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Theoretical and hands-on Workshop course (WP2.3) & Training (WP3.2) on:
"The implementation of ICT documentation techniques for
Heritage Educational Purposes"

"Evaluation of 3D models"

Alexandria
28 May -2 April 2022

Evaluation of 3d models.

This presentation analyses the quality of the 3D models created in the context of EduMUST.

The quality of the objects is examined in terms of

- texture accuracy,
- number of points (consequently number of polygons),
- quality of the produced 3D mesh (holes, spines, connected components)
- and the parameters of the photographs (focal length, ISO, shutter speed).

1. Camera's initial parameters.

Parameters that should be taken into account, when shooting an object, include the following: **ISO**, **F-Stop**, **Shutter** and **Focal Length**.

- **ISO** stands for **International Organization of Standardization**, which is the main governing body that standardizes sensitivity ratings for the camera.

  ISO **refers to the light sensitivity** and **when changing the ISO on a digital camera, the sensor is rendering with more or less sensitivity to light**.

- **Focal length** provides information about
  - the **angle of view**, how much of the scene will be captured,
  - the **magnification** and
  - **how large individual elements will be**.

  Focal length should be the same and fixed while taking the photos.

1. Camera's initial parameters.

- **Shutter speed** is the **length of time for which the camera's shutter is open, exposing light into the camera's sensor**.

  When using a long shutter speed, the sensor is exposed to a significant period of time, resulting in one of the biggest effects of shutter speed, motion blur.

- **F-Stop shows if photos are taken with a large aperture or small aperture**.

  One of the most important effects of F-stop is the depth of the field (the amount of the photo that appears to be sharp from front to the rear).

  Consider high F-stop when shooting objects (under f/8).

2. Number of polygons.

The number of polygons depends on the quality required and the platform targeting.

- For mobile devices, a lower number of polygons is needed (somewhere between 300-2000)
- For a desktop platform the ideal range is about 1500 to 6000.

Nevertheless, these numbers of polygons should be the final products of the whole procedure without losing the important details and information of the object.

This is achieved by producing a high number of polygons first (approximately 2.000.000-3.000.000 polygons), extract, edit or correct important elements (etc. texture, holes) and finally decimating the mesh.

Producing more faces, will not provide more accurate results, in terms of higher detail, and will slow down the whole pre-and after-procedure.

2. Number of polygons.

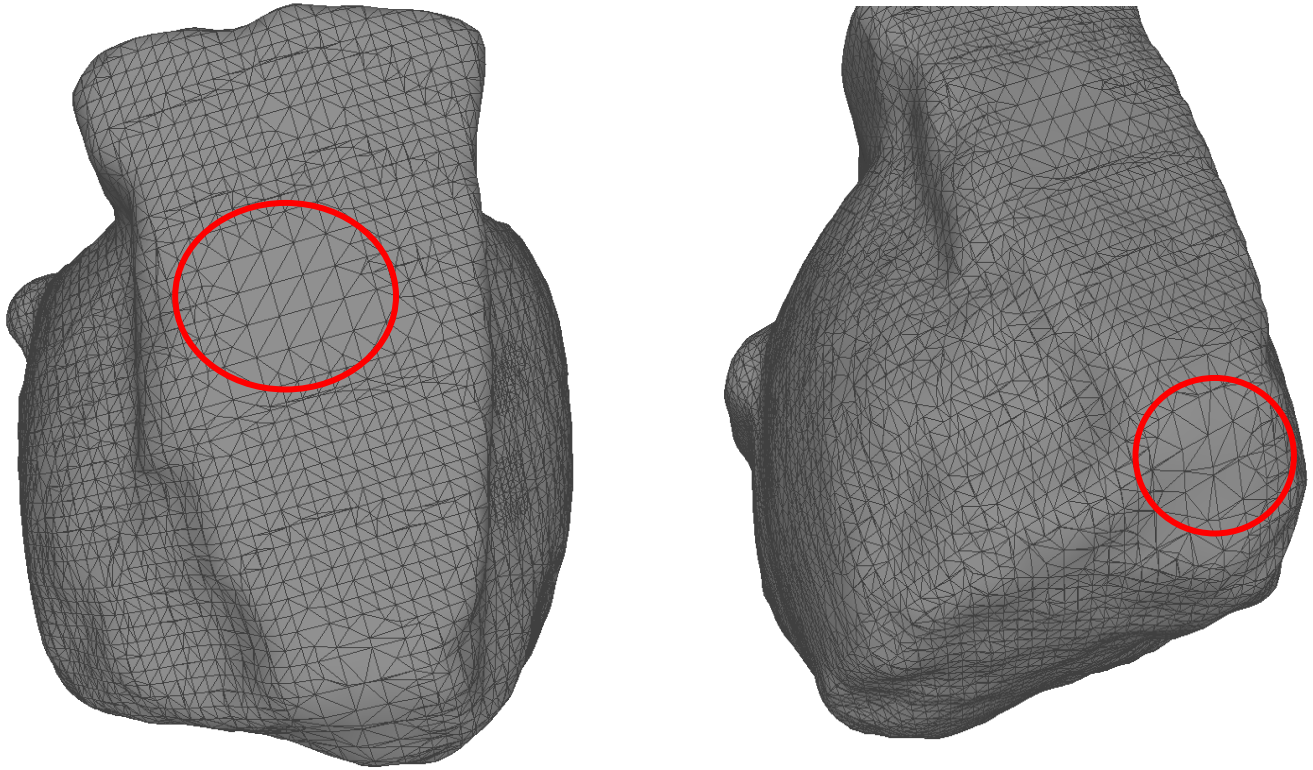
Example 1:

It can be easily denoted from example 1 that a small number of points has resulted in a small number of polygons and thus to low-quality 3D object in terms of texture.
Small size polygons result in a surface of high quality.

2. Number of polygons.

Example 2:

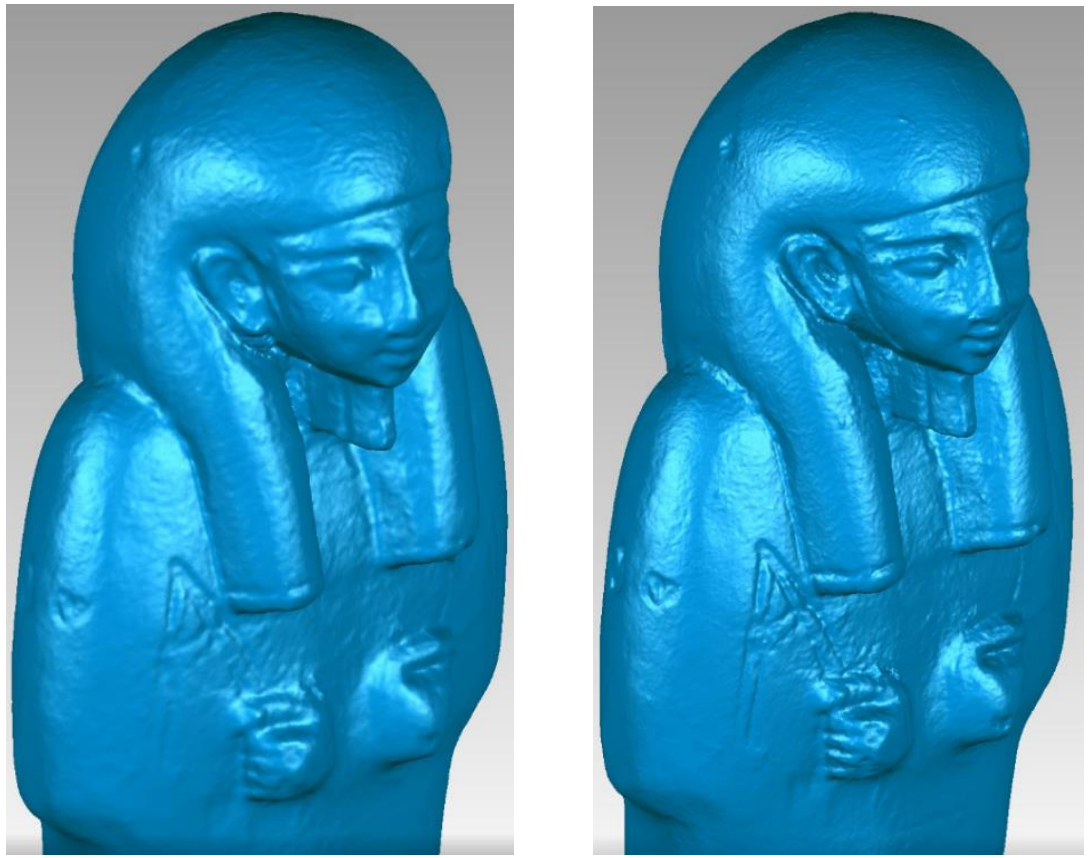
It is important to check the quality of the produced mesh especially in the areas that are almost flat or edges. Where the surface of the object is changing, more face are anticipated



Large polygons of the created artefact losing surface detail.

2. Number of polygons.

Example 3:



Difference between the sent object (left) and the re-created by DUTH object with more faces (right).

3. Texture quality.

The texture is one of the most important parameters when evaluating a 3D model, as it provides information about the material of the artefact.

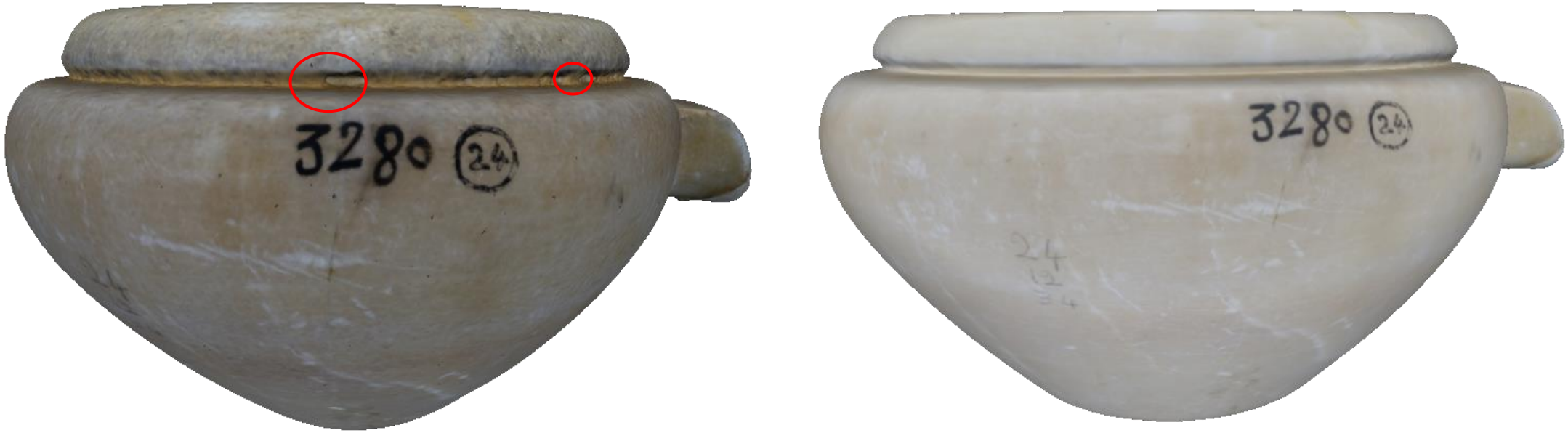
The constructed surface should resemble the real one as regards appeal and realism.

High texture quality can be achieved by changing the width and height of the produced texture, as whereas, by changing the method of producing the texture quality.

photos of the items had low image quality (due to motion blur)
thus these images should not be taken under consideration
when creating the texture of the object.

3. Texture quality.

Example 4:



3D object (left) and the 3D reconstructed by DUTH object with new parameters (right).

4. 3D model compactness and quality.

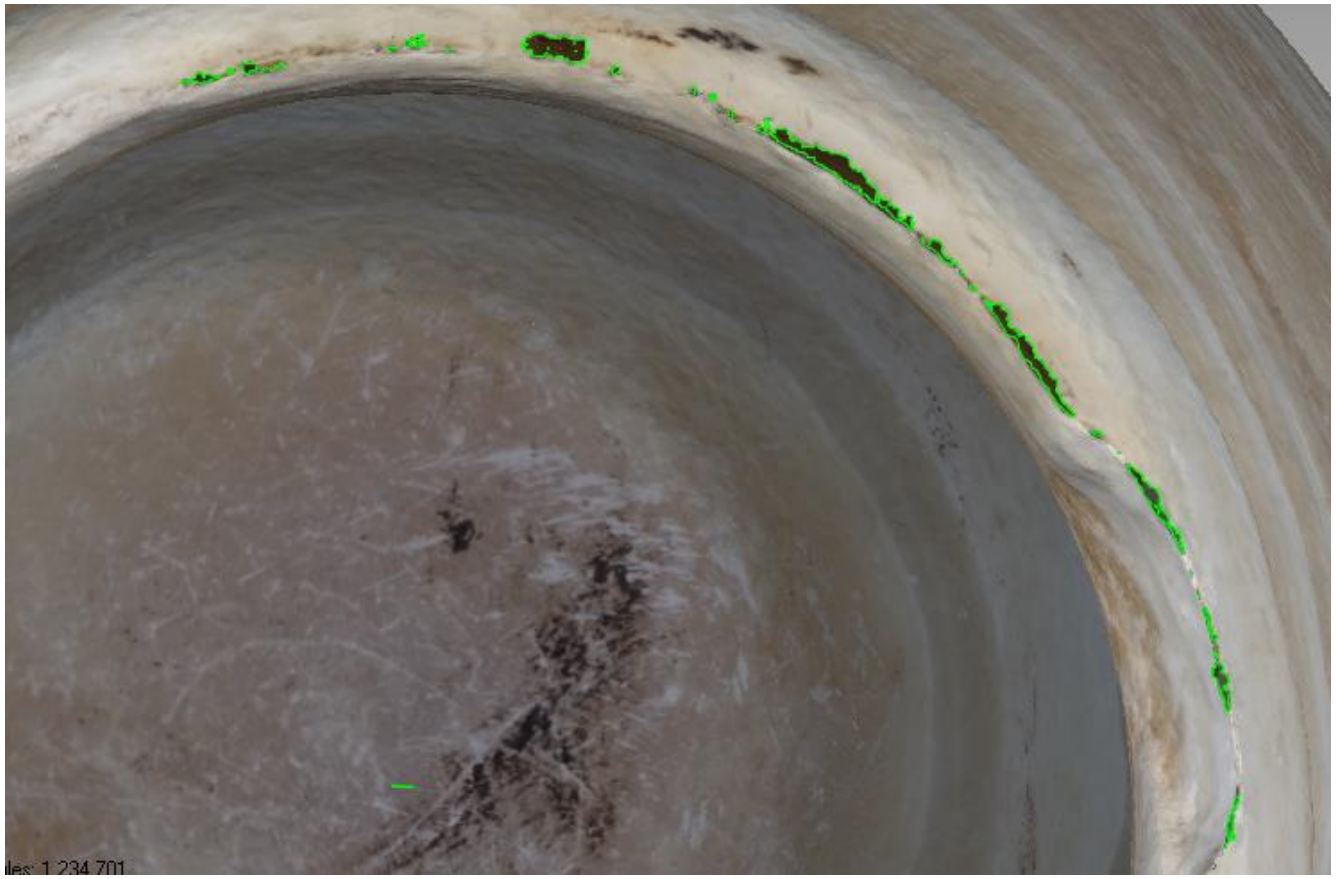
Apart from texture and number of faces, 3D meshes are evaluated in terms of **compactness and quality**.

The 3D objects are analyzed for

- holes,
- small components,
- self-intersections,
- heavily creased edges
- and a number of spikes.

4. 3D model compactness and quality.

Example 5:



Holes problem in artefact.

4. 3D model compactness and quality.

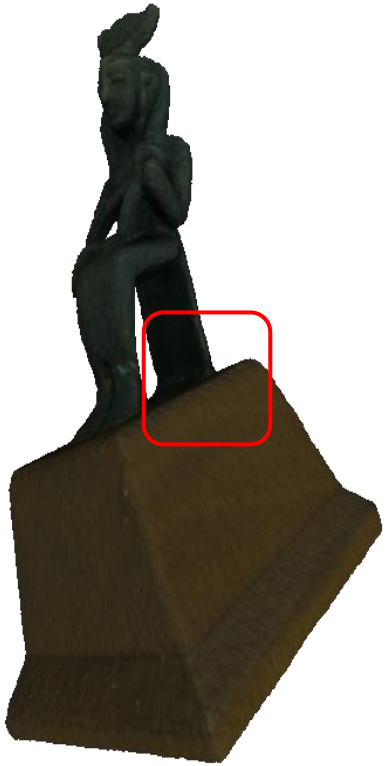
It is necessary that the produced 3D models of the artefacts respond to reality as much as possible.
Some 3D models have bumps on their surface, that do not correspond to the real items. These bumps probably are produced due to the flat surface of the artefact.

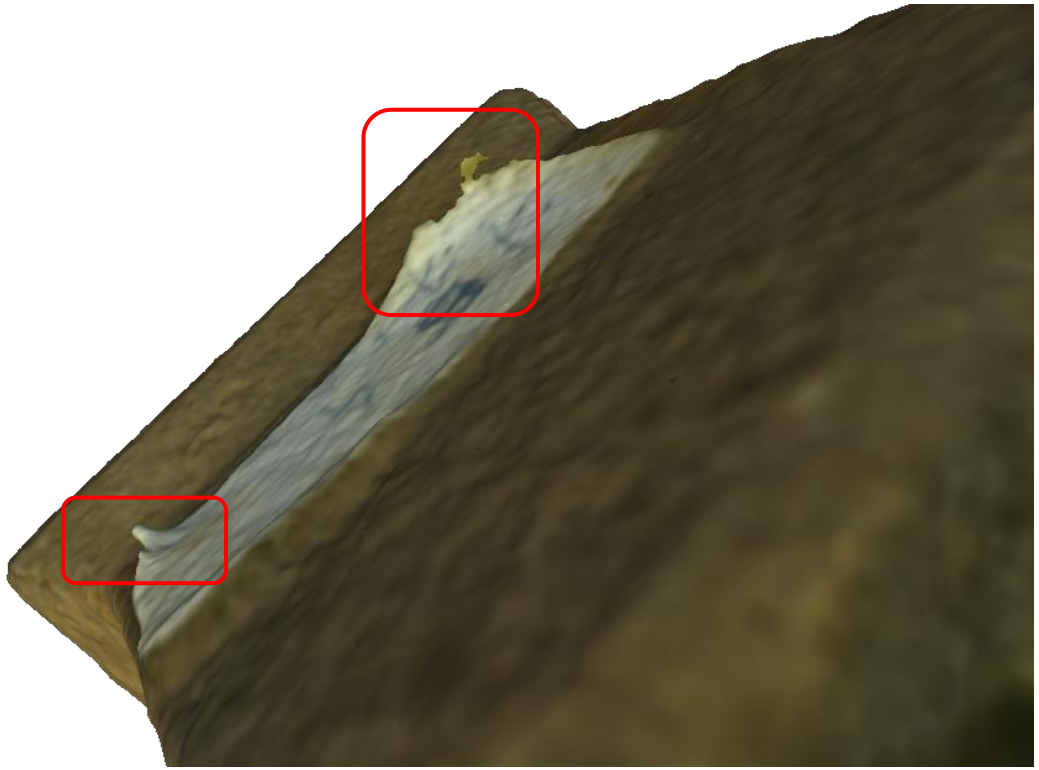
Example 6:

3D model with bumps (left) and reconstructed with a smooth surface (right).

4. 3D model compactness and quality.

Example 7:





5. Scale and Orientation.

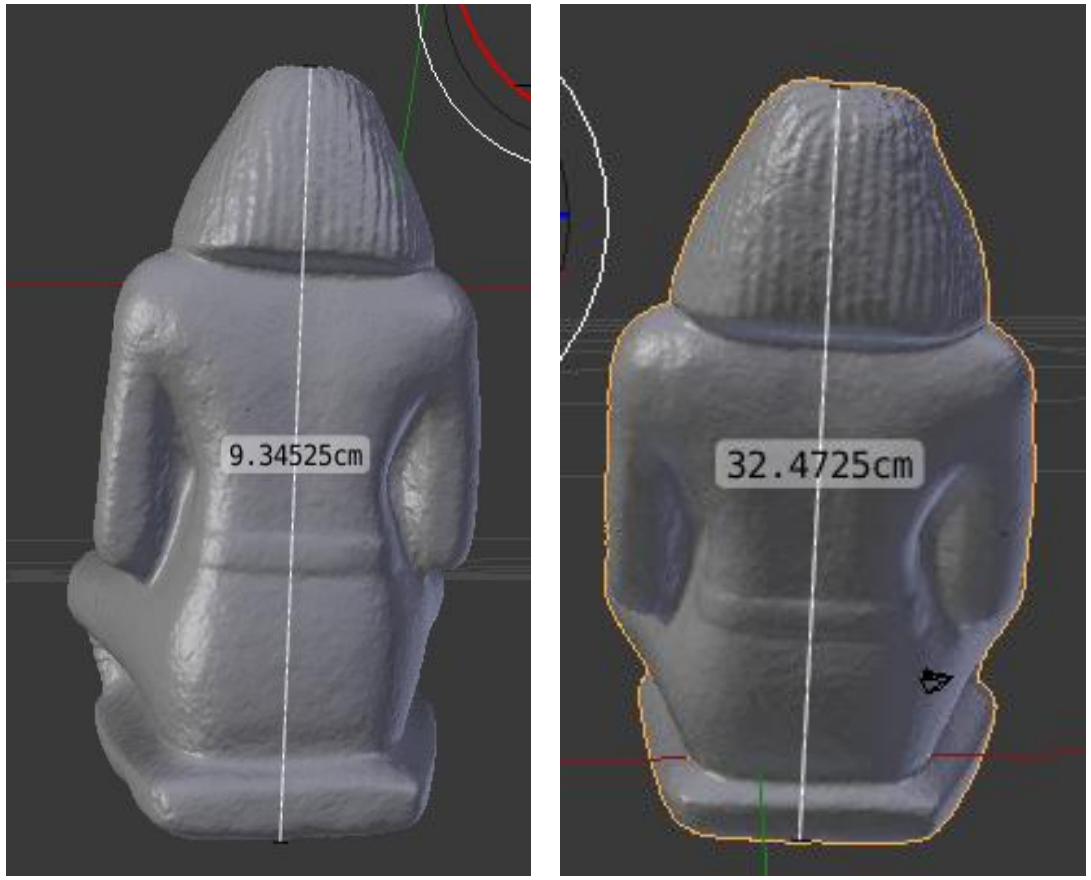
Scale and Orientation are two important parameters in order to bring the produced 3D model to reality.

Using markers one can **set the real dimensions (height, width, length) of the object** and important information can be extracted, such as the volume of the object.

Orientation is also required to be correctly set because these objects will be used as exhibits to a virtual museum. Thus, this is especially important in the case of 3D printing these models.

5. Scale and Orientation.

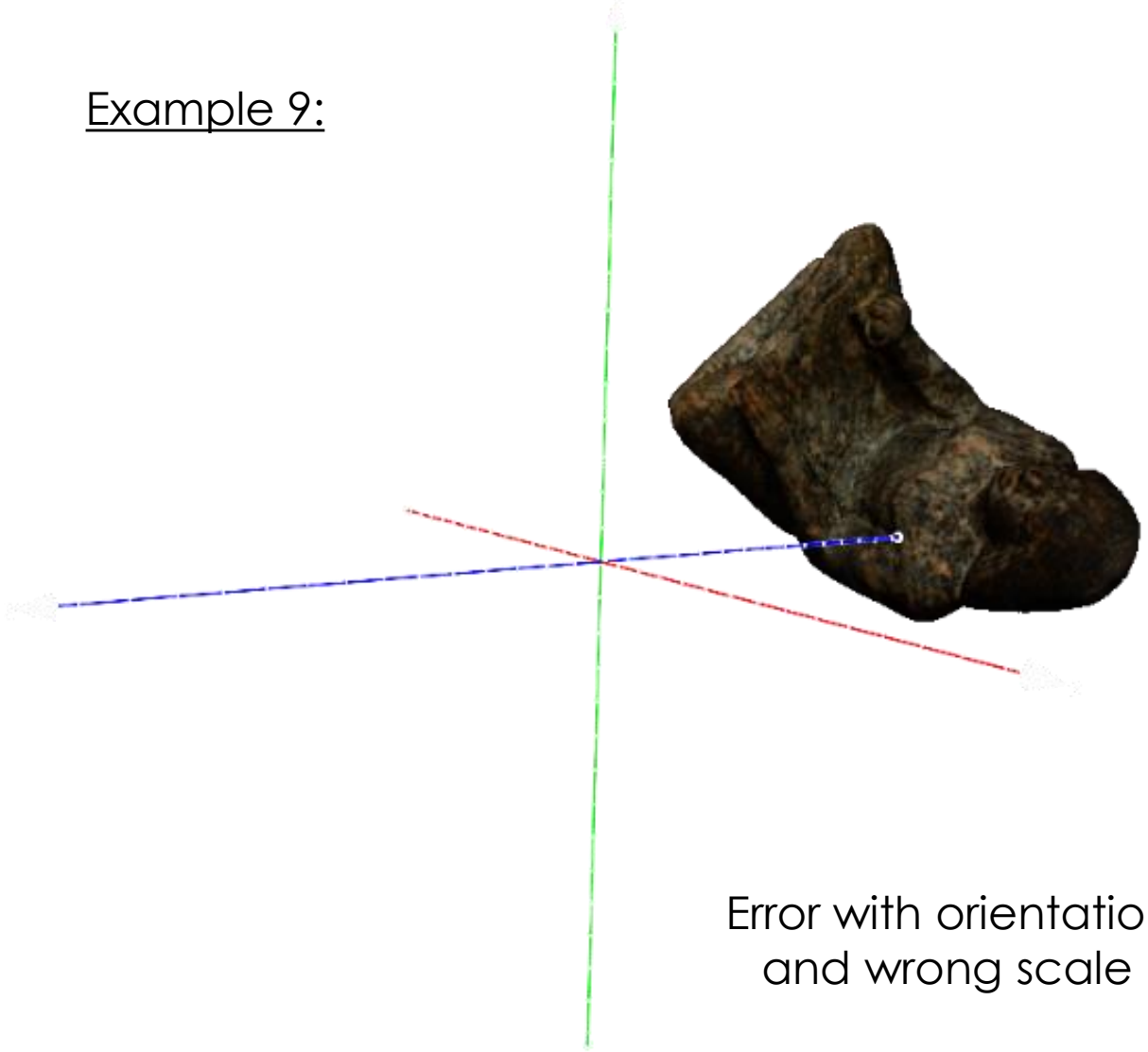
Example 8:



Wrong height (left) and corrected (right).

5. Scale and Orientation.

Example 9:



Error with orientation (left) and wrong scale (right).