Democratization of 3D Reconstruction

A LOW-COST ALTERNATIVE TO AGISOFT METASHAPE

Purpose

As an archaeologist and GIS specialist one of my areas of interest is the intersection of the past and technology's ability to make it accessible to the masses. With the advent of low cost, portable systems to detect, record, analyze, and display not only positional quantitative data but qualitative data, the economic barriers to this technology are becoming more porous. Given the recognized utility of 3D modeling software in archaeology, both on the site and artifact level, it must be asked whether a freeware option possesses suitable utility to be deployed where subscription based programs are economically unfeasible.

- Off-white, modeled from real skull based on features and my osteology experience. Floral and geometric patterns in bas-relief on surface. Halloween decoration.
- Approximately 5.5”H x 7.25”L
- Blackout curtain material background

Input

- 40 .jpg taken with my iPhone XR
- 51.6MB total
  - 943KB each
  - Pixels 3024 x 4032
  - Resolution 72 dpi
  - Bit depth 24

- 40ea .jpg taken with iPhone XR 12MP camera at approximately 12in. standoff. Pictures taken using patterns and techniques outlined in Agisoft online training document “Full body/head scanning capture tips.”
- 51.6MB total
  - 943KB each
  - Pixels 3024 x 4032
  - Resolution 72 dpi
  - Bit depth 24

System Used

- CPU: AMD FX-6300 Six-Core Processor 3.50 GHz
- RAM: 8 GB
- 64-bit operating system
- Windows 10; Version 2004
- GPU: AMD Radeon RX 560 w/4GB RAM

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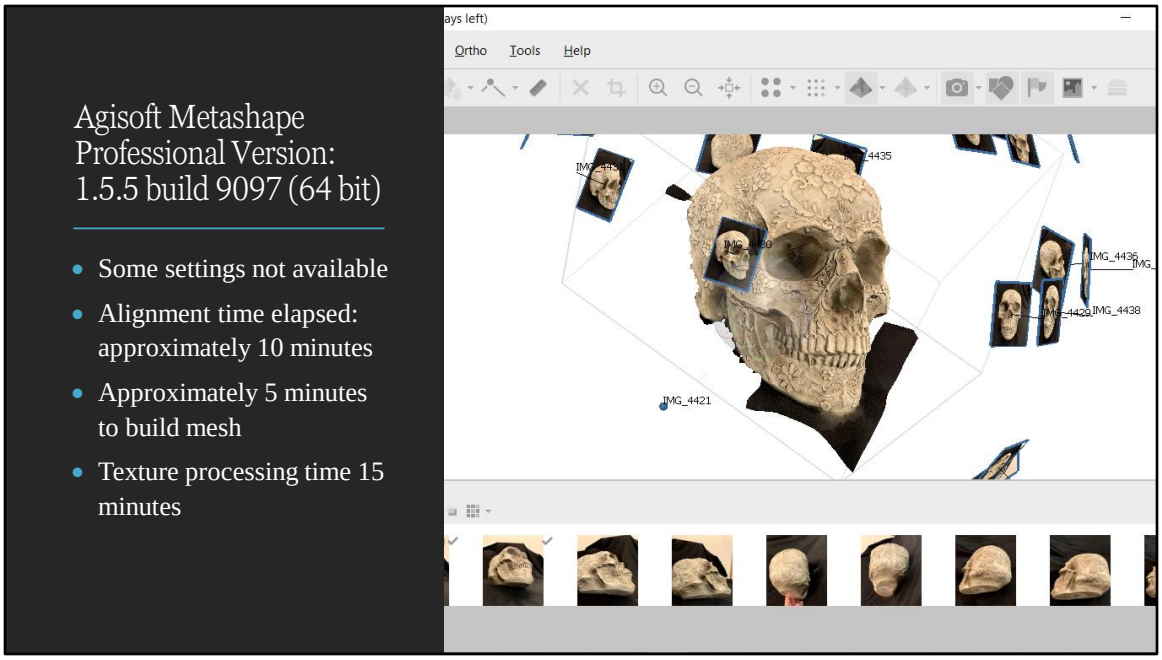


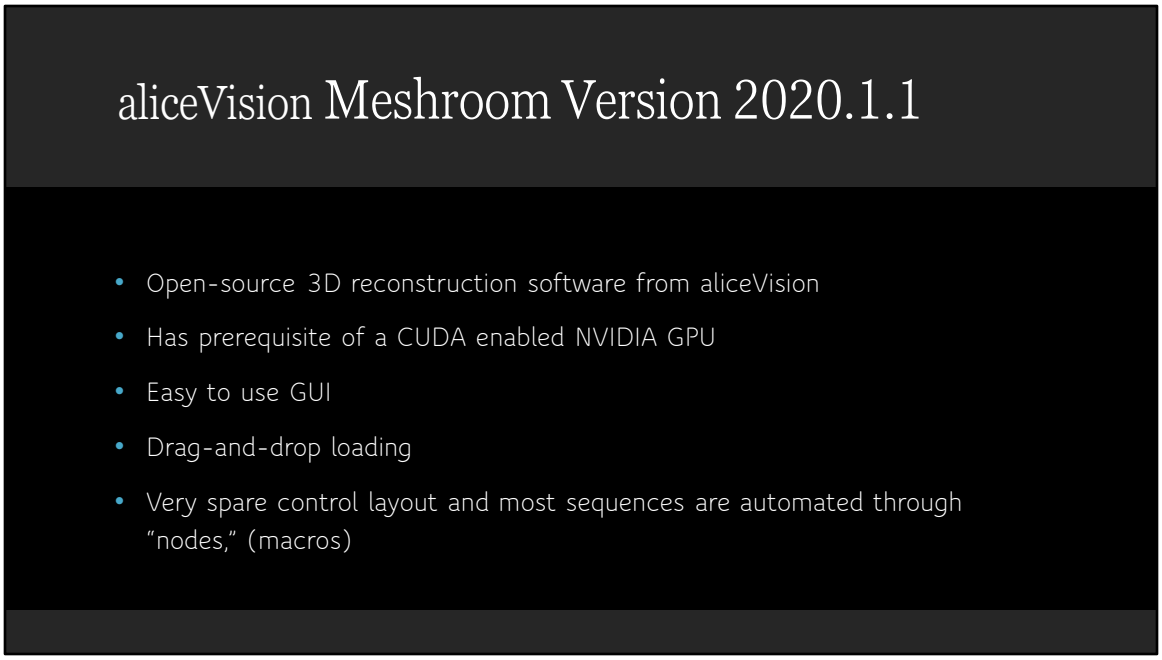
Agisoft "3D Model Reconstruction" online tutorial document was followed as closely as possible. Options available at mesh building, texture building, and export steps did not allow selection of some recommended settings despite current build of Metashape Pro and recent update of the document on 8 October 2020. Agisoft supports both NVIDIA and AMD for GPU acceleration.

- Photo alignment time elapsed: approximately 10 minutes. Seven photos failed to align, 33 aligned. Approximately 5 minutes to build mesh

- First attempt to build texture using recommended setting of 16,000 “Texture size/count” resulted in a consistent estimate of approximately 11 hours to completion. Second attempt, with setting of 10,000 resulted in 15 minutes processing time.

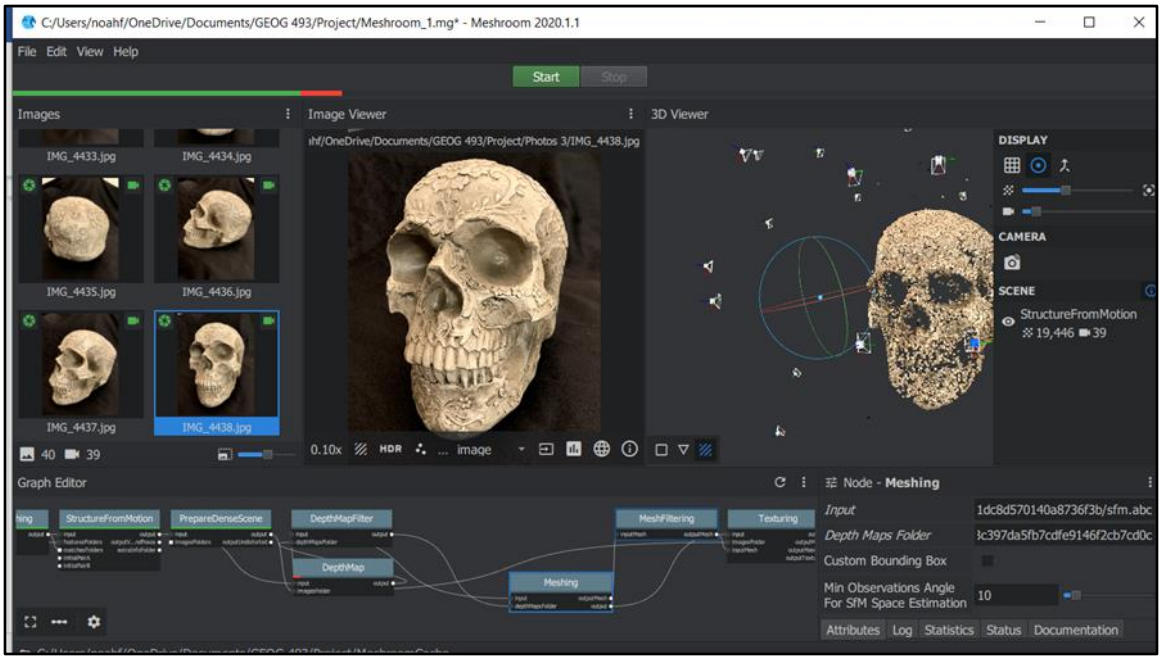
Metashape Exports

- 3.94MB .obj
- 10.1MB .jpg
- Cannot display .mtl file without Adobe Photoshop



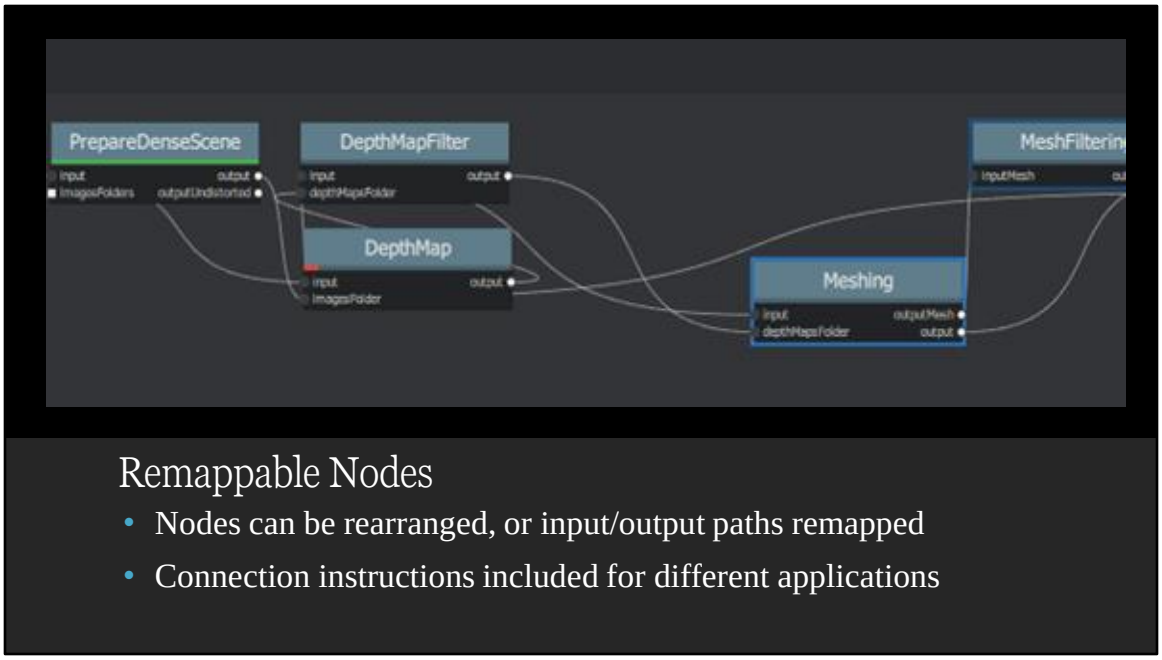
- Meshroom is open-source 3D reconstruction software from aliceVision, a European non-profit founded by 14 academics and members of industry with the goal of democratizing 3D reconstruction.
- This program has a prerequisite of a CUDA enabled NVIDIA GPU, this prevented me from completing the process despite a written procedure to bypass this requirement at lower resolution. Thus, all I could analyze were the initial steps, and the user interface.
- The interface has a very spare control layout and most sequences are automated through "nodes," a set of

macros that allow for the least technical understanding of the programmatic functions. These macros can be rearranged or input/output paths remapped, or even provide different outputs.



One simply loads photos into Meshroom by drag-and-drop, or a menu option. Unlike Agisoft, Meshroom recognizes and can extract .zip files. Once all “cameras” are loaded, one simply presses the large, friendly “Start” button at the top of the display. Within approximately 10 minutes, the dense point cloud was plotted and ready for depth mapping. This was the step my GPU was not capable of performing, thus halting my analysis of the process. The Meshroom guide shows a detailed flow chart to bypass the full Depthmap rendering and create a low resolution mesh to preview objects without a CUDA enabled GPU. I found however that the text instruction is

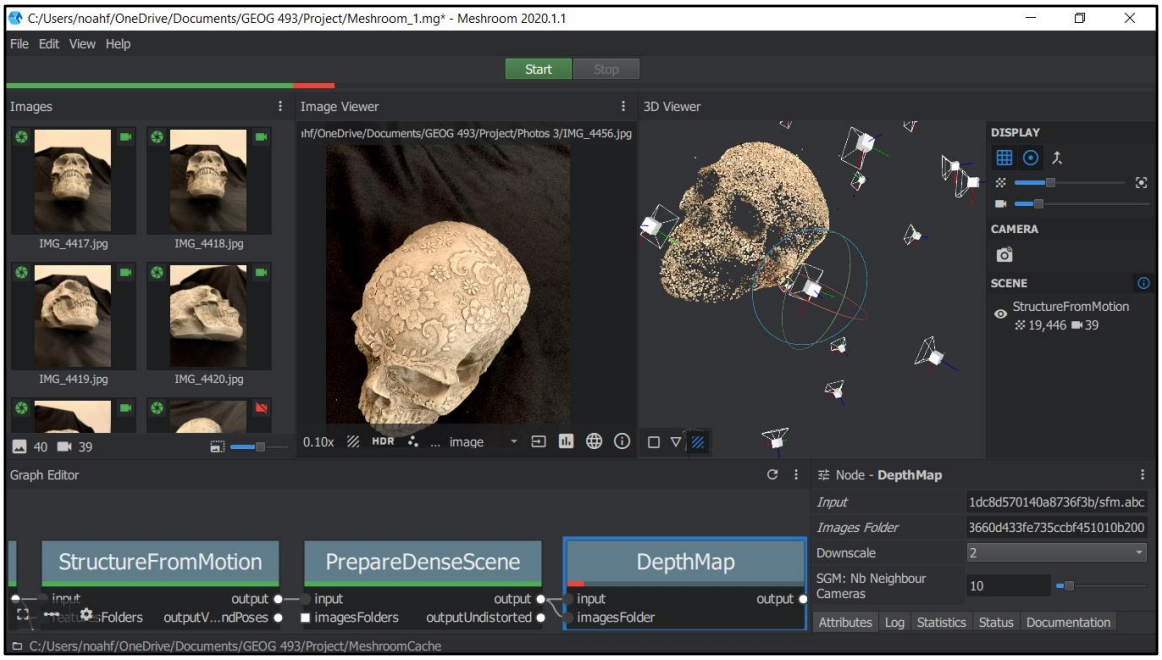
vague, and the graphics do not match the actual program as it stands in its current build. If the point cloud is a reliable indication, Meshroom appears to have been able to identify enough points to reconstruct the back, and base of the skull, unlike Agisoft.



Remappable Nodes

- Nodes can be rearranged, or input/output paths remapped
- Connection instructions included for different applications

All in all this software was simple to use, the plug-and-play functions intuitive for anyone familiar with modern GUIs. Though its reliance on a high-end GPU does not make this a truly democratic software, it certainly mitigates the entry pricepoint for 3D reconstruction.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Input
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Images Folder
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Downscale
2
SGM: Nb Neighbour Cameras
10
Attributes Log Statistics Status Documentation
C:/Users/noahf/OneDrive/Documents/GEOG 493/Project/MeshroomCache

Resources

- https://www.macworld.com/article/3433784/shoot-to-thrill-three-camera-features-the-iphone-should-add.html
- https://www.newegg.com/cyberpowerpc-gamer-xtreme-9767s/p/N82E16883230474
- https://www.agisoft.com/
- https://alicevision.org/