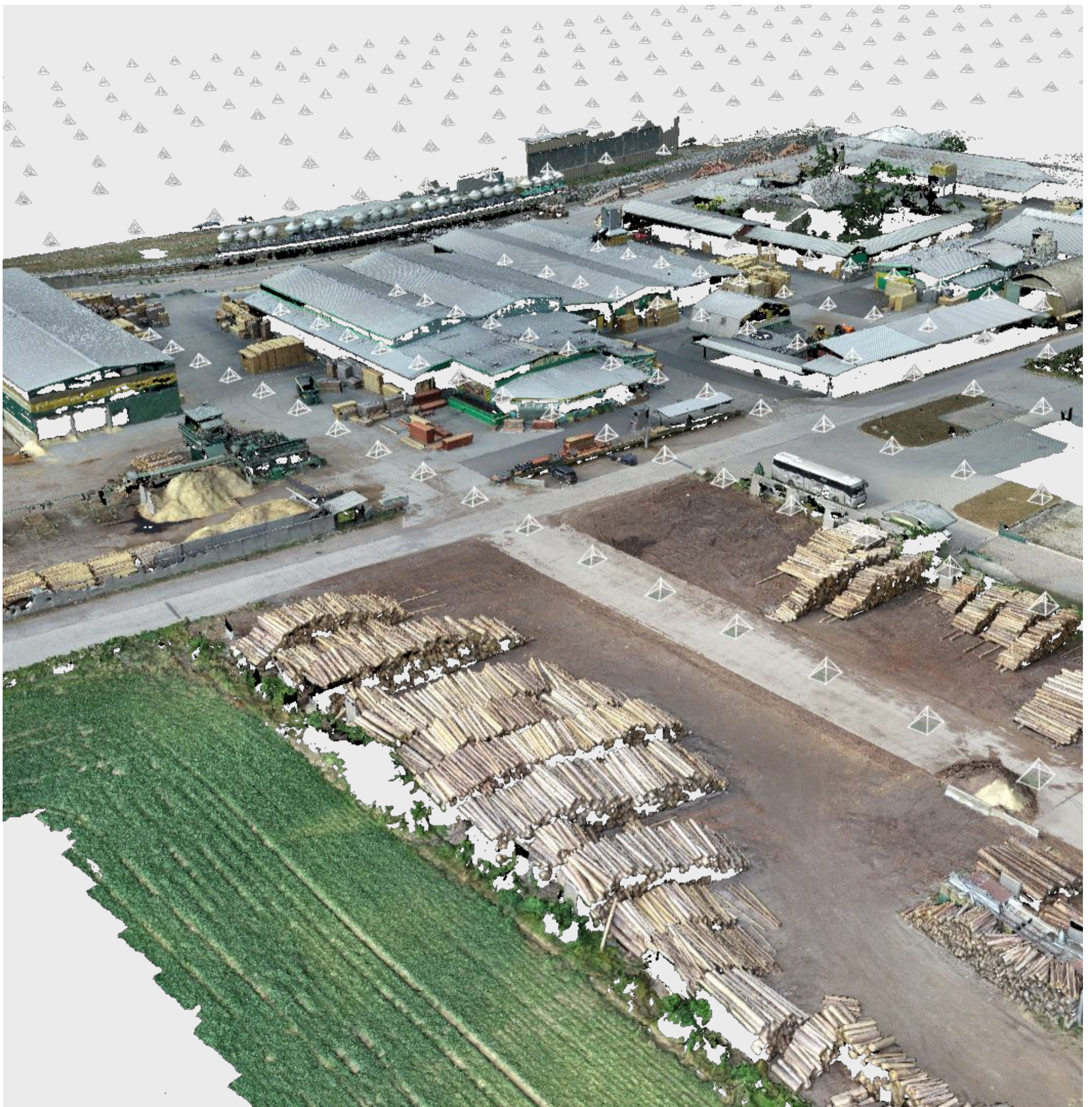


AI Photogrammetry in Artec Studio 19 Quick Start Guide



Version 1.3



Introduction

Congratulations on the purchase of Artec Studio.

Whether you want to share a case study or demonstrate new ways in which you work, or if you need any guidance along the way, we are always ready to listen. Please feel free to get in touch with us at support@artec3d.com!

For the Artec Studio full User Manual and other Artec manuals, scan the QR code.



NOTICE

Two new algorithms have been added to Artec Studio 19 to allow users to reconstruct 3D models from sets of photos and videos.

Artec Studio recommends compiling neural networks during the first run after installation. Do not skip this step.

Types of Photogrammetry algorithms

Photo Reconstruction pipeline in Artec Studio is split into two consecutive stages:

Step 1. Create Preview: Where a set of photos imported into Artec Studio can be processed, resulting in positioning them in 3D space. The output is a **Photo Scan** in the Workspace, representing the alignment of the images for further processing.

Step 2. Create model: This stage involves creating a triangular mesh that can be used in Artec Studio in a traditional way (to process and texture). Depending on the scene type, there are two types of algorithms:

1. **Separate object**
2. **Whole scene**

Both algorithms will generate a mesh, but each is suited for different purposes. We recommend using the two algorithms under different conditions and for various scenes. While some scenes can be processed by either algorithm, others may be better handled by one over the other.

Separate object

Separate object algorithm is best suited for handling various objects, such as a controller, a statuette, a pen, or a chair. To enhance the quality of separate object algorithm, a specialized object-detection algorithm processes all photos to generate masks for each one. For optimal results, ensure the entire object is fully captured within the frame and well-separated from the background. This clear separation is essential for the algorithm to create accurate masks and avoid potential reconstruction failures.

Whole scene

In this photogrammetric scenario, there is no requirement for a strong separation between the object and the background. In fact, this could work both with or without masks. This type of reconstruction works best for feature-rich scenes, such as aerial or drone captures, or objects like stone, statues, architectural objects, etc.

Introduction

Pipeline

Here is the general pipeline for processing photogrammetry data in Artec Studio. You can follow these instructions when performing your first reconstruction.



Data capturing

In Artec Studio 19, there are several limitations related to photo acquisition.

1. Try to capture your object in a well-lit environment. Aim for a strong ambient light. The best light conditions are typically achieved by capturing outside on a cloudy day.
2. Ensure that the entire object is distinctly in focus, so no areas of it appear blurred. If you find any blur, it is generally advisable to infuse additional light into the scene, marginally close the lens aperture or do some combination of both.
3. When capturing data suited for **Create Preview (Separate object)**, ensure that **each photo captures the entire object within the camera frame and separated from the background**. Refrain from the scenarios where the majority of the frame is covered by the object with some parts of the background still visible, as this may confuse the object detector.

Good photos for the algorithm:



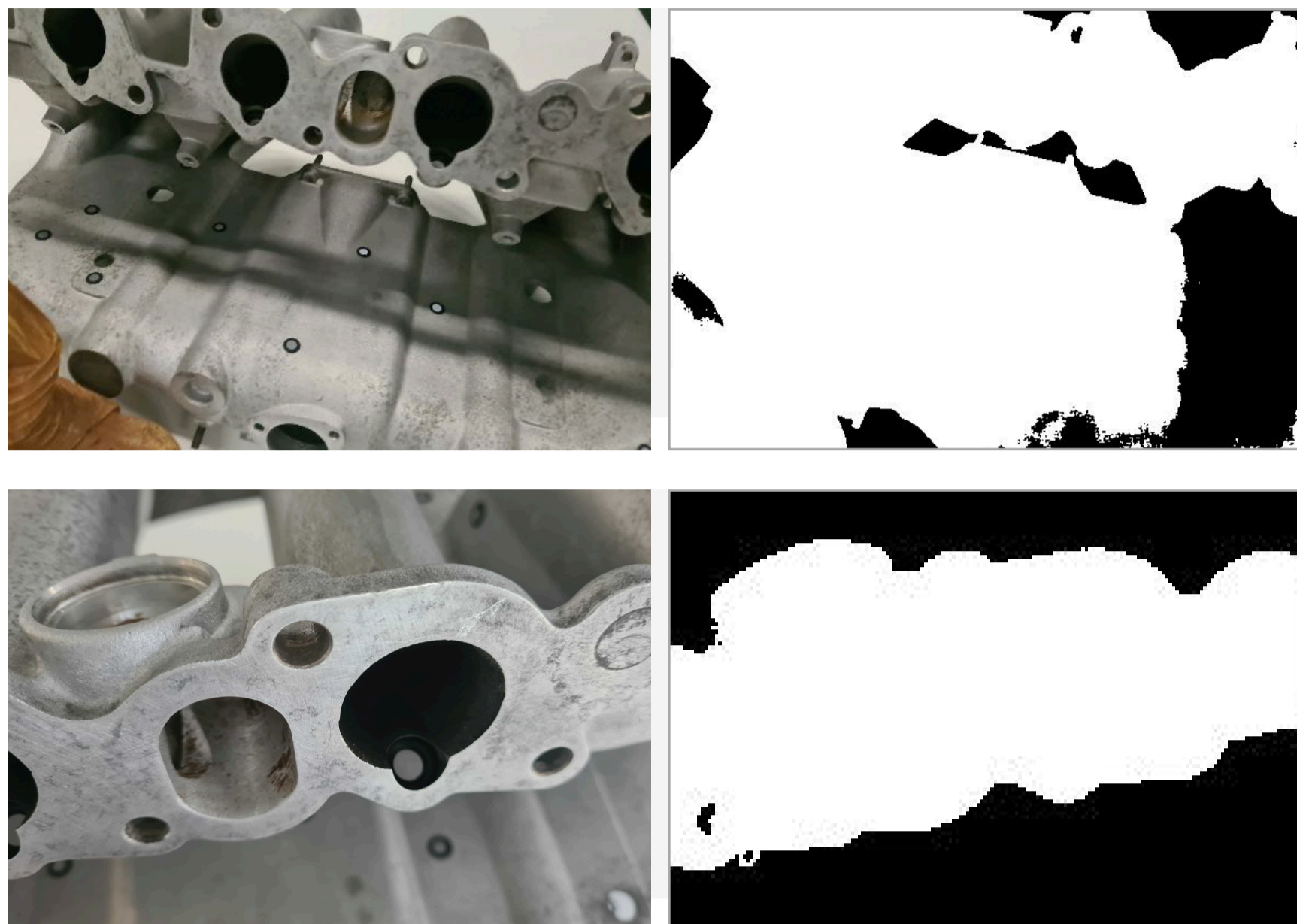
Photos which may confuse the object detector:

Several objects within the camera frame

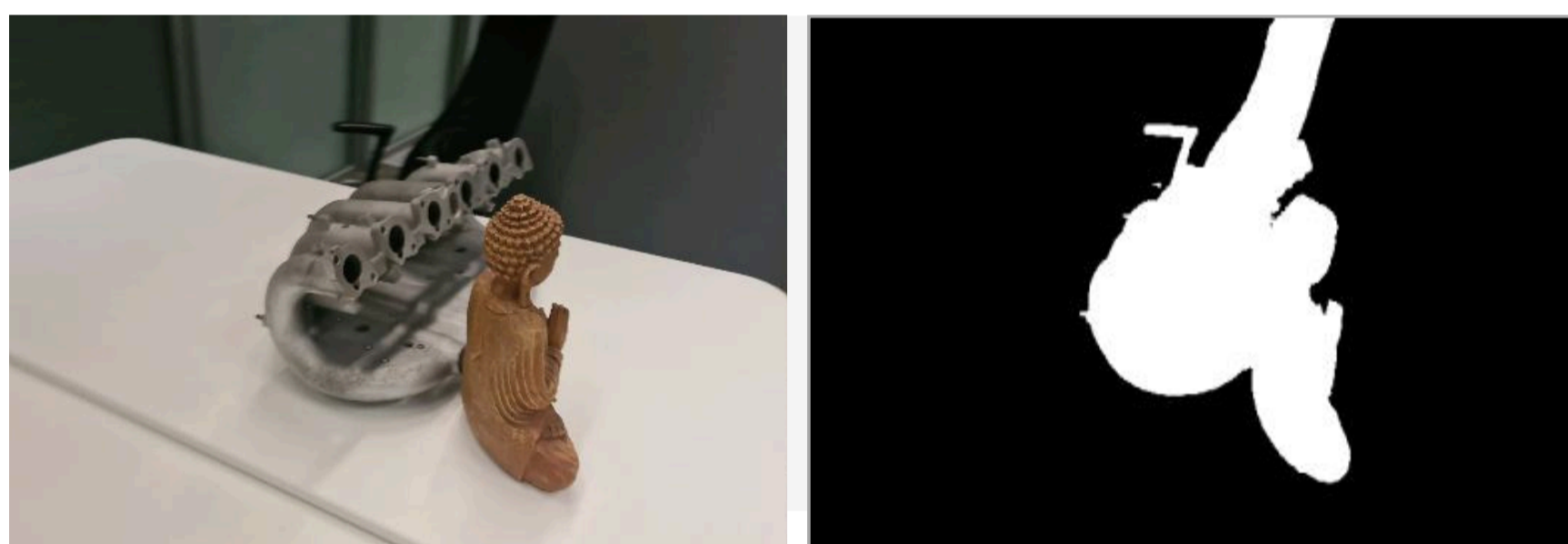


Data capturing

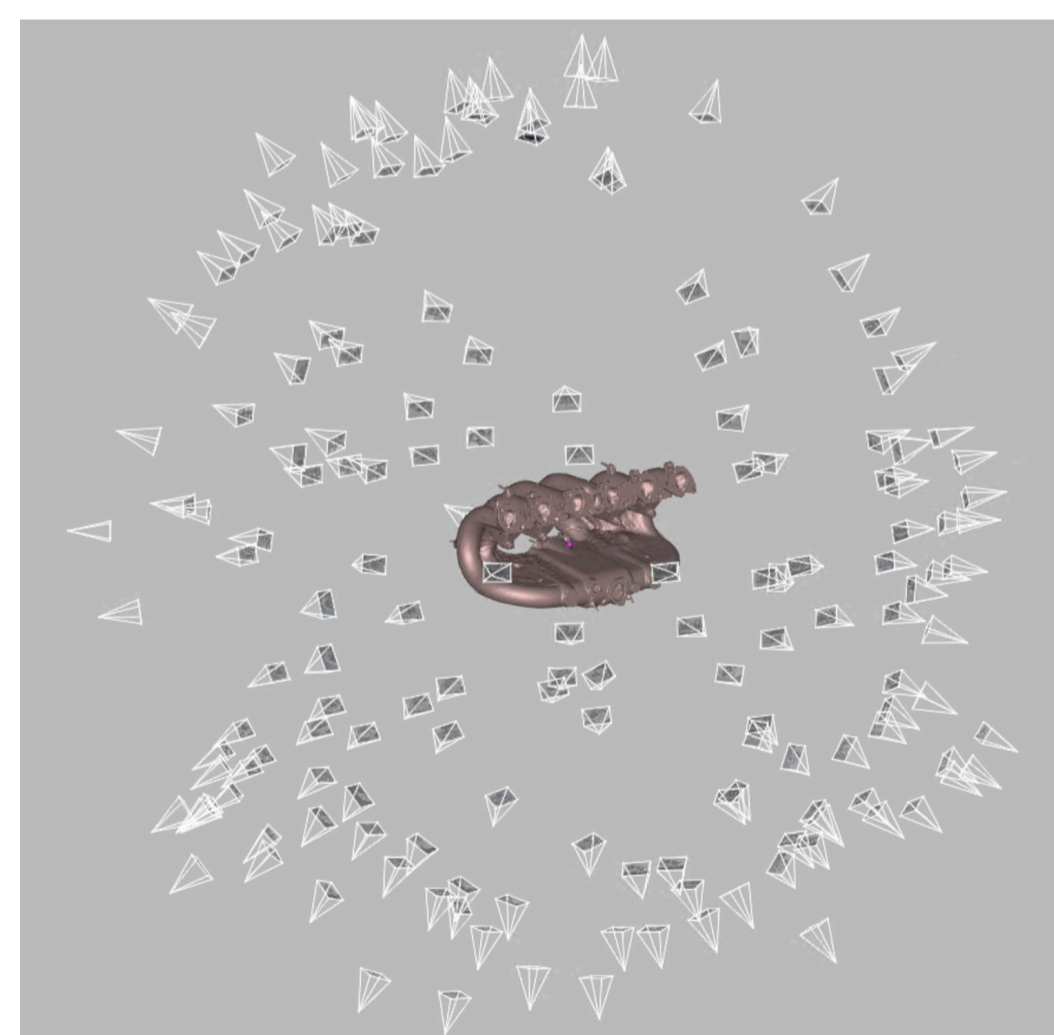
Closeups, when part of the object could be considered a background



Overloaded background, when part of the background could be considered an object



4. When capturing a scene, you may disregard the point above (point 3).
5. Try to capture your object from all the directions so the algorithm is fed with a big variety of views. A good practice here is to imagine a virtual sphere around the object and try to capture images from different angles.
6. You can turn the object to another side and repeat the capture to get full 3D reconstruction. In that case make sure that images from each object orientation are imported into Artec Studio as a separate photoset.



7. If your object lacks texture, ensure that the background contains many features.
8. For **Create Preview (Separate object)**, 50-150 photos is typically enough to achieve good quality.

Import Photos and run Create Preview

Import photos or videos into the Workspace (either by dropping a folder with photos or video files or using the File menu via File → Import → Photos and videos).

General pipeline

Scale bar

Scale references come in two types: **Scale bars** and **Scale crosses**.

A **Scale bar** allows you to obtain the correct scale for your model by using the distance between two targets. It defines the scale of an object but only along a single axis, making it useful for determining size but providing no information about orientation in 3D space.



Scale cross

In contrast, a **Scale cross** provides a reference not only for the scale of an object but also for its position and orientation in 3D space. It consists of two intersecting scale bars. This comprehensive reference is particularly valuable when you need to determine both the size and alignment of an object relative to the scene.



If you do not have a physical scale cross-reference, you can use a printed version, available as a PDF document at:

C:\Program Files\Artec\Artec Studio [version]

The file names are ASC A4.pdf for Europe and ASC US Letter.pdf for the USA.

Run Create Preview

The **Create Preview** algorithm registers photos by determining their position in space, resulting in a **Photo Scan** with aligned photos.

If a video file is imported, Artec Studio will create a photo set in the Workspace out of it. You need to specify frame rate at which photos will be imported from the movie file. Select the imported photos in the Workspace and run the **Create Preview** algorithm from the **Tools** panel.

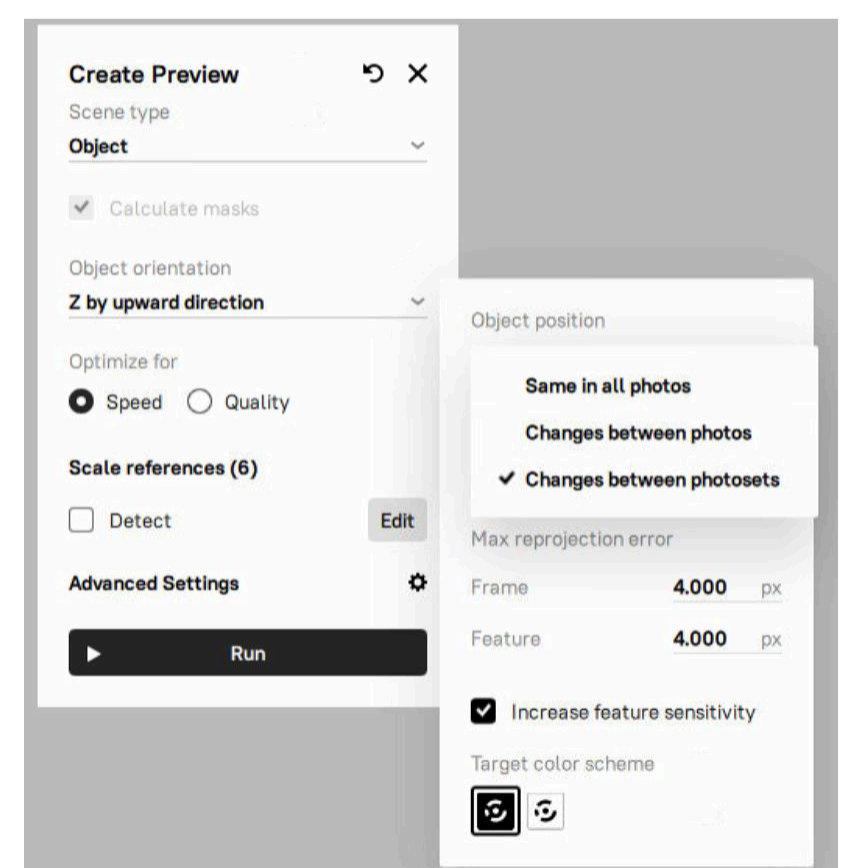
Basic settings

- **Scene type:** Allows users to choose the optimal algorithm for processing either separate objects or complex scenes.
- **Object orientation:** Defines the direction the object is facing, which can be manually adjusted by selecting one of the available options.
- **Optimize for:** Suggests two options to prioritize optimization - either *Speed* or *Quality*.
- **Scale references:**

Detect: Enables the recreation the object's original dimensions based on the added scaled references.

Advanced settings

- **Object position:** Specifies the object's position relative to its background.
 - **Same in all photos:** Choose this if the object's position is the same across all photos.
 - **Changes between photosets:** Use this option when the object's position remains consistent within a single photoset but varies between different photosets.
 - **Changes between photos:** Select this when the object's position changes within the same photoset. This is typical for cases where the object appears in different orientations relative to the background in each photo, such as when using a turntable.



General pipeline

- **Default FOV:** Specifies the camera's field of view, used when this information is missing or unreadable from photo metadata. The default value is 60°.

Max reprojection error

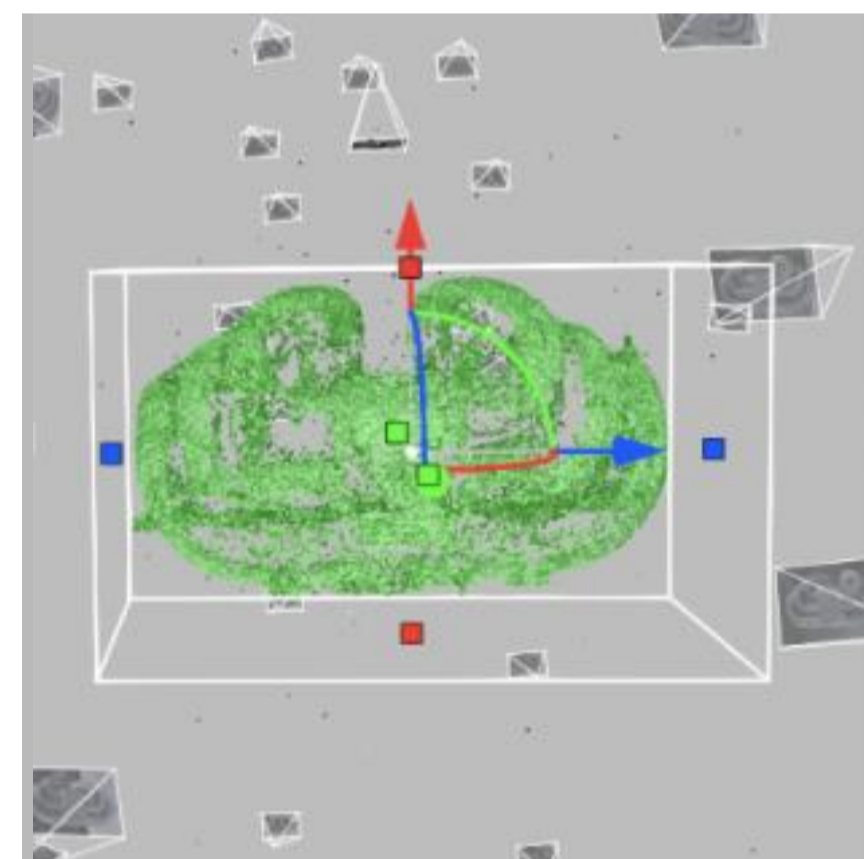
- **Frame:** specifies the maximum allowable deviation for matching points between individual frames or photos. It limits how much point positions can vary within a photoset; if the reprojection error exceeds this value, the program may mark such frames as mismatches. The default value is 4.000 px.
- **Feature:** sets the maximum error for matching object features, such as contours or textures; lower values lead to more precise reconstruction of object details. The default value is 4.000 px.
- **Increase feature sensitivity:** Enhances the algorithm's sensitivity to fine object features, allowing it to more accurately recognize and account for small elements during reconstruction. This can improve model quality but may slow down the process or increase demands on photo quality.
- **Target color scheme:** Defines the color scheme of the targets for detection, with options for white on black or black on white.

Once calculation is finished, a **Photo Scan** object appears in the Workspace. This photo scan is colored so you can see the general shape of your object.

Prepare for Create Model

Double-click on the newly created **Photo Scan** object in the Workspace and modify the cropping box around the object to adjust the region of reconstruction.

The cropping box is required as it narrows the region of reconstruction. It is advisable to align it to follow the main directions of the object and tightly enclose the object, while still maintaining some space between the object and the cropping box.



Inspect masks

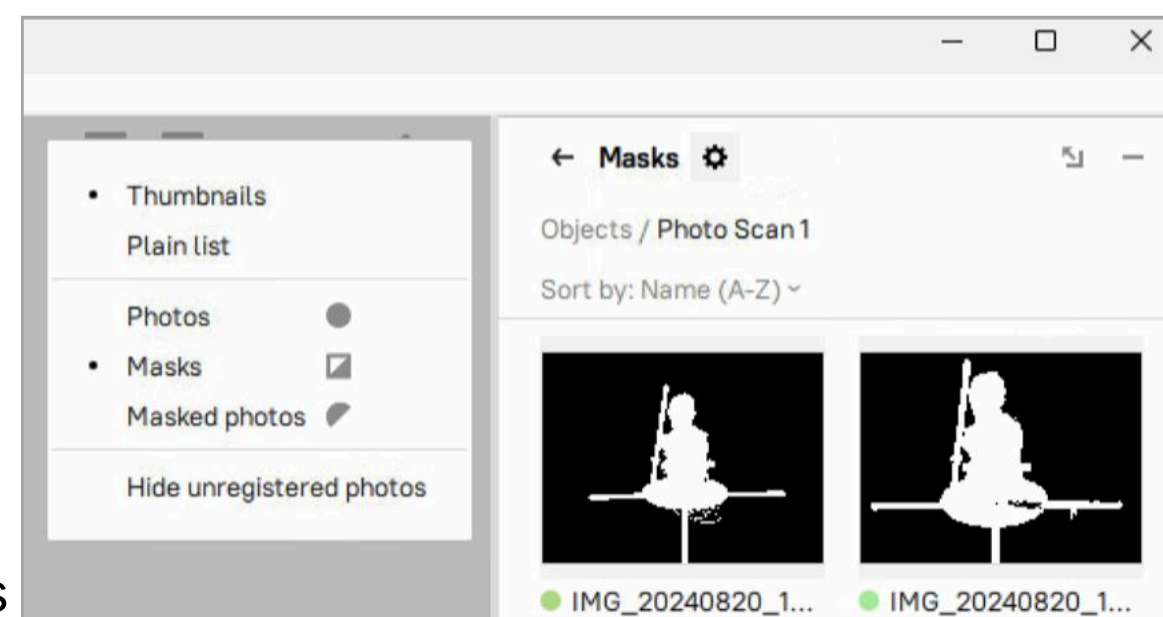
The inspection of the masks should be carried out under two conditions:

- When using **Create Model (Separate object)**
- If you encounter poor results or suspect that you did not adhere to our guidelines during capture

Note: For **Create Model (Separate object)**, masks are consistently used throughout the process.

Inspect masks by left-clicking the gear icon and enabling masks view. Alternatively, you can use hotkeys for faster navigation:

Press 1	for images
Press 2	for masks
Press 3	for masked photos



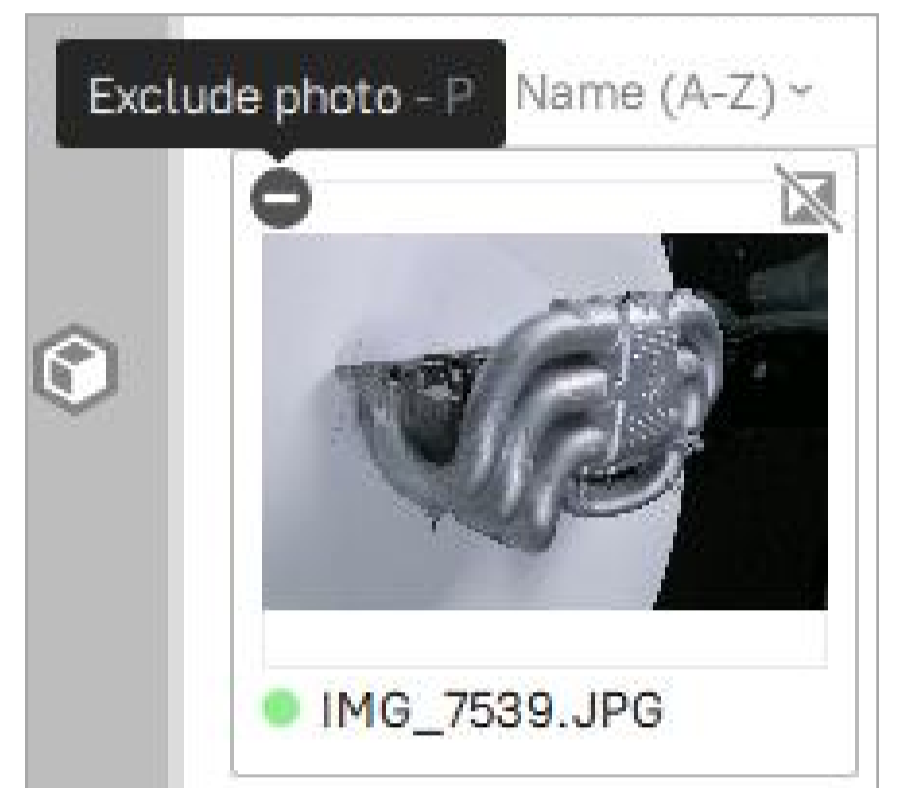
General pipeline

Ensure that the masks are generally correct. If they are entirely inaccurate, users can switch off the photo from **Create Model (Separate object)**.

Note that if you plan to use **Create Model (Whole scene)**, using masks is not always necessary. For example, they are typically not required for drone captures. However, if you choose to use them and find that most masks are highly inaccurate, simply disable the **Use Masks** option in this algorithm. Manually turning off individual masks will not improve the results.

It may happen at times that the object detector fails to detect the central object due to the complexity of the scene or additional objects appearing close to the scanned one. If this is the case, disable the photo entirely. Disabled photos will be skipped during the **Create Model (Separate object)** algorithm.

To do this, select a photo and press the 'P' key or, use the button in the left corner of the image thumbnail.



If a mask includes a stand or part of the object that extends beyond the cropping box, it can potentially lead to artifacts after **Create Model**. In this case, try expanding the cropping box to encompass both the object and the stand entirely.

Run Create Model

Return to the Workspace using the  arrow in the Workspace window header. Now, deselect everything except the **Photo Scan** object.

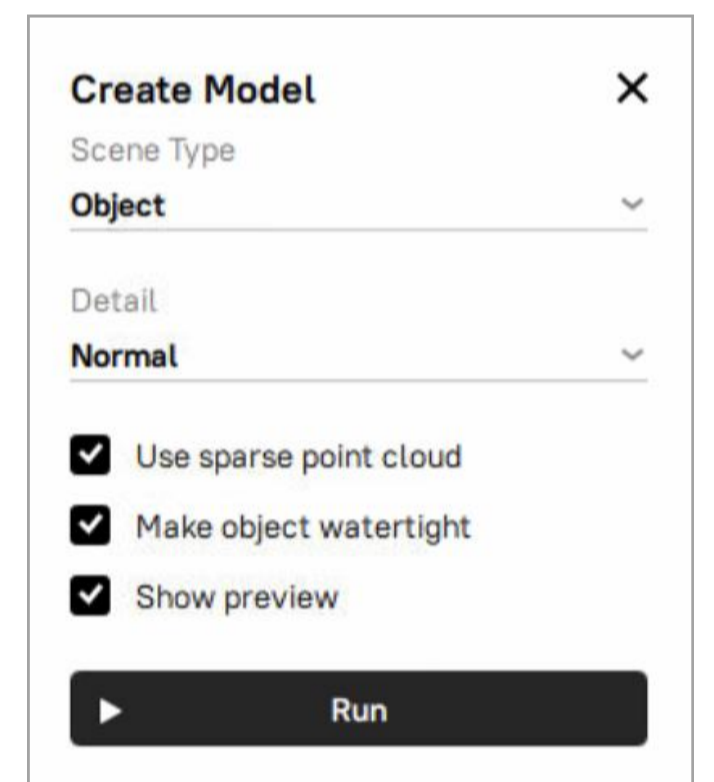
Open the **Tools** panel and click the gear icon of the **Create Model** algorithm to open its settings window.

Create Model (Separate object)

Scene type: Allows users to choose the optimal algorithm for processing either separate objects or complex scenes.

When reconstructing an object that is well-separated from its background, switch to the *Separate object* option of the *Scene type* setting. The object should be captured in a way that it is fully within each frame and distinct from the background.

- **Detail:** Choose between *Normal* and *High* options. In most cases, the *Normal* option would be enough. Use the *High* option if you need extra level of details or better reconstruction of thin structures of the object. Note that the *High* option might result in more detailed but noisier reconstruction compared to the *Normal* option. It also takes longer to calculate.
- **Use sparse point cloud:** Utilizes preliminary geometric data to assist in reconstructing concave areas and cutting out holes where necessary. However, for highly reflective objects, it may introduce artifacts such as unwanted holes in the surface, so it's advisable to disable this option and retry the reconstruction if issues arise.
- **Make object watertight:** Toggles between creating a model with filled holes when enabled or leaving them open when disabled. Enabling this option ensures that the model is fully enclosed.
- **Show preview:** Enables a real-time preview.



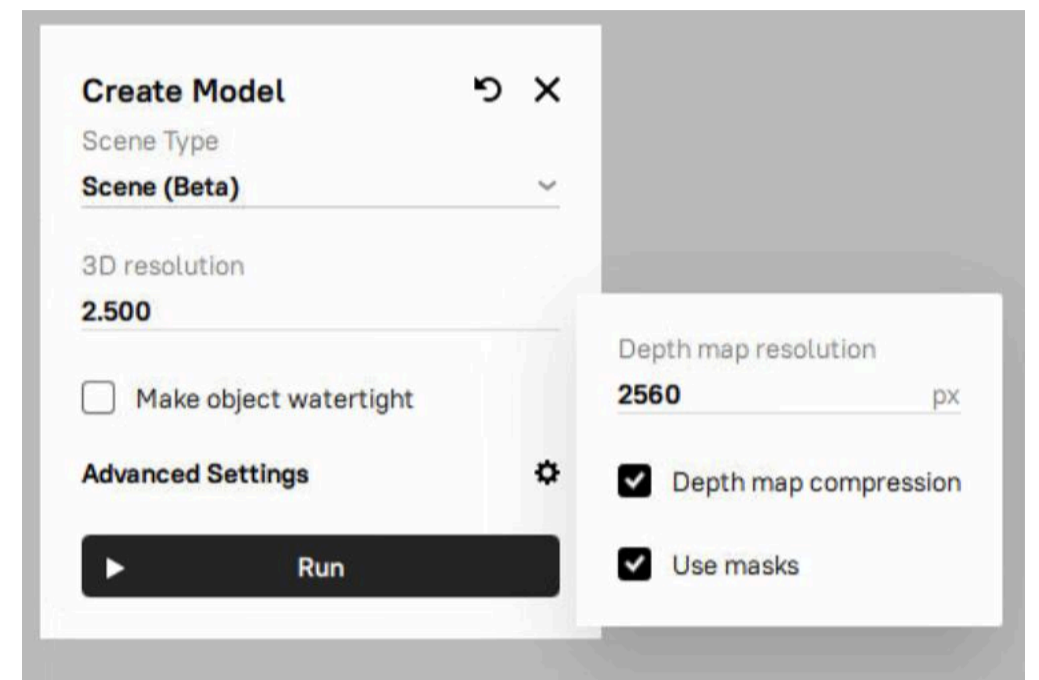
General pipeline

Create Model (Whole scene)

When reconstructing scenes or unbounded big objects, switch to the Whole scene reconstruction by changing the **Scene Type** option to the *Scene (Beta)*.

Here you can adjust several parameters:

- **3D resolution:** Defines the smoothness of resulted surface.
- **Depth map resolution:** Defines maximum image resolution during creating model. Higher values result in higher quality at a cost of increased process time.
- **Depth map compression:** Enables lossless compression of depth maps, which may slow down calculations due to additional processing time for compression and decompression. However, it reduces disk space usage, making it beneficial for systems with slow disks (HDD or network storage).
- **Use masks:** Defines whether to use masks during the reconstruction or not. This can greatly improve speed and quality but should be disabled for scenes or aerial scans.

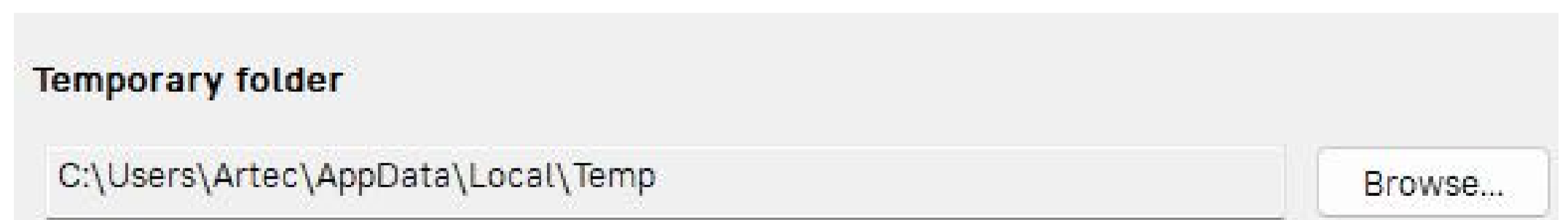


Limitations

Here are certain limitations and caveats exists that you should be aware of:

1. Speed of reconstruction is an area for improvement. Now, we do not recommend processing large datasets (more than 1000 photos) in the current version of Artec Studio.
 - 1.1. The time required for the Separate object algorithm does not depend on the number of photos in the dataset and depends on the:
 - 1.1.1. Video card used (modern NVIDIA cards are required).
 - 1.1.2. Selected profile: Normal or High resolution. The latter is 1.5 to 2 times slower.
 - 1.2. The time required for the **Create Model (Whole Scene)** algorithm depends on the:
 - 1.2.1. Number of photos
 - 1.2.2. Video card, SSD speed, and CPU of your computer
 - 1.2.3. Selected resolution
2. Graphics Card requirements:
 - 2.1. We highly recommend using a modern NVIDIA card (other graphics cards are not supported)
 - 2.2. We highly recommend having at least 8 GB of Video RAM
 - 2.3. We highly recommend updating your graphics card drivers
 - 2.4. The standard duration for Separate object algorithm typically ranges from 10 to 30 minutes when operating with the Normal resolution.
3. Disk requirements
 - 3.1. During the **Create Model (Whole Scene)**, a lot of disk space is needed to process the data. The amount of disk space required depends on the resolution of photos and selected resolution. This part can consume approximately – 15 GB of disk space per 100 photos. **It is highly recommended to have 100 to – 200 GB of free disk space on the disc where the Artec Studio Temp folder is located.**
 - 3.2. 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 on the General tab of Settings (F10).
 - 3.3. Nevertheless, it is advisable to set your Temp folder in Artec Studio settings to the disk with the highest speed and ample free space.

To set the Temp folder, open Settings (F10) and browse to the new destination.



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