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THE USE OF 3D SCANNING AND PRINTING IN CONSERVATION AND RESTORATION TREATMENT OF DELFT BLUE-AND-WHITE TULIP PYRAMIDS

INTRODUCTION

Traditionally conservators use mould making and casting technique to make objects missing sections. A mould is made usually in sillicone rubber and the missing parts are casted either in plaster or a resin. This poster explains in a nutshell a different approach to the same problem using 3D scanning and 3D printing technologies on a pair of 17th Century Dutch Delft Blue-and-White Tulip Pyramids.

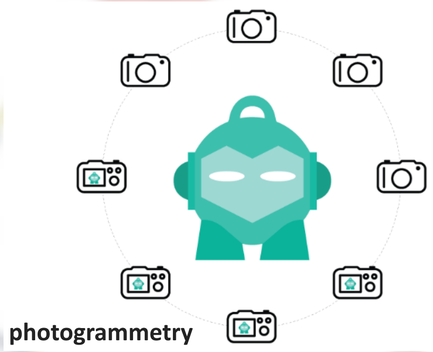
3D SCANNING AND 3D PRINTING EXPLAINED

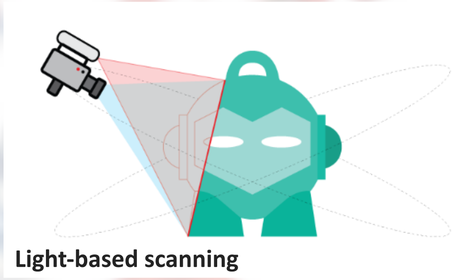
3D Scanning technologies allow for the creation of of 3-dimensional objects. By using 3D scanning you will be able to capture a digital copy of a physical real world object. There are roughly two relevant techniques of 3D scanning:

1. ***Photogrammetry*** - The method is based on taking 2D pictures around an object, from different angles, and stitching them together into a single 3-Dimensional image. The last part being handled by software. It only requires a camera to do so and that means that you can go ahead and do it right now, even with your smartphone!
2. **Light-based scanning** - There's two common types of light based scanners used for 3D scanning - *"structured light"* and *"laser scanning".*

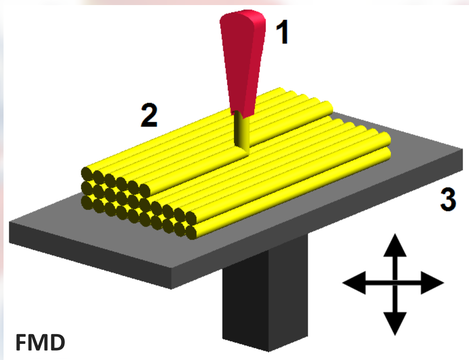
Structured light scanners send patterns of light onto the object to capture. Based on the deformations of the pattern it determines the model form and creates a 3D mesh, or digital replica.

Laser scanning uses a slightly different method. It measures the angle of the reflected lasers which it can translate into coordinates of an object and therefore into a 3D mesh.


photogrammetry


Light-based scanning

3D printing or additive manufacturing is a process of making three dimensional solid objects from a digital file. The creation of a 3D printed object is achieved using additive processes. In an additive process an object is created by laying down successive layers of material until the entire object is created. Each of these layers can be seen as a thinly sliced horizontal cross-section of the eventual object. To prepare a digital file for printing, the 3D modelling software "slices" the final model into hundreds or thousands of horizontal layers. When the sliced file is uploaded in a 3D printer, the object can be created layer by layer. The 3D printer reads every slice (or 2D image) and creates the object, blending each layer with hardly any visible sign of the layers, with as a result the three dimensional object.

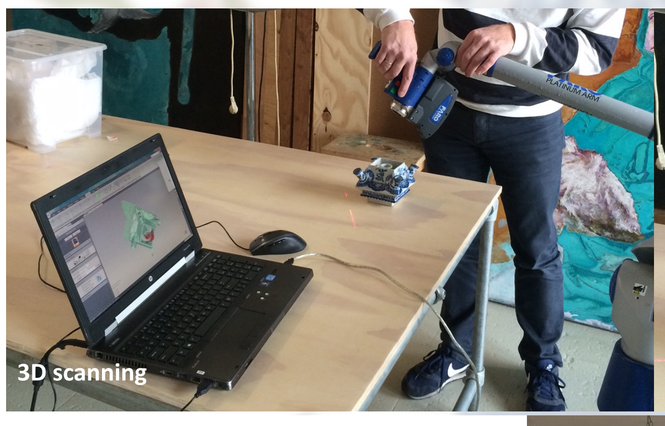


FMD

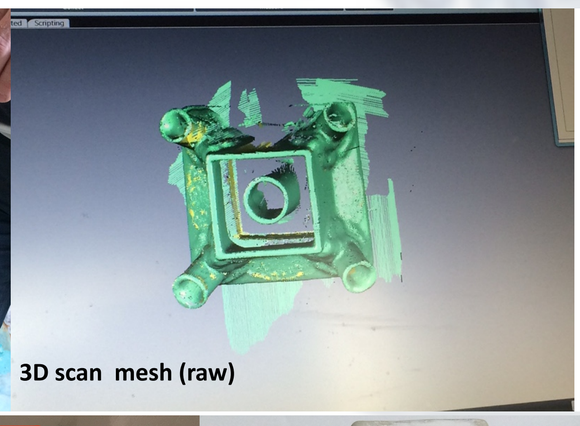
CASE OF TULIP PYRAMIDS EXPLAINED IN PHOTOS

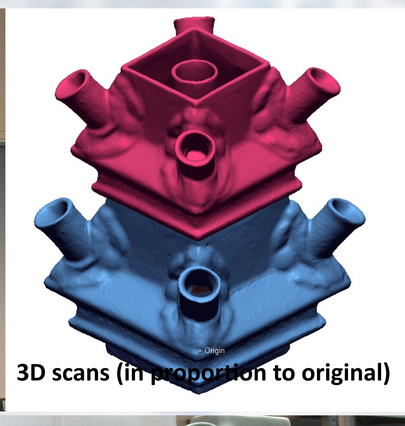
For the making of missing sections Laser scanning technique and the prints were made in so called Fused deposition modeling (FDM) was applied. The FDM technology works using a plastic filament or metal wire which is unwound from a coil and supplying material to an extrusion nozzle which can turn the flow on and off. The nozzle is heated to melt the material and can be moved in both horizontal and vertical directions by a numerically controlled mechanism, directly controlled by a computer-aided manufacturing (CAM) software package. The object is produced by extruding melted material to form layers as the material hardens immediately after extrusion from the nozzle.

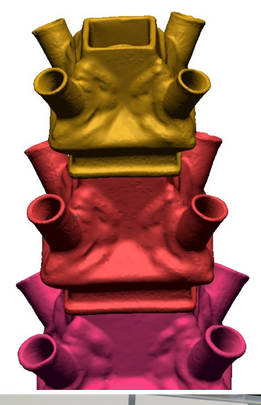
The pair of Tulip Pyramids are made of separate sections stacked on the top of each other and both towers originally consisted of eight sections. Unfortunately both towers were missing two of the exact parts. Photo's below show the process of 3D scanning and the treatments of 3D prints during the project with the final results.

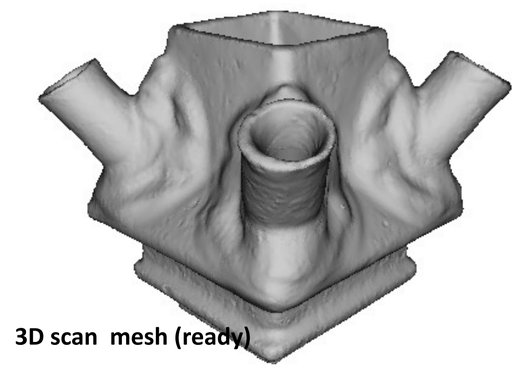

3D scanning

3D scanning


3D scan mesh (raw)


3D scans (in proportion to original)

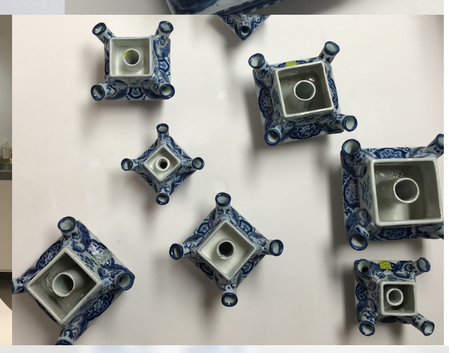


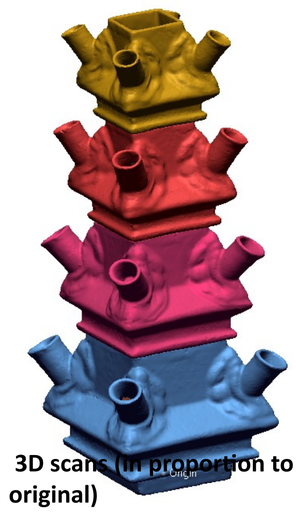

3D scan mesh (ready)

preparation of 3D scans for retouching

3D scans retouching

3D scans retouching




3D scans (in proportion to original)