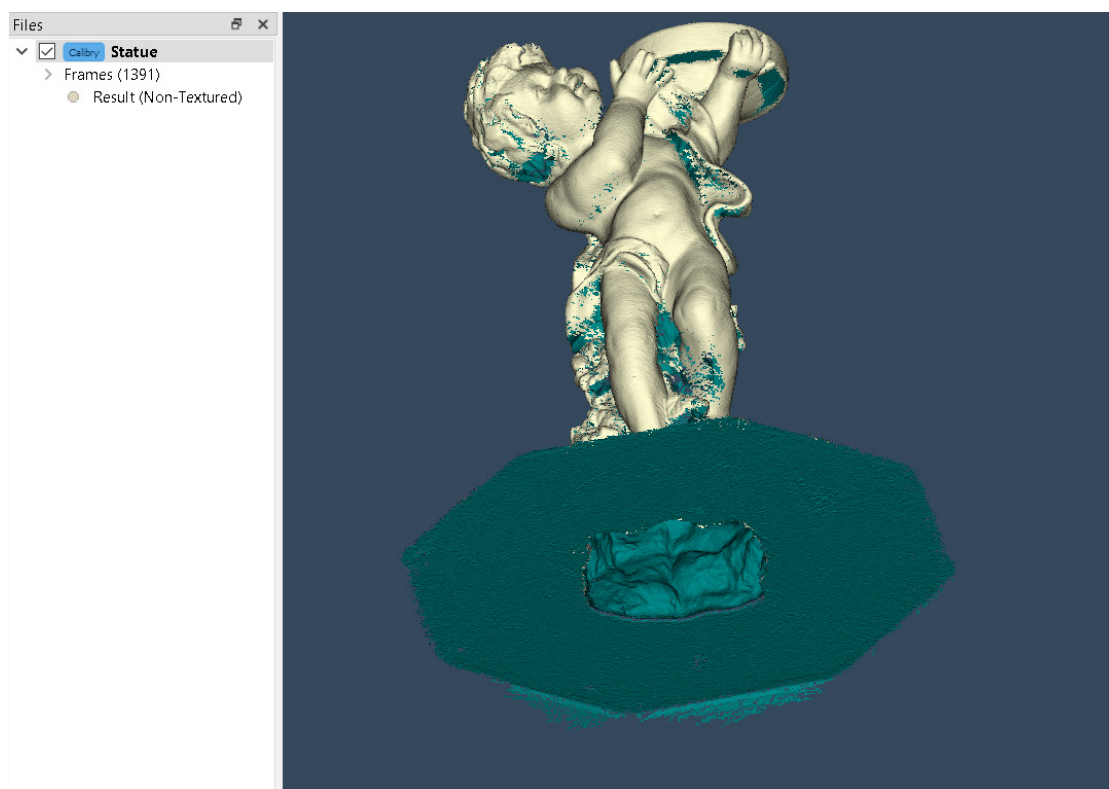
The result of running the algorithm with a **low resolution (4 mm)**



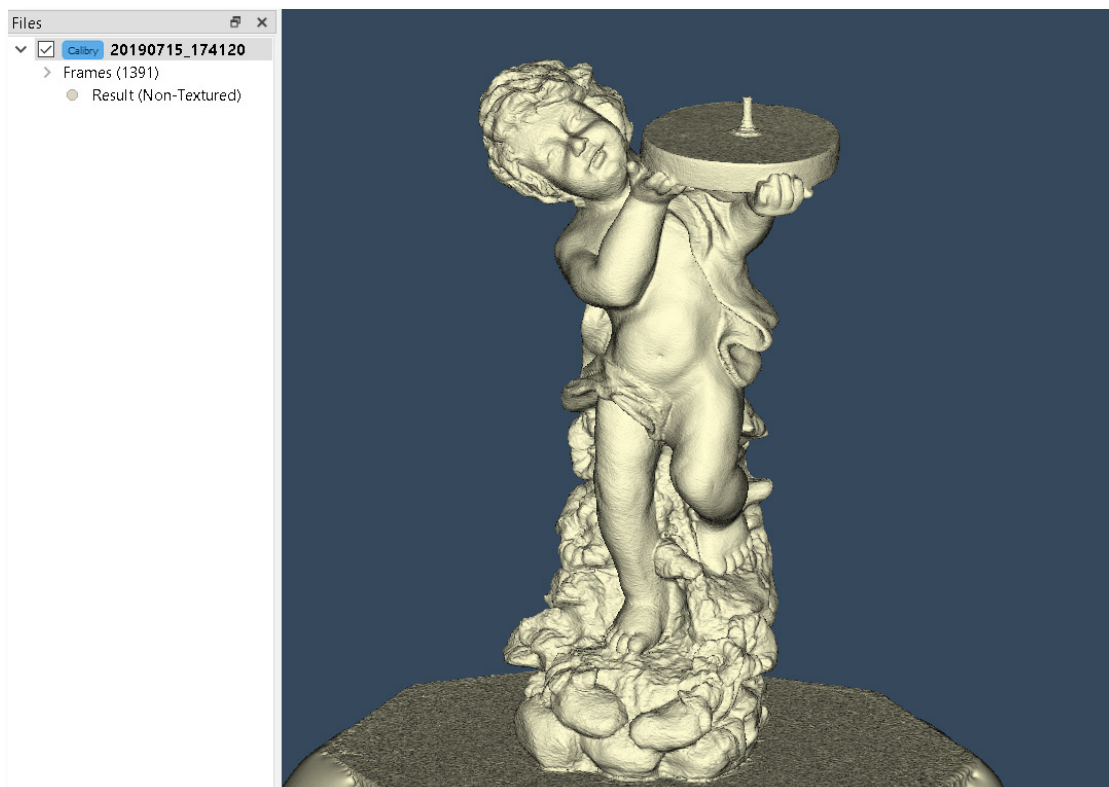
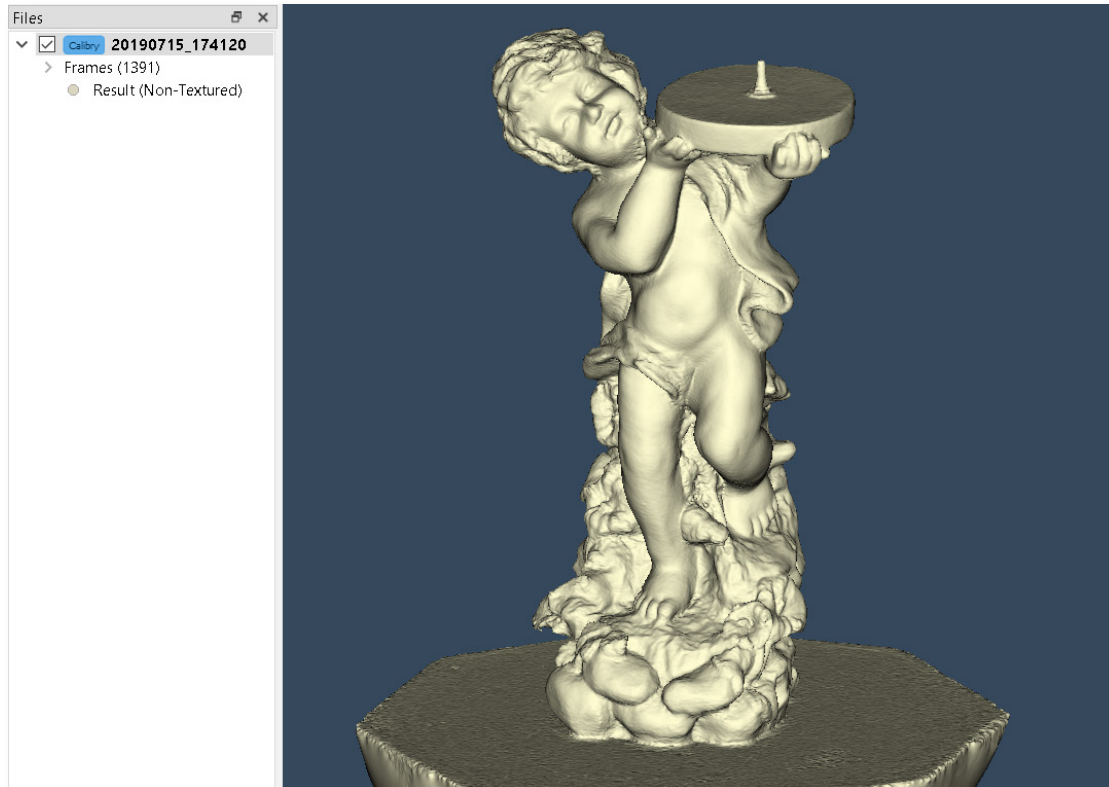
The result of running the algorithm with a **high resolution (0.7 mm)**

Fill holes. On the obtained surface of the 3D model, holes can appear. If the real object being scanned actually has holes on its surface, this is normal. But sometimes the holes are formed as a result of insufficient raw data. In this case the situation can be corrected algorithmically at the finalization stage. All holes can be filled on the 3D model (*Fill holes = all*). Also, only smaller holes can be filled when their radius does not exceed a certain value (*Fill holes = Radius (___mm)*). In this case it is assumed that all larger holes are real voids in the surface of the object being scanned.

In the example below, the *Fill holes = Radius (0.5mm)* parameter is not chosen correctly. On the resulting model there are holes with sizes exceeding 0.5mm. A larger hole radius for filling should be specified.



Sharpness. This parameter determines the appearance of the polygon mesh. At a low level of sharpness, the polygons are merged more smoothly, without sharp angles, while high sharpness makes geometry more detailed and thus the image becomes more clear.



Additional procedures which can be executed at the finalization stage.

Remove markers. Use this procedure only when the scanning was made in marker tracking mode. Put a tick against Remove markers and choose marker radius in order to remove it from object geometry. This parameter can vary depending on the model of your scanner, as well as on marker type: markers can be both magnetic and printed by you on the printer.



Markers are not removed on the texture

	Calibry	DRAKE Maxi	DRAKE Midi	DRAKE Mini
Round	12 mm	12 mm	6.5 mm	3.5 mm
Square	15 mm	15 mm	7.2 mm	4.0 mm

The algorithm automatically identifies all markers on the surface, removes them and fills newly formed holes. If markers are in areas of the surface with nonuniform geometry, the holes may be filled incorrectly. Therefore, when placing markers, it is recommended not to overrun the perimeter of an object, as well as to avoid an area with significantly large geometry.

Filtering by size. The filtering algorithm removes noise and extra objects which could fall into the field of scanner vision in the process of scanning. When the Leave the biggest part option is chosen all smaller objects as compared to the largest one will be removed. When the Remove parts smaller than option is chosen the algorithm will remove objects that are smaller in size than the selected value (in polygons).

Floor detection. The procedure automatically recognizes and cuts the floor surface. Cut height is counted from the floor and is specified according to how the model has been scanned. When the Thor3D rotary table is used the parameter of 150 mm should be set, when scanning is executed without this table the value of 5 mm should be set.



Basement creation. After the floor has been cut, an arbitrary basement for the model can be created. The *Count of sides* parameter specifies the number of faces in a generated basement, and *Height* and *Radius* parameters specify the corresponding height and radius of the basement in millimeters.



Remeshing. The calculated 3D model consists of multiple triangles. In general, the lengths of triangle sides can differ greatly. For some CAD applications, it is much easier to work with models which consist of identical triangles. For this purpose, a remeshing procedure is used. Specify the required length of the triangle side (*Edge Length*) as an additional parameter.



If during the remeshing process the **Edge Length** parameter greatly exceeds the resolution of the 3D model, the level of detail of the new model will decrease. But if the **Edge Length** value is lower than the 3D model resolution then the size of the new model and its processing time will increase.

Simplification. The mesh of the resulting model may not be optimal for some applications because it contains too many polygons. This can make its further processing more difficult. In order to optimize a model with minimum degradation of accuracy the simplification algorithm can be used. The value of *Amount of faces in the simplified mesh* specifies the extent of geometry simplification. (Example, if the initial model has 1,000,000 polygons, then reducing it to 20% of the original will yield a model which consists of 200,000 polygons). By checking the **Absolute** (*Absolute value*) parameter you can specify the number of polygons in the final model. Resulting model detailing will vary depending on the specified number of polygons. The more polygons used, the more detailed the 3D model will be, but at the same time, more time will be required for its processing.

Texture mapping

Calibry scanners are equipped with a color camera which allows you to take images of three-dimensional surfaces with texture. Texturizing is performed by projecting separate captured color frames onto a finished 3D model. The Texture size can be specified manually by choosing one of three provided options: 1024 × 1024, 2048 × 2048 or 4096 × 4096. The larger the size, the more exact and sharp the result will be, and, accordingly, the more time required for 3D model processing.



It is recommended to use simplification prior to texture mapping. Simplification significantly reduces the time of texture mapping.

Simple Postprocessing – Generalized Algorithm

Steps in *italics* are optional.

1. Registration

1.1. *Preliminary cleaning*

2. Finalization (Resolution, Fill holes, Sharpness)

2.1. *Removing markers [Marker size]*

2.2. *Filtration by size [Leave the biggest part / Remove all parts smaller than...]*

2.3. *Floor detection*

2.3.1. *Basement creation*

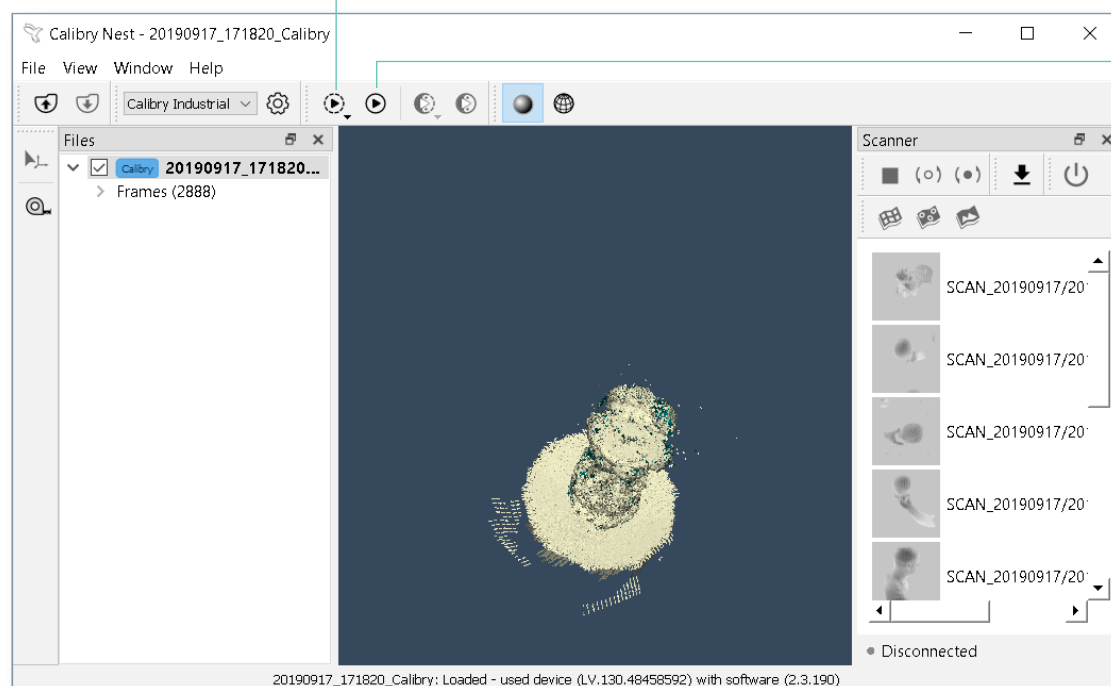
2.4. *Remeshing [Triangle leg size]*

2.5. *Simplification [Percent of initial model / Number of triangles in new model]*

3. Texture mapping [Texture size]

! When any postprocessing procedures are executed, the Calibry SW cannot execute other operations. Scanning, opening and processing other projects, etc. are impossible. Wait for completion of the current post-processing procedure in order to proceed with new operations.

To start simple postprocessing without texturizing press **F5** or click **Start – Non-Textured**. By holding the button pressed for a while, you can separately launch registration and finalization procedures.



To start simple postprocessing with texturizing press **F6** or click **Start – Textured**.

Multiple Postprocessing

To build 3D models of certain objects, it is sometimes necessary to execute several scanning sessions. Most frequently, this is necessary to scan an object from all directions. E.g., scanning an object from above and then turning it over and to scan from below. As a result, it is necessary to assemble the 3D model in several parts.

Multiple postprocessing is data processing where several project files are used to build a 3D model.

In general, multiple postprocessing algorithms are as follows:

1. Simple postprocessing each separate part of an object;
2. Alignment parts of an object;
3. Multiple registration;
4. Multiple finalization;
5. Multiple texturizing.

Alignment parts of an object

Alignment consists of positioning of several parts of an object into a single entity. For this purpose, object parts should have common points. This must be taken into account during scanning. If two parts of one object do not have intersecting areas it is impossible to align these parts.



You cannot align textured parts with non-textured parts. You cannot align object parts scanned with marker tracking with parts scanned without the use of markers.

Points located on both of the aligned parts can be specified manually. There must be a minimum of three points. You can specify more than three points, increasing the probability of high-quality alignment. This is called manual alignment.

If the scan was created using tracking by markers, several scans can be aligned automatically (no need to identify three of the same points on different scans). This is called automatic alignment.



For automatic alignment using markers, all object parts should be scanned in marker tracking mode. When postprocessing each object part, the markers should remain on these parts. Do not cut out the markers at the postprocessing stage of object parts.

Automatic alignment

For simplicity, at first let's consider the procedure of automatic alignment an object of three parts by markers.

In the project window, highlight the 3D models of all components to be aligned and click Alignment by points. The alignment window will appear.

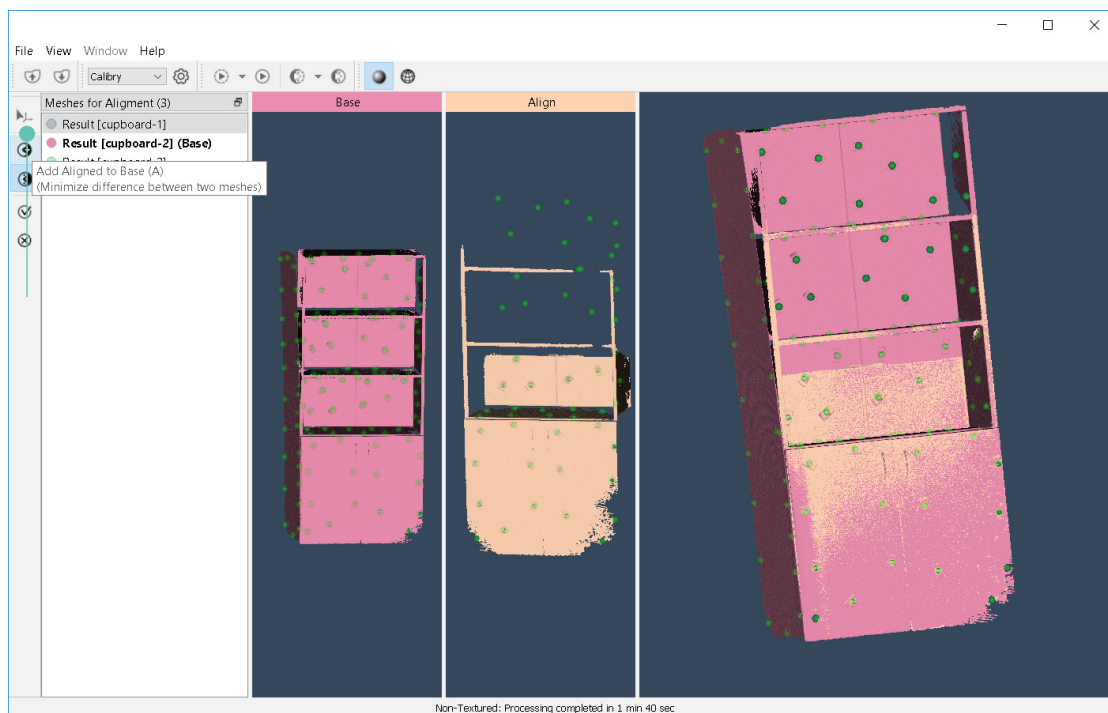
The working alignment window is divided into three parts:

1. Basic window. There is part of the object selected as a base to which all other parts of object will be aligned to;
2. Alignment window. Here the part of the object is displayed that is aligned to the base in current iteration;
3. Result window. Here the result of alignment is displayed.

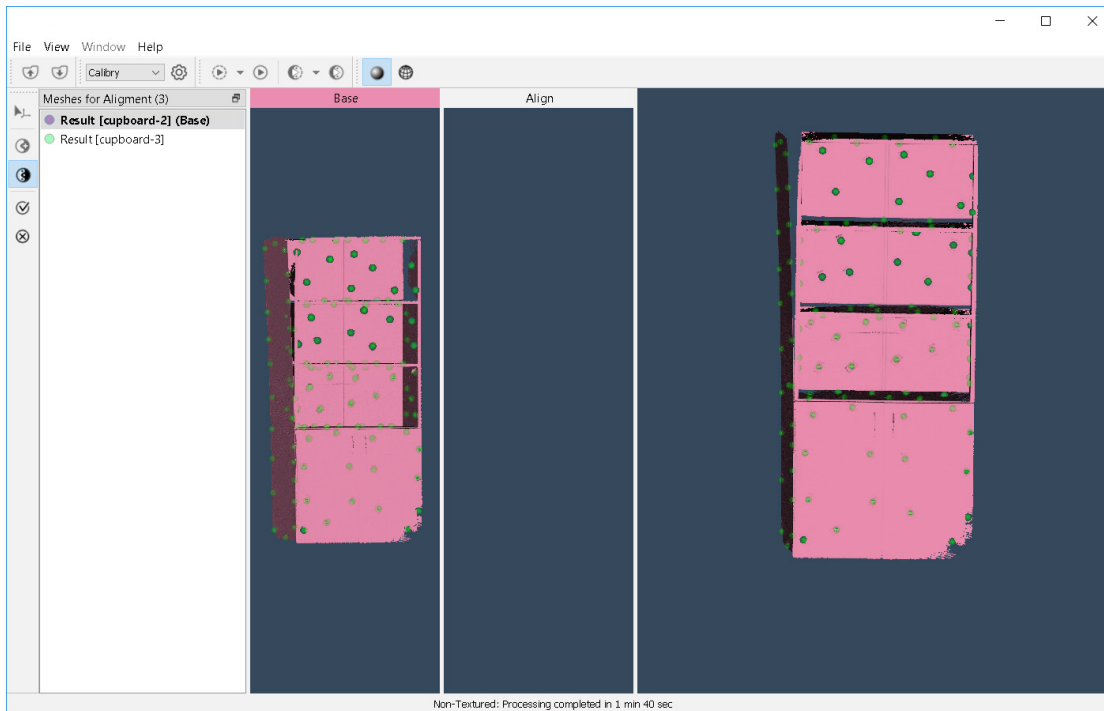
In order to change the scan which will stand for the basic one, right-click it in the scan list window (Meshes for alignment) and select «Set base».

To change the position of the basic window and the alignment window, simply drag-and-drop them using the left mouse button.

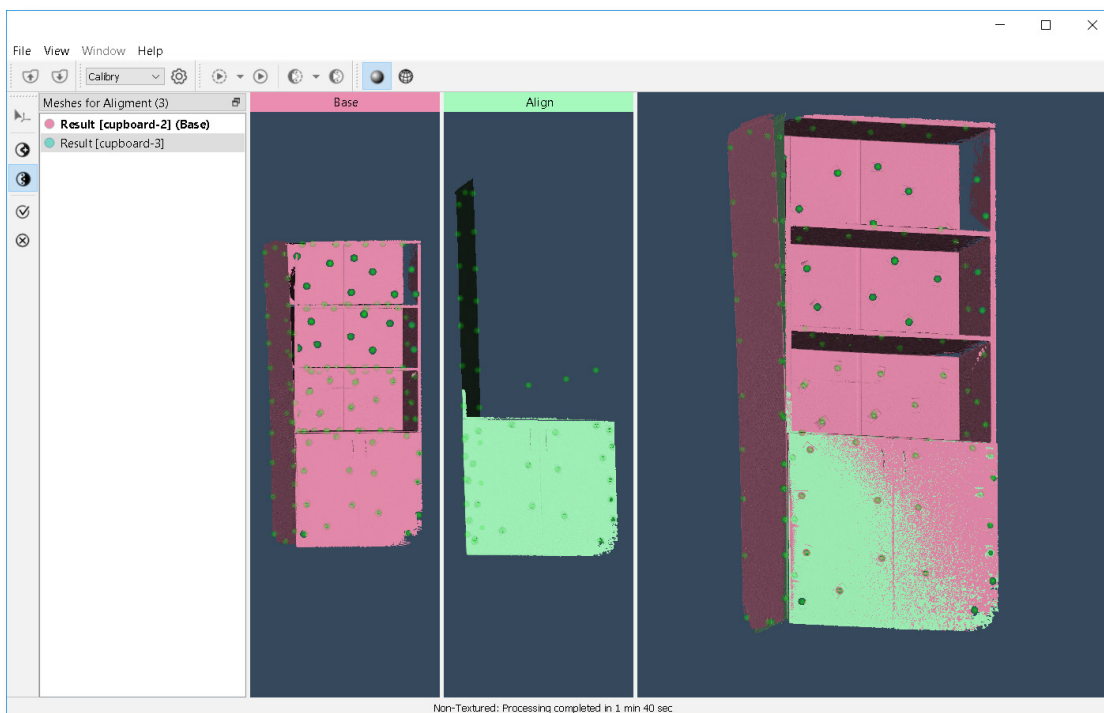
If the model in the result window looks acceptable then click *Add Aligned to Base*.



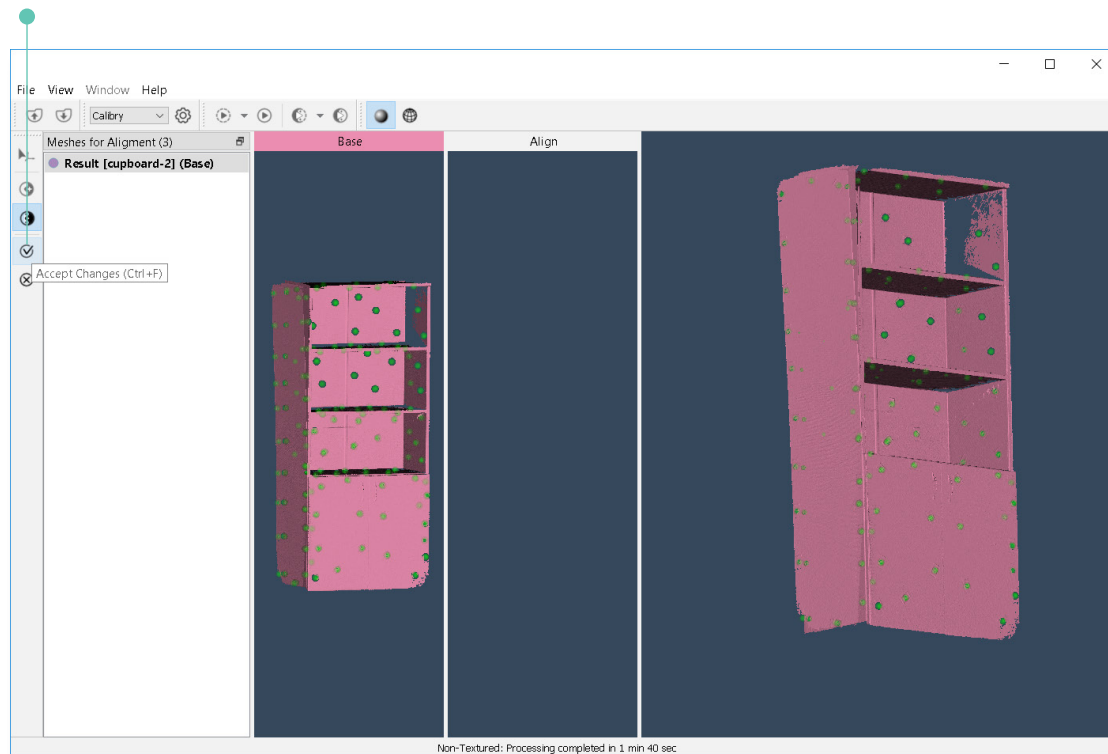
Eventually, the resulting model consisting of parts #1 and #2 will be displayed in the basic window, just like in the result window.



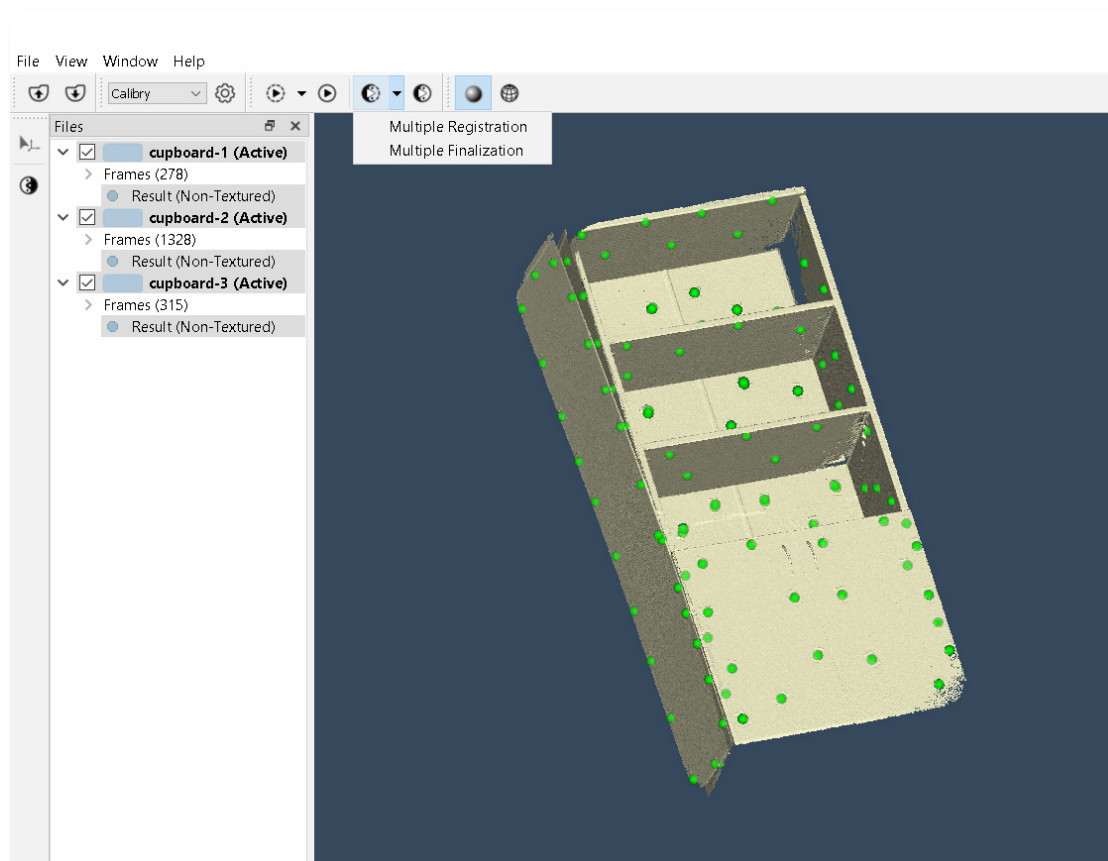
We need to «stick» the remaining third part to this model. To do this, left-click it in the scan list window (*Meshes for alignment*). The third part of the object will appear in the alignment window and will be ready to be aligned with the base.



Click *Add Aligned to Base* once more. The other parts of the object can be added to the base model in a similar way until all of them «stick» to the base. When all parts are aligned together click *Accept Changes*.



The complete point cloud of an aligned model will be displayed on the screen.



Everything is ready for starting up multiple registration and multiple finalization procedures. The intent of these procedures, as well as settings applied are similar to the relevant procedures for simple postprocessing. The difference is only in that for their execution the data obtained in several scanning sessions is used together. The multiple postprocessing procedures starting panel is similar to the same panel for starting procedures of simple postprocessing and is located to the right of it.

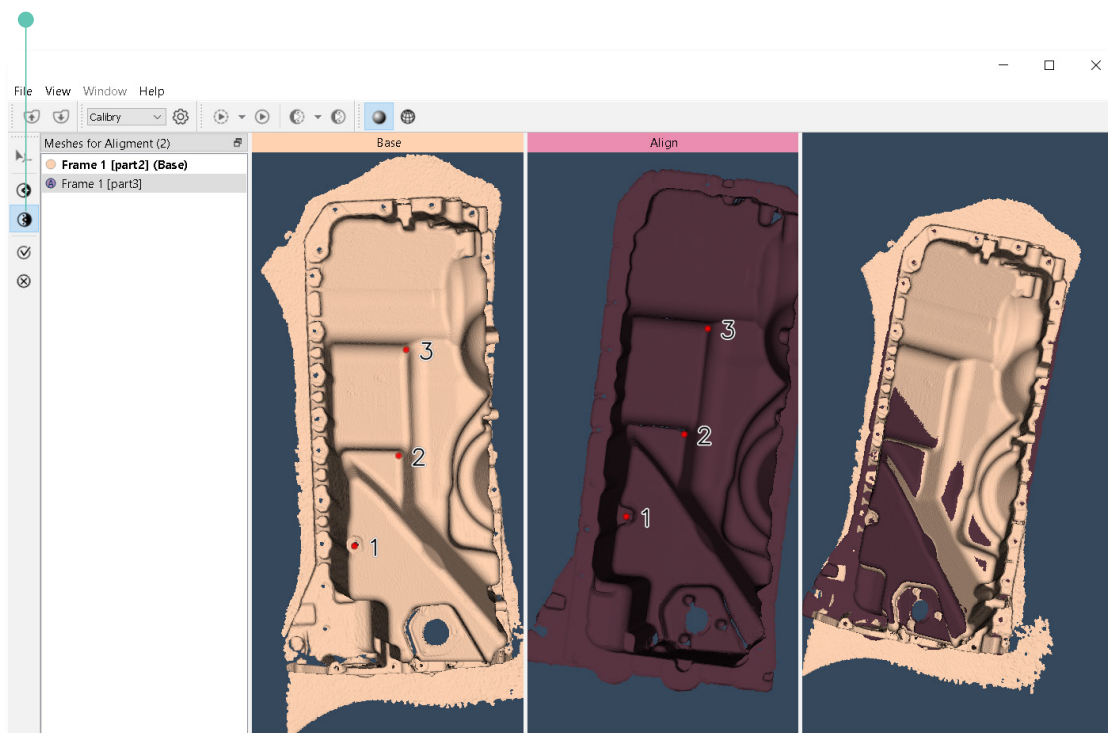


Prior to starting multiple postprocessing procedure be sure to select the projects from which final 3D model is assembled. Data from projects not marked by tick will not be used in multiple postprocessing procedures.

Manual alignment

If object parts were scanned in tracking by geometry and/or by texture mode, then you must specify the common points which are present on parts to be aligned.

Make 3d models of the parts being aligned and click *Alignment by points*.



Select the common points on the base and align scans.



It is recommended to choose common points in areas which are easily identifiable by specific geometric or textural features. This will allow the algorithm to minimize the difference in location of the same point on the base and the model to be stuck.

To place an alignment point, double-left-click it first on the base and then on the second model. Specify a minimum of three alignment points.

Double-click a point to remove it. Press and hold CTRL key and move a point to relocate it.

If you like the result which you see in the result window, click *Alignment by points*.

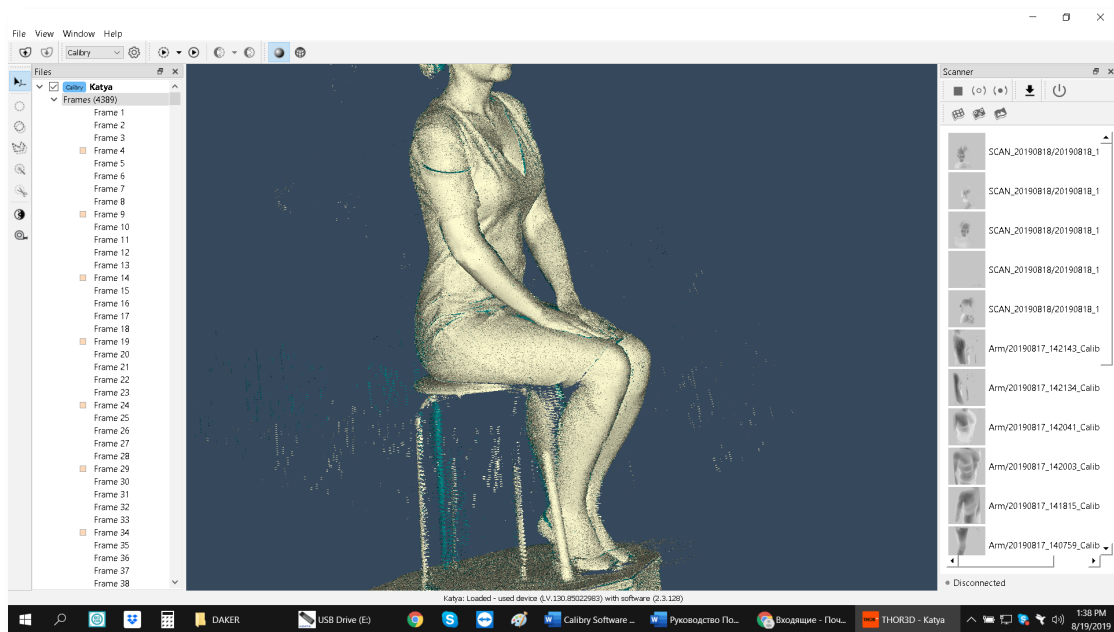
Further actions are similar to 3D model assembling in automatic alignment mode.

Additional Processing Tools

Raw Data Processing

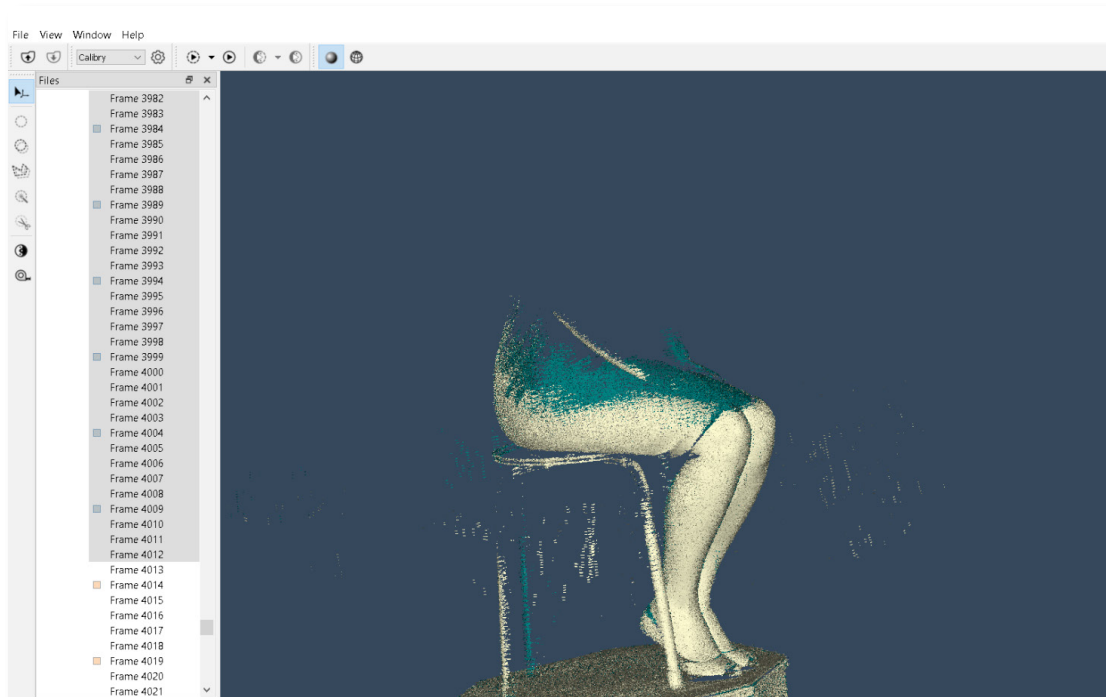
Raw data is presented in the program as a list of textural and geometric frames. When selecting one or more frames, you can see the respective raw data which can be edited using tools on the left panel or deleted. These tools are available to correct issues that might have occurred during scanning. For example, when scanning a human being, even a small difference in facial expression can lead to a blurred texture or geometry divergence. In this case, bad frames can be deleted or the face area can be cut out from them.

In the example below geometry divergence can be observed; the scanned model shows splitting of the surface of the leg.

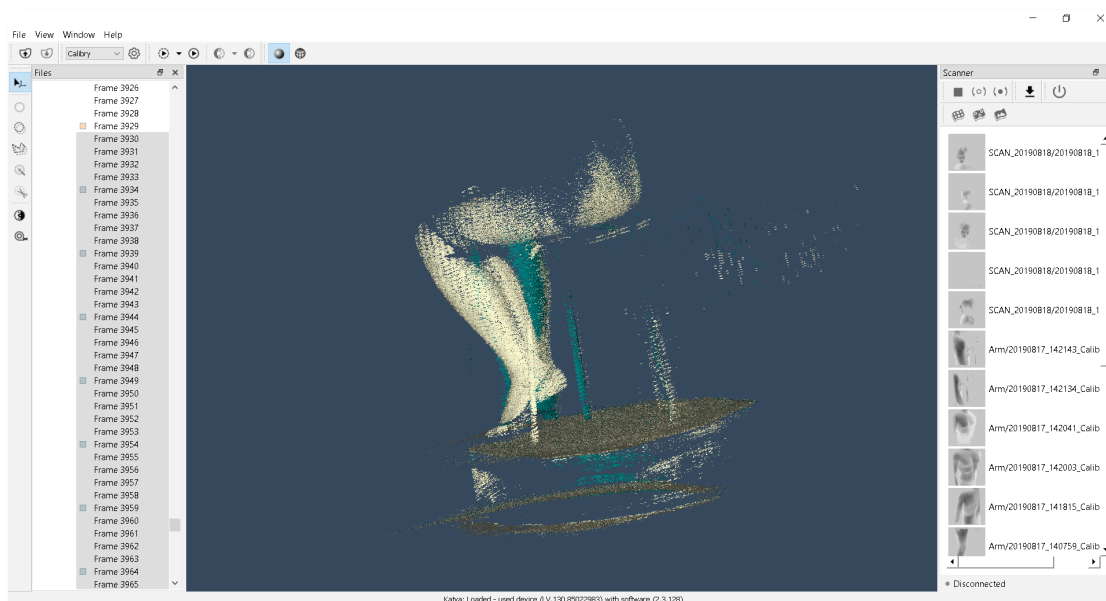


To search for bad frames, use data visualization. Click the frame in the tree, press Shift, then press the up or down arrows to highlight new frames. Frames can also be highlighted by rotating the mouse wheel. In the visualization window, you will see a cloud of points to which subsequent frames will be added each time. Thereby, once bad frames have been highlighted this can be seen.

In the context of our example, let's begin to highlight frames starting from the very first. Having added more than 4000 frames to selection we see that divergencies in leg geometry are still not present.



Now let's begin to review frames from bottom to top starting from the last. From a certain moment (approximately from Frame #4050) the leg starts to split.



Therefore, we can conclude that in frames ##0–4050 the leg surface is mapped correctly. After this, the leg has probably moved. Therefore, in frames ##4051–4455 the leg surface begins to recover differently, and its splitting appears.

The situation described above can be corrected in several ways.

Deleting Bad Frames

In the context of the relevant example, it can be noted that the 3D model is obtained even without the last group of frames which cause the splitting of the leg. Therefore, all the frames starting from #4051 onward can simply be deleted.

Highlight bad frames, right-click them and choose *Delete* in the drop-down menu.

Project Fragmentation

In the example under our consideration, there are not many bad frames. We have 4050 frames left for further postprocessing and have deleted at worse around 400 frames.

However, in some cases divergencies in geometry can be fixed as early as in the middle of a scanning session. For instance, some part of the model surface in frames ##0–1000 has one spatial orientation, and in frames ##1001–2000 – other orientation. When half of project frames are deleted there will be insufficient raw data. In this case, you can try to divide the project into several parts (perform fragmentation). Right-click the required frame and choose *Divide project* in the drop-down menu. Then try to assemble the 3D model with parts from several projects.



In the context of relevant example, it is possible to try to divide the project into two parts: ##0–4050 and ##4051–4455. If splitting of the leg surface was caused not by its movement but by inaccuracies in algorithm work then, with a high likelihood ratio, the final 3D model will be correctly built of two parts. If leg movement during scanning nonetheless took place, then there is no need to divide the project into two parts as, with a high likelihood ratio, the leg shape in frames ##0–4050 and ##4051–4455 will differ.

Editing Frames

When one or more geometric frames are highlighted in the project tree the tool bar appears on the right.

Highlighting brush. Move the marker over the cloud of points formed by frames. The points affected by the tool are colored red. You can change marker size by rotating the mouse wheel.

Polygonal lasso. The same as Highlighting brush, this is a selection tool. Only the area of selection differs – it is determined by polygons where the shape and size are chosen by the user.

Delete selected. When this button is pressed, all highlighted in frames and red points will be deleted.



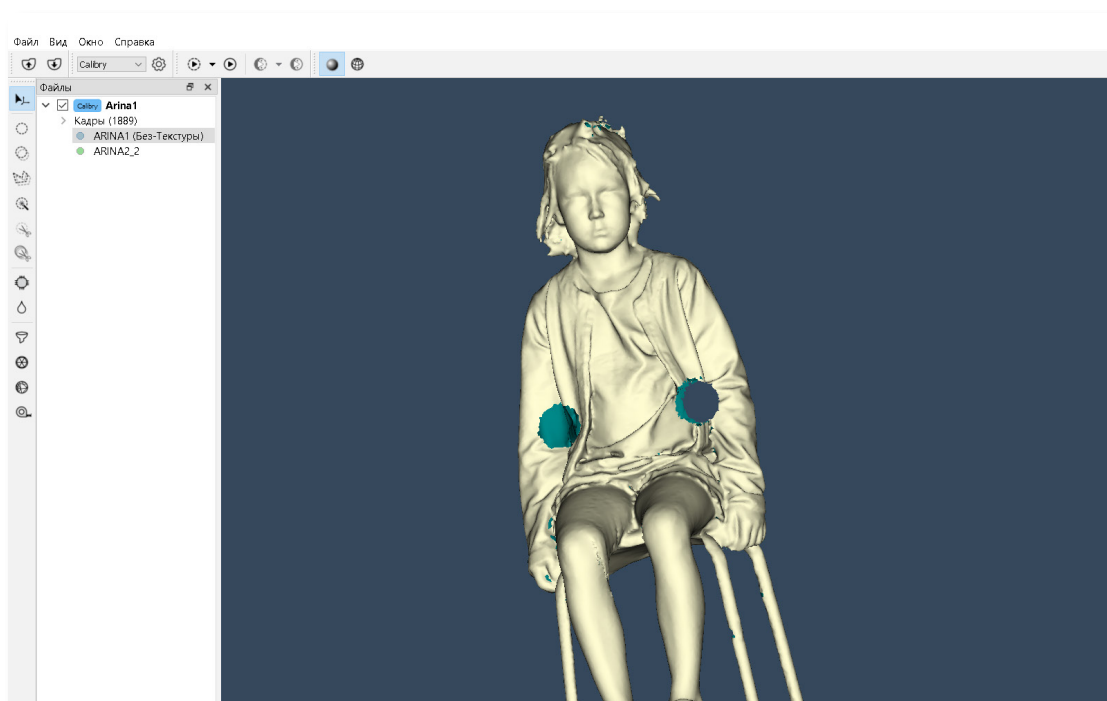
In the context of the relevant example, you can try not to delete frames ##4051–4455 as bad frames, but simply “erase” the leg image on them by deleting the corresponding points from the cloud.

3D Model Processing

Left-click the 3D model resulting from postprocessing. To the right of the projects, the toolbar will be displayed.

Marquee Brush. Move the cursor over the model surface. The surface areas affected by the tool are colored red. By rotating the mouse wheel, you can change cursor size.

Marquee Double Side Brush. The tool differs from Marquee Brush by its cross-section action. Thus, the tool acts not only on the surface over which the cursor was moved, but on all surfaces under it.



In the above example, for the left hole the surface area has been selected by the conventional Marquee Brush, therefore the hole was formed in that part of surface which was touched by the tool. For the right hole, the surface area has been selected by the Marquee Double Side Brush, therefore a through hole was obtained.

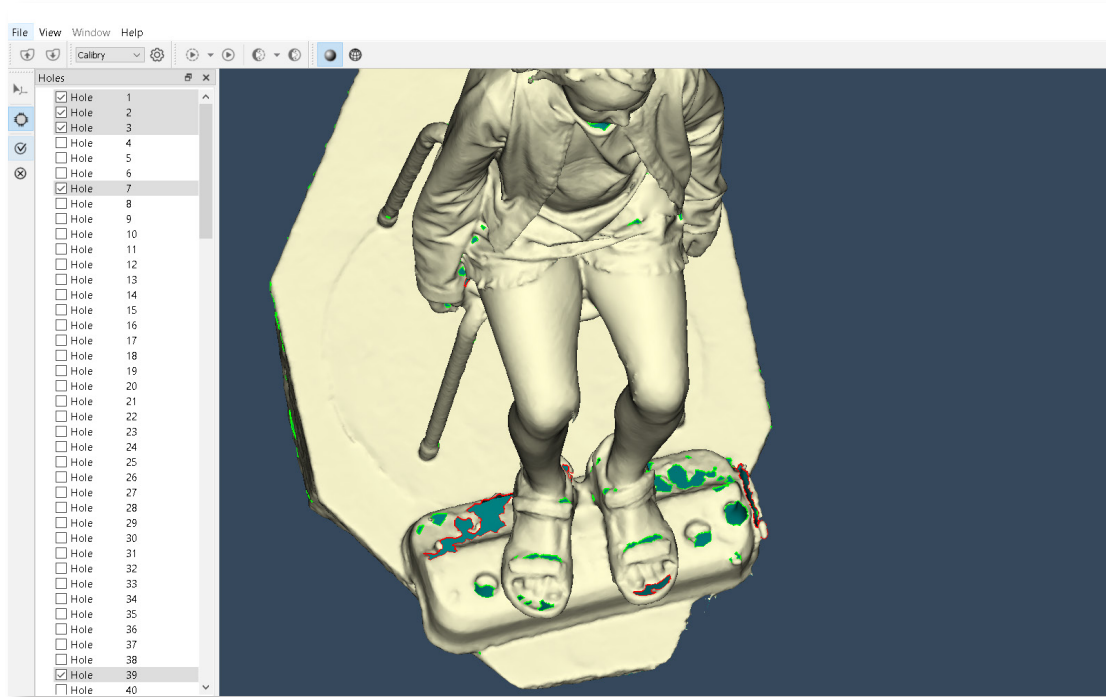
Polygonal lasso. The same as the Marquee Double Side Brush, this is a selection tool for cross-section action. Only the area of selection differs – it is determined by polygons whose shape and size are chosen by the user.

Magic Wand. The tool for selecting the entire surface. This tool is convenient for cases when the 3D model consists of several mutually separate surfaces.

Cut (Del). When the button is pressed all selected areas of the model surface are deleted.

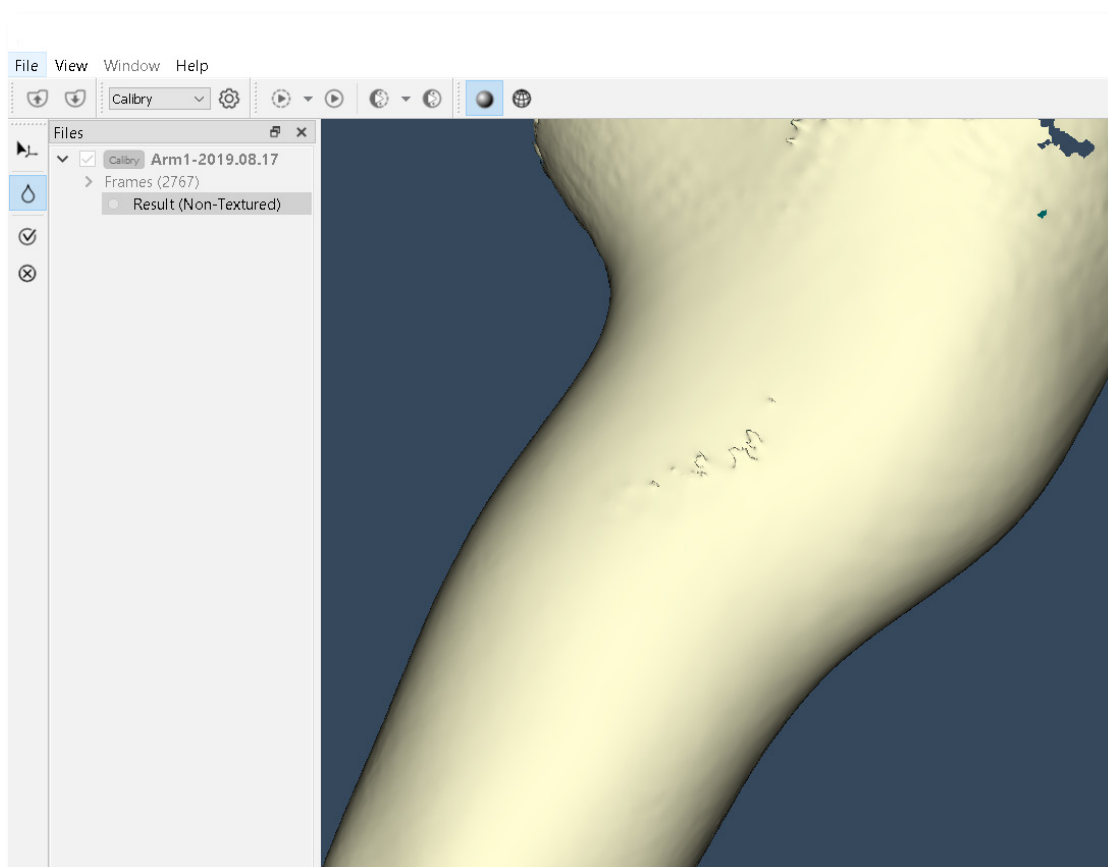
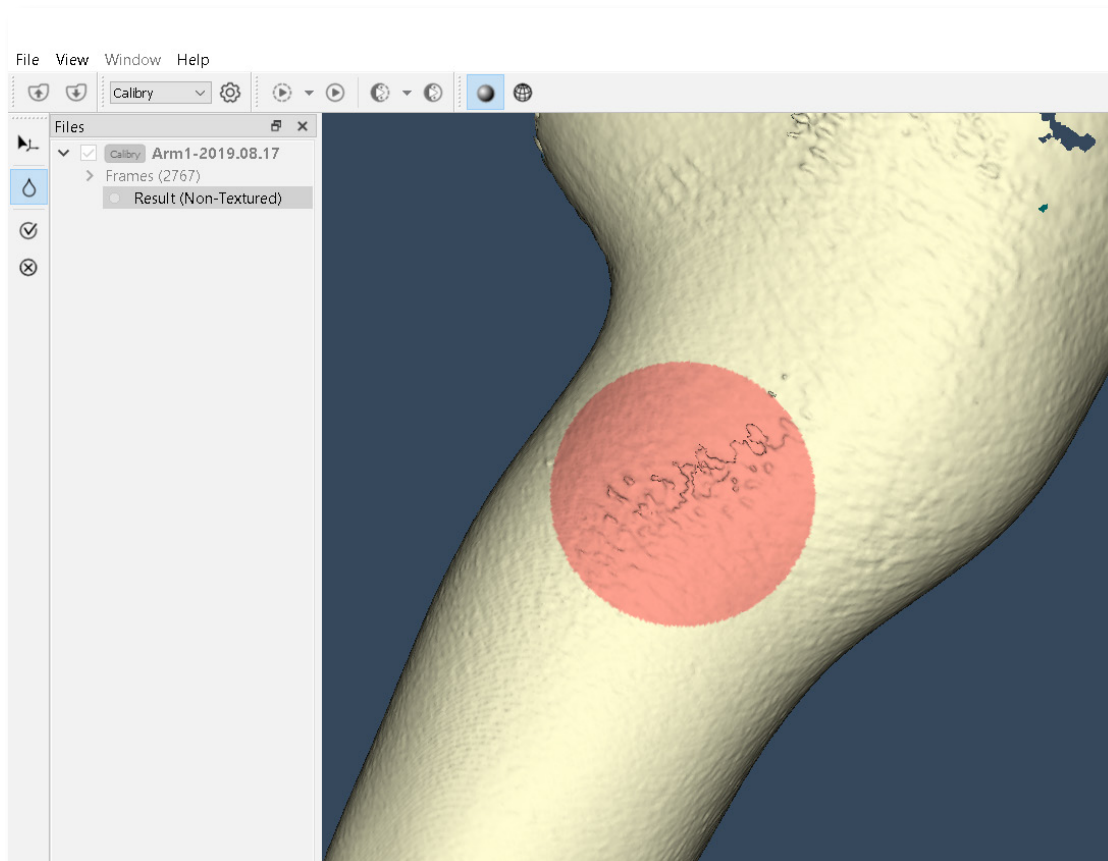
Cut on Frames. When the button is pressed all selected areas of model surface are deleted not only from the model itself but also from corresponding frames.

Fill selected holes. When the button is pressed the list of all holes detected by the algorithm on the 3D model surface is displayed in the project tree. In the visualization window, holes on the model will be highlighted by a green color. When corresponding holes are selected in the list its highlighting changes from green to red.

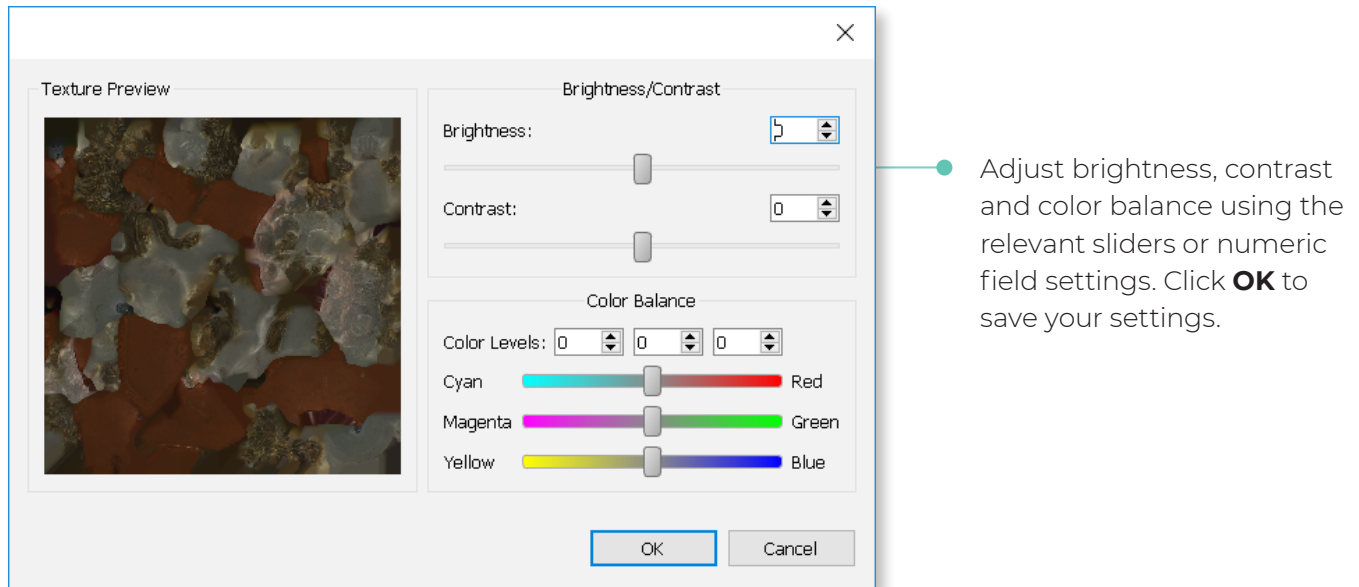


Click *Accept changes* for the algorithm to fill the selected holes.

Smooth. Move the cursor with the left mouse button held over the model surface to smooth it.



Texture correction. When this tool is selected this window appears:



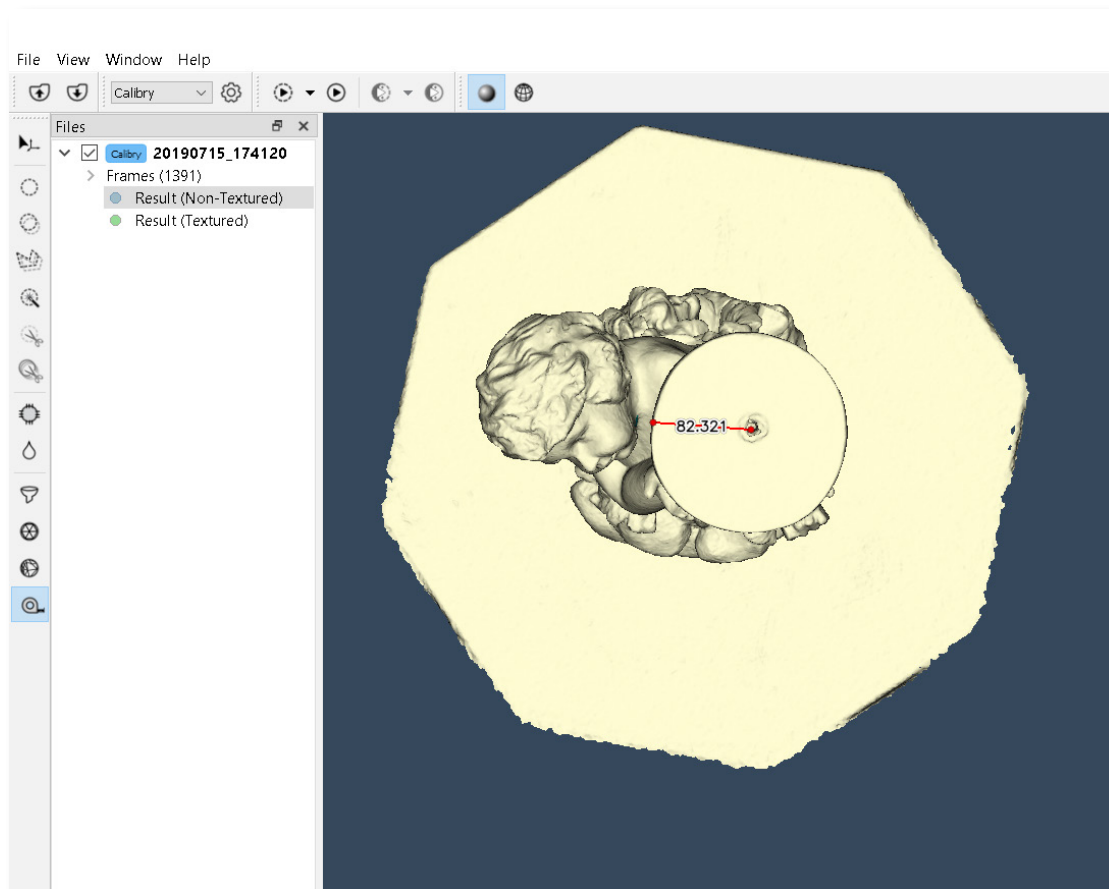
Luminosity brush. This is a tool for textured model processing. Move the cursor over the model surface to increase texture brightness. To decrease brightness (e.g., to delete glare from flash) move the cursor while holding down the Ctrl key. Right-click to adjust brush strength and hardness.

The finished model can be saved in the required format separate from a project.

Other Calibry SW Capabilities

Ruler

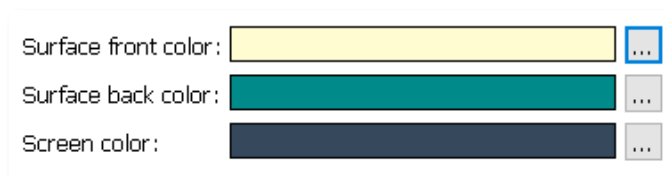
Enables you to measure the distance in millimeters between two selected points in frames or on a model.



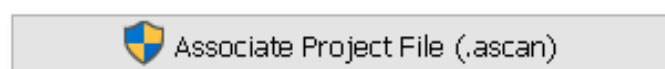
Interface

The interface tab enables editing of user interface settings and includes the following settings:

- *Surface front color* – color of polygonal model surface;
- *Surface back color* – color of polygonal model inner surface;
- *Screen color* – program background color.



Associate Project File – bind an .ascan extension to the program.





DRAKE

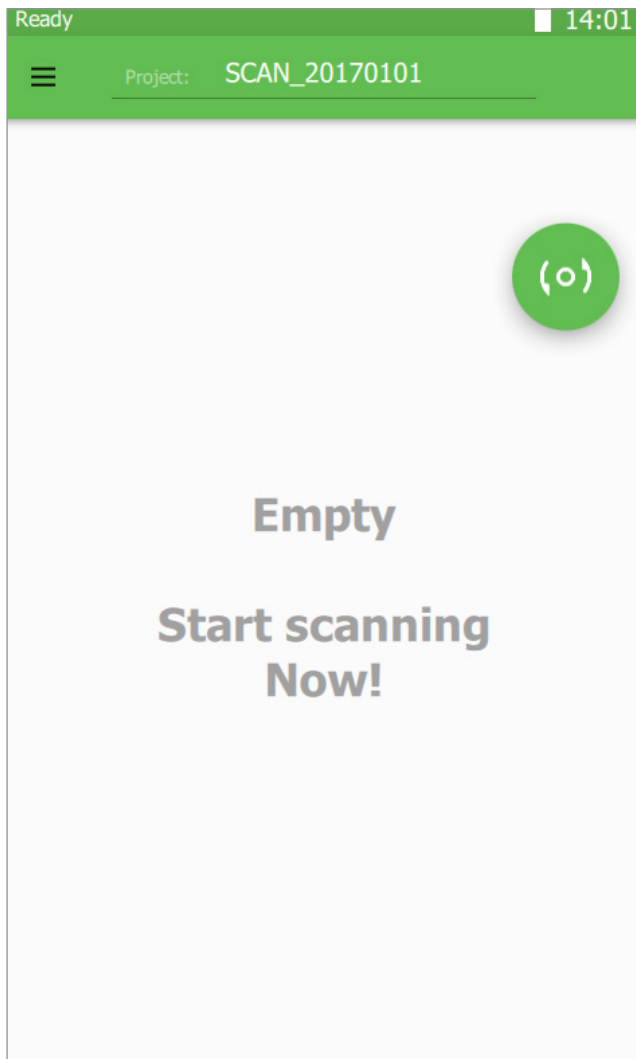
User manual

Scanner operation

To begin

To turn the scanner on, press the power button which is located under the screen. Wait until the scanner loads and the main window appears on the screen. The main window will contain:

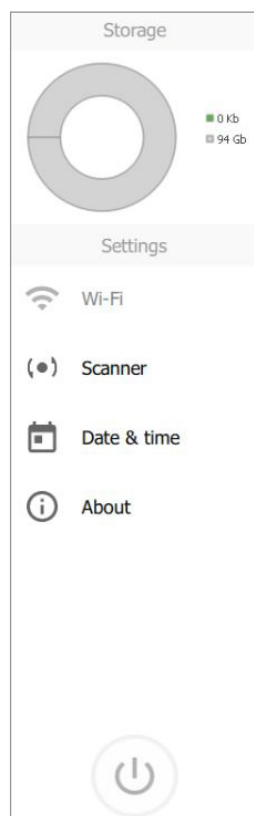
- Status Bar
- Control Panel
- Side Panel
- List of scans (if any)
- Main Thumb Control Buttons



Status Bar

The status bar will display the current status of the scanner, battery life, time of day, as well as the strength of the Wi-Fi signal whenever a Wi-Fi USB adapter is plugged in.

Scanner operation



Control Panel

Here, you can change the name of your scan by pressing the heading in the center. All objects scanned will be placed in the folder with that name. If the folder is not named, by default it will be named like "SCAN_ 20170101" (Year, month and date).



On the left, you will find the button, which when pressed will open the side panel.

Side Panel

This side panel contains information on the memory available on the internal hard-drive of the scanner, as well as available memory on the USB drive which is currently plugged in.

Below that, you will find the following menu items:

- Wi-Fi – allows you to connect to your local Wi-Fi network. It is available only when a USB Wi-Fi adaptor is connected to the scanner.
- About – contains information about the scanner: model, serial number, version of software, version of firmware, calibration number and calibration version.

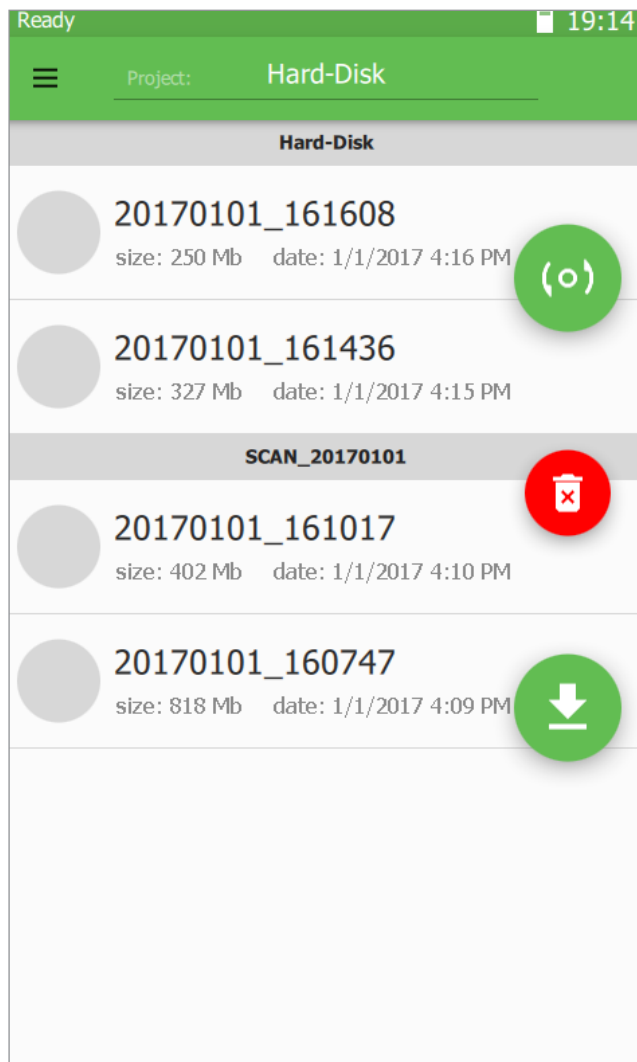
On the bottom of the panel, there is a "safe" off button. To properly turn the scanner off, press and hold this button for two seconds.



For a hard-reboot, you may also press and hold the power button for two seconds. This button is located on the scanner itself, under the screen.

Scanner operation

List of Scans



List of scans

The center of the screen is devoted to the list of scans. These scans are sorted by date (the newest on top) and are located in the appropriate folder. There is an icon next to each scan, which represents the first frame captured. You can switch between folders (a.k.a. projects) at any time by selecting the appropriate section on the screen or by creating a new project by naming it on the control panel above. You can use any USB drive (Flash, HDD) to save your projects, preferably, however, they should be formatted for the NTFS file system.

Once a USB drive is properly connected, you will see a new button on the screen which will allow you to transfer the data from the internal hard-drive of the scanner:



** To check whether you have enough space on your USB drive, as well as properly eject the USB drive, go to the side panel.*

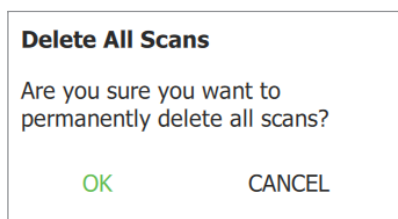
Scanner operation

After pressing this button, your files will begin to copy, with the exception of those that are already on the USB drive.

To delete any unnecessary scan from the hard-drive, simply swipe your finger across the scan.



You can cancel any deletion within 5 seconds by pressing **Cancel**. To delete all scans from the hard-drive, use the button:



Press **OK** to confirm deletion of data.

Main Thumb-Control Buttons

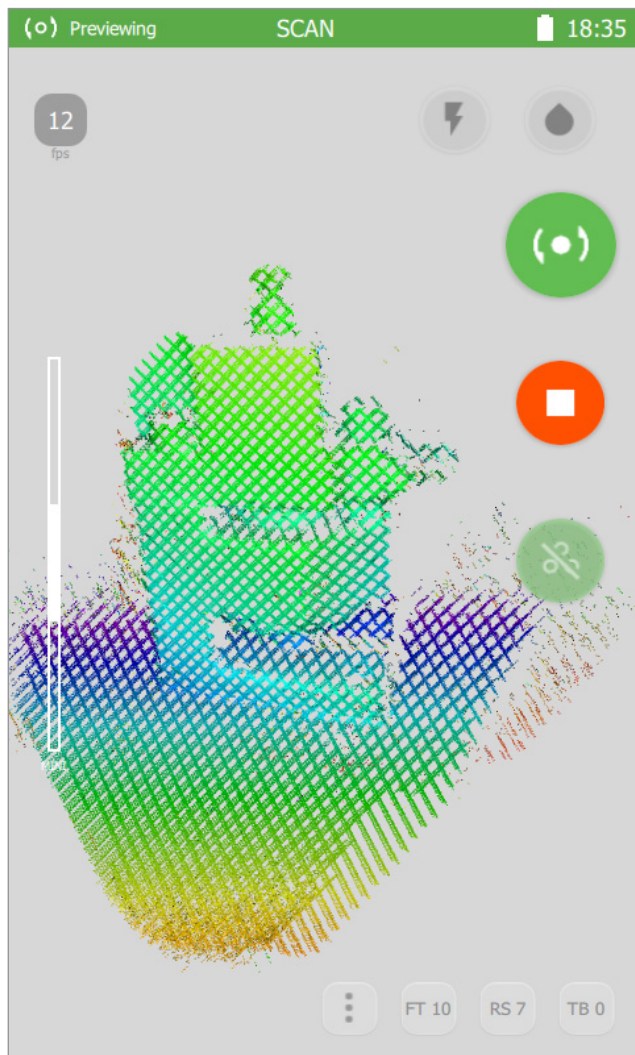
The scanner is controlled via touch-screen. Use your right hand thumb, while the rest of the hand supports the scanner. The main buttons are conveniently located on the right side of the screen and can perform the following actions:

- Start Preview and Start Scanning.
- Stop Preview and Stop Scanning.
- Turn on/off «Marker» Mode.
- Delete all data on the scanner.
- Save all data onto a USB flash drive.



Scanner operation

Preview Mode



Turn on Preview Mode by pressing this button.



To stop scanning press.

Begin every scan in the Preview Mode. This allows you to find the right distance to the object, evaluate the surface, and gauge whether there are enough markers (if scanning with markers).

It is important to find the optimal working distance between the scanner and the object. The ideal working distance (also known as Depth of View) depends on which set of lenses you are using (Mini, Midi, or Maxi). For ease-of-use, the object on the screen, in real-time, is shown in different colors. If the surface is blue, you are getting too far from the object. If it is red, the scanner is in danger of being too close. The op-

timal distance is shown in green, so try to keep the scanner at that distance to the object during scanning. Another way to assess the correct distance to the object is to use the white indicator on the left side of the screen. The closer you are to the object, the lower the bar will drop. Try to keep the white bar in the middle of the scale during scanning. Above this white indicator, you will find the real-time frame rate information (FPS), as well as the number of markers visible (if in «marker» mode).

Scanner operation

Marker Mode

To activate or deactivate «Marker» Mode toggle on/off the switch during Pre-viewing:



While scanning with markers, it is important that each frame contains at least 3 markers. Because markers are identified in real-time by the software at up to 12 times per second, not every marker will get identified in every frame. That is why it is recommended to have at least 5 markers in each frame. So, 3 is the minimum, 5 or more is recommended. To monitor this, use the marker indicator in the top left corner of the screen:

- If there are 4 or less markers in view – the indicator will turn red (the value is critically low and tracking might be lost).
- If 5 markers are in view – the indicator is yellow (warning).
- If more than 5 markers are in view – green (all is good).

Scanning will automatically stop when tracking is lost (less than 3 markers in view) and go back to Preview mode. You can find a better position for the scanner and start again. You will be able to automatically align all the scans together in post-processing later.

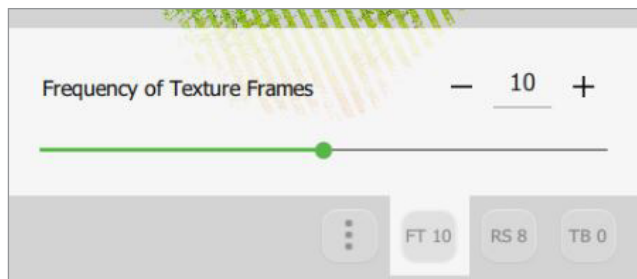
Settings

Sometimes it is necessary to adjust settings for optimal scanning. To do that, press the



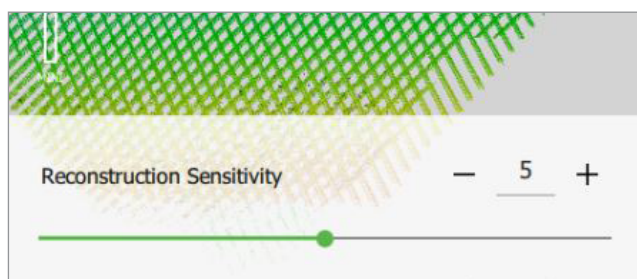
button during Previewing. The changes will take effect in real-time, so if you are pointing the scanner at the object, you will be able to understand when these changes are optimal for your scanning situation.

Scanner operation



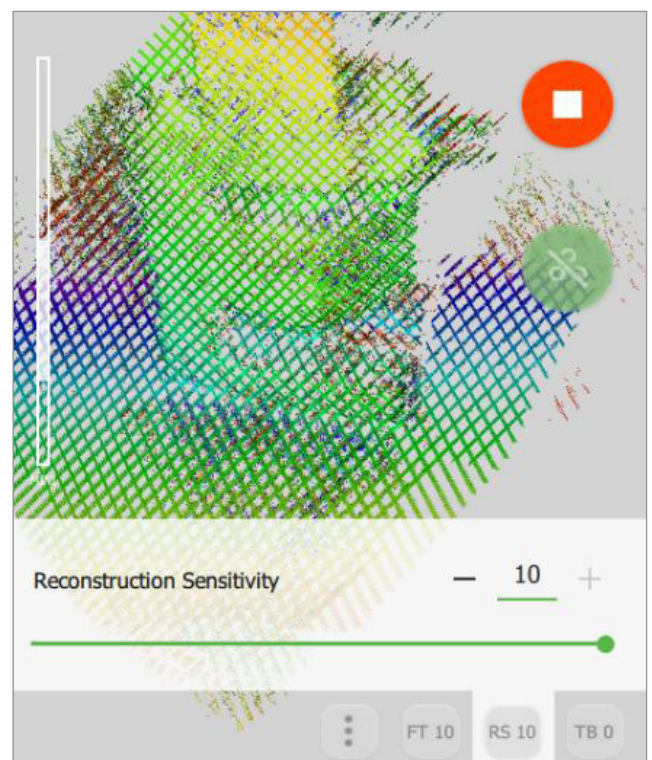
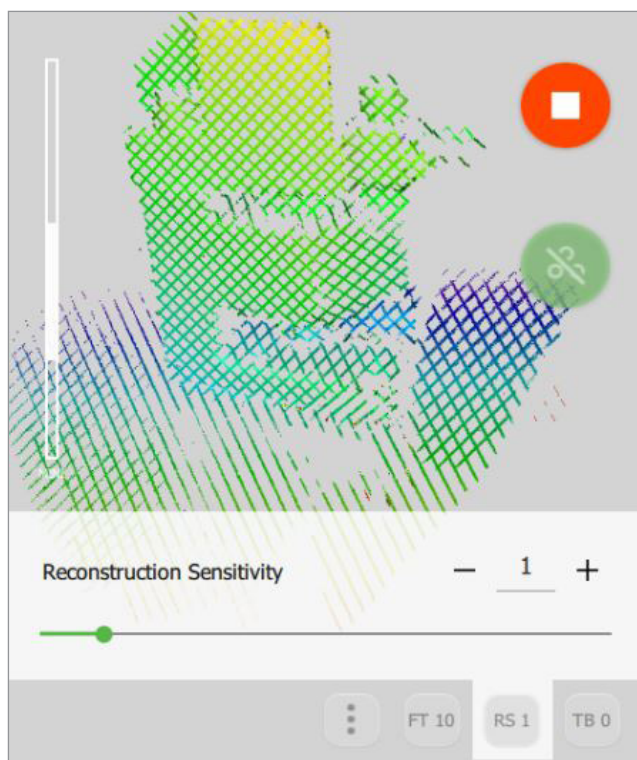
Frequency of Texture Frames

This parameter indicates with what frequency the recording of texture frames is carried out. These frames are needed for texturizing the final model. The lower the parameter, the higher the frequency and thereby the higher the amount of texture frames recorded. Setting the parameter at 0 will turn the textures off.



Reconstruction Sensitivity

If during scanning there is a lot of “noise” on the screen that means that either the object is very dark (black objects are generally more difficult to scan than those of lighter colors) or there is too much ambient light in the room. To correct this, try adjusting this parameter.



Increasing the value will increase the “sensitivity”, allowing the scanner to see more data, but also increasing the amount of “noise”. Decreasing the value, will decrease both. The default value is set to 6.

Scanner operation

Flash Indicator

There are three modes for the power of the circular LED flash.



Full flash



Half flash



Flash light
turned off



**Circular LED flash
capacity**

Color mode

This feature allows you to capture black and shiny objects.

If the object is black use –



If the object is white use –



The default value of the color mode is

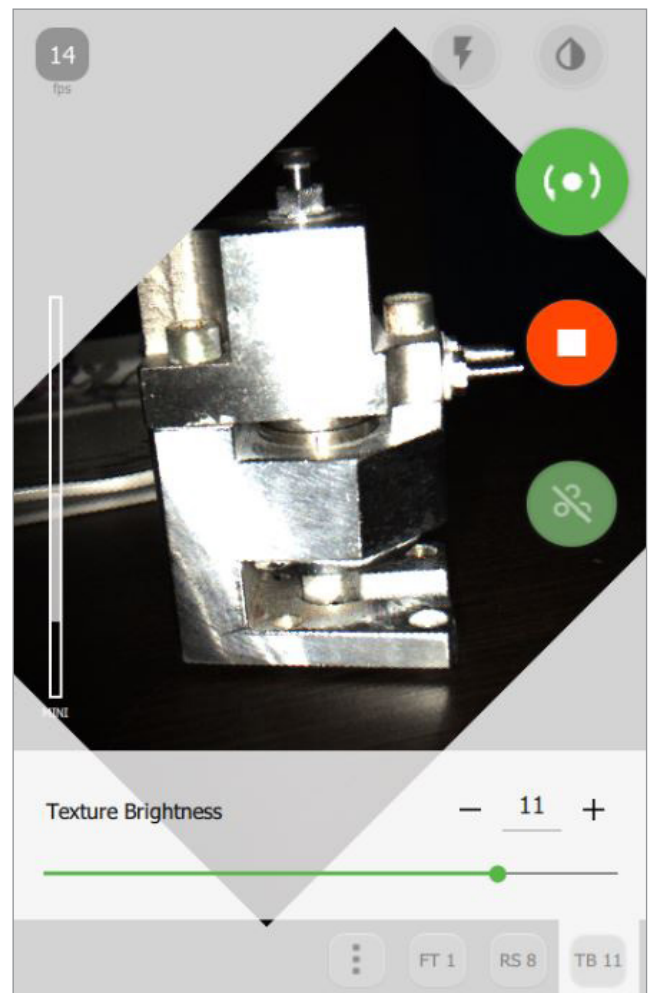


Scanner operation

Texture Brightness

Make it higher or lower to make the texture more or less bright. This proves especially useful for scanning humans as this setting helps achieve the most natural-looking texture.

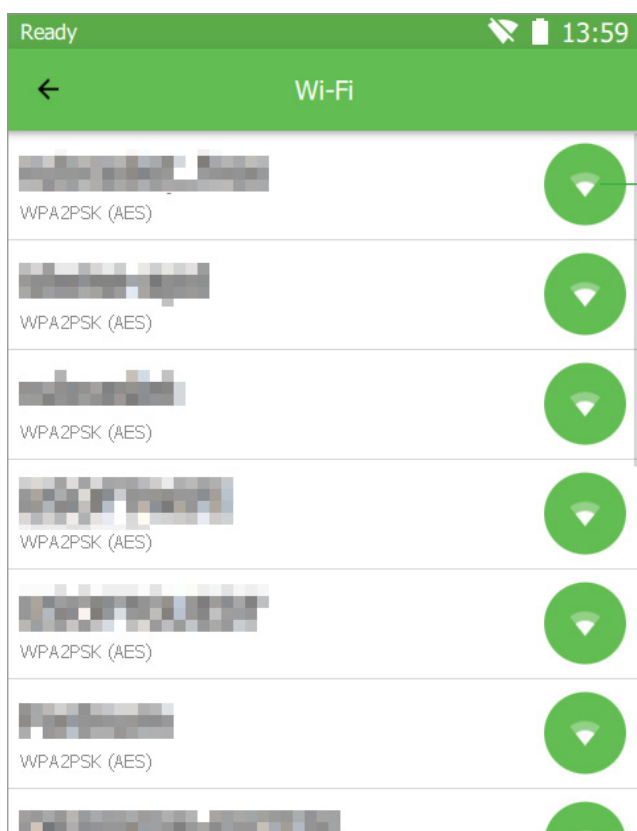
You also might like to leave the default value, and instead adjust brightness when processing the model in **Calibry Nest** software.



Scanner operation

Wi-Fi Settings

To enable wireless data transfer from Drake to a network computer via a local Wi-Fi connection, first plug in a USB Wi-Fi adapter. An indicator will appear in the top right corner of the screen (an antenna with a line through it). This indicates that the Wi-Fi adapter is plugged in, but not yet connected to the local network. A list of available Wi-Fi connections can be found by selecting the appropriate option on the side panel from the main screen.



Choose the network you would like to connect to from the list. A pop-up dialog box will prompt you to enter the Wi-Fi password. Press **CONNECT**. If the network is hidden, scroll to the bottom of the list and select **Hidden Network**. Enter the name of the network (SSID) and password and press **CONNECT**.

Hidden Network

SSID:

Password:

CONNECT **CANCEL**

After connecting, this network will be saved and you will not need to enter your credentials again in the future. This network will now be first in the list of networks and when connected, an indicator signal strength will appear in the status bar.

**Aside from a Wi-Fi USB adapter, you can also be using an Ethernet USB adapter to connect to a local network.*

Find the scanner under “Network” on any computer that is also connected to the same network. Look for a device called “THOR” and after transferring the data from the scanner, look for it in a folder by the name of “Scans”. For quick access, press WIN+R: \\THOR\Scans and create a shortcut to this folder.

**Data transfer speeds over Wi-Fi depends on the type of network equipment you have installed.*

Scanner operation

Calibration of the scanner

Manual calibration

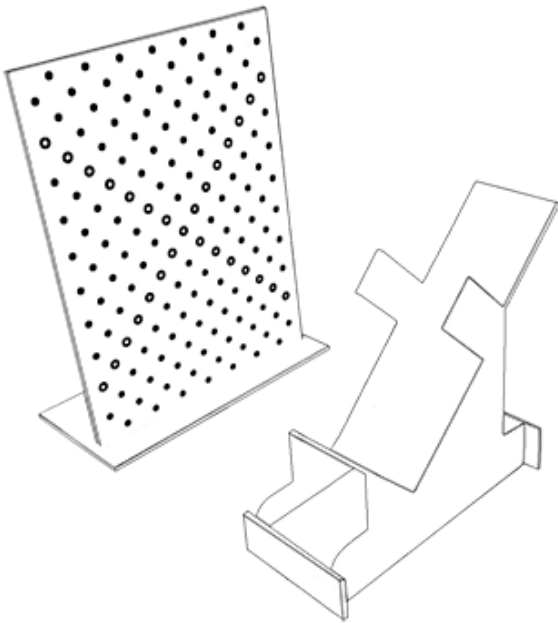
The Drake 3D scanner is a precise measurement instrument and is factory-calibrated. In order to ensure high accuracy of every scan, Thor3D has a calibration procedure that the user can perform himself.

Preparation for calibration

To calibrate the scanner, unpack the calibration stand and assemble it.

Attach the pole to the base

Attach the correct board to the base and the pole.



Ease the scanner into the stand and secure it by screwing in the tripod mount at the base of the device

Place the stand with the scanner approximately 20cm (8in) away from the board

You are ready to calibrate.

** Board will vary depending on which lens is being calibrated.*

Scanner operation

Calibration of the scanner



Calibration procedure

To begin calibration procedure, turn on the scanner and open Side Panel.

- Select “Scanner” and “Calibration”
- Press “Start”

The device will start to scan and the screen will prompt you to move into the first position. To place the scanner perfectly in the first position, follow the prompts on the screen.

The scanner needs to be aligned in three ways:

1. Find the correct distance to the calibration board by moving the stand with the scanner closer and further from it. The indicator on the left side of the screen will illustrate when the device is at the correct distance.
2. Second, angle the scanner a few degrees to the right and to the left, until the smaller of the two red circles is aligned to the same-sized black circle.
3. Thirdly, shift the stand with the scanner slightly to the left and right until the larger red circle is aligned to the black circle of the roughly the same size.

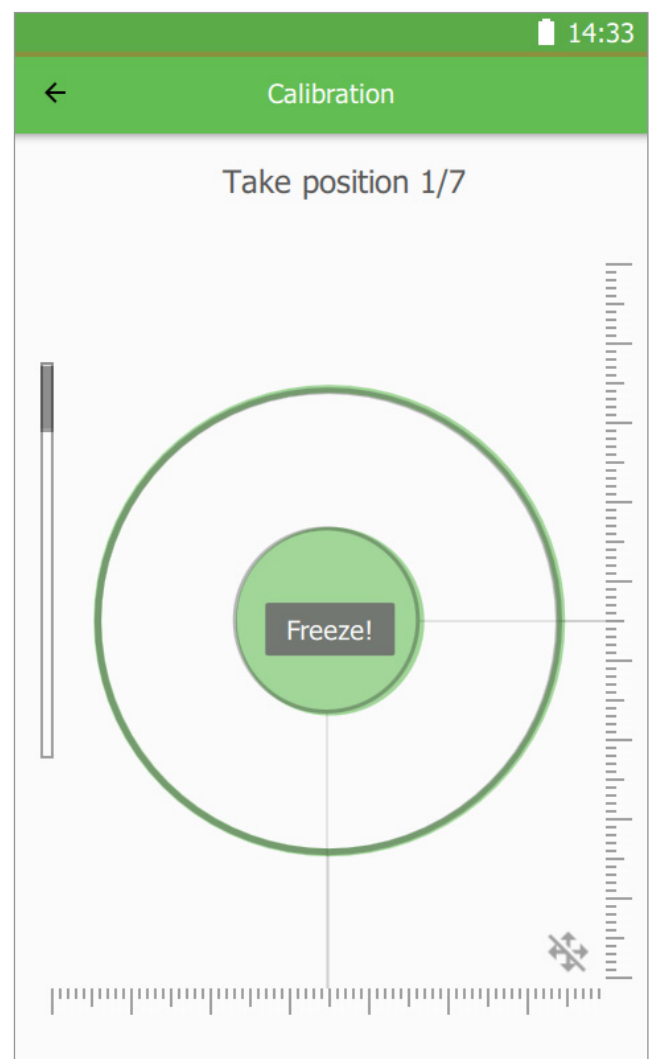
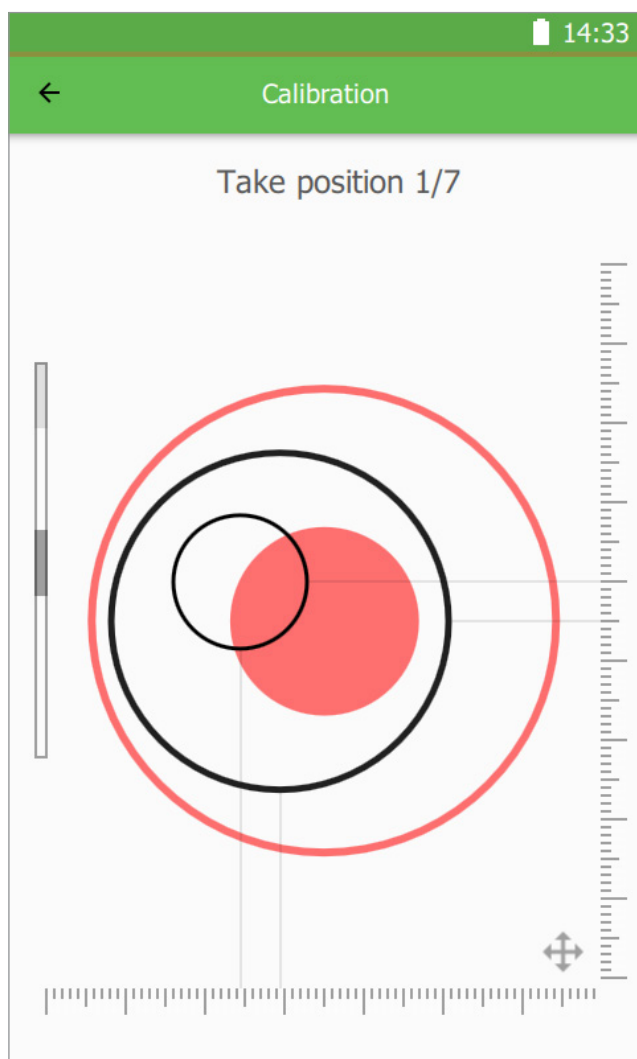
Scanner operation

Calibration of the scanner

Once the positioning is correct, the scanner will prompt you to **Freeze** and the red indicator circles will turn green. Do not move the scanner while this is happening. It will take 2-3 seconds to finish. Once finished, the screen will prompt for second position.

Move the scanner slowly away from the board and watch the distance indicator for guidance as to how far to move. Once the software finishes calibration in second position, it will prompt for the third, the fourth, etc. There are 7 positions in total.

Once the scanner has been calibrated at all 7 positions, the software will restart automatically and the device is ready for use.



Scanner operation

Calibration of the scanner

- * To ensure the highest accuracy, do not calibrate the scanner in a well lit room (avoid direct sunlight) and in high or low temperatures. The scanner is best calibrated in a room with temperatures between 21 and 24 degrees C (70 and 75 degrees F).
- * Depending on your model, the distance from the board to the scanner will vary greatly. The scanning board will also be different for each model. Drake MINI will use the smallest board with the smallest circles on it and the first position of the scanner will be approximately 18cm (7in) away from the board. Drake MIDI will use the medium board and its starting position will be at approximately 32cm (12in) away from the board. Drake MAXI needs the largest calibration (a combination of two medium boards) and its starting position will be approximately 50cm (30in) away from the board.
- * Calibration of Drake MAXI will also require the user to raise the scanner higher and two extra pieces of the stand will be provided in the calibration kit. Attach the two extra "legs" to the main stand, thereby raising the scanner off the table by 18cm (7in)
- * The screen is less sensitive to the touch when the scanner is plugged in. During calibration, it is easier and quicker to disconnect the power cable from the scanner.

