CV_Midterm_scan_statue_Shadow3D

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Introduction

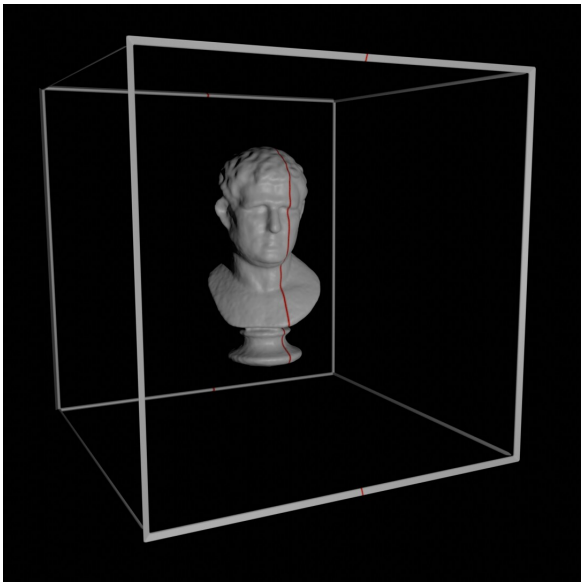
- In essence, the task involves utilizing homography to estimate distance values and coordinates of laser-scanned areas. The primary objectives can be divided into three main tasks:

1. Image Processing ⇒ Determining the src/target range points required for homography calculation.
2. Homography ⇒ Computing and storing the resulting images of each slice as .jpg files for subsequent coordinate calculations.
3. Size Transformation and Point Cloud Generation ⇒ Sequentially reading .jpg image files, calculating size transformations, outputting actual coordinates, and merging them into a .xyz point cloud file.

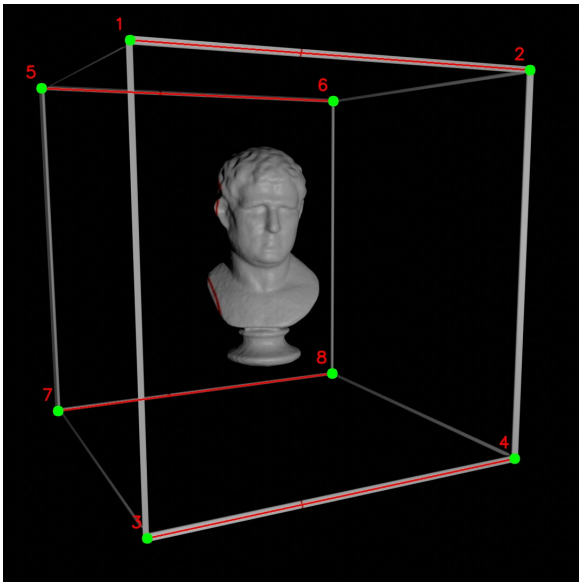
Methodology

Part 1: Image Processing

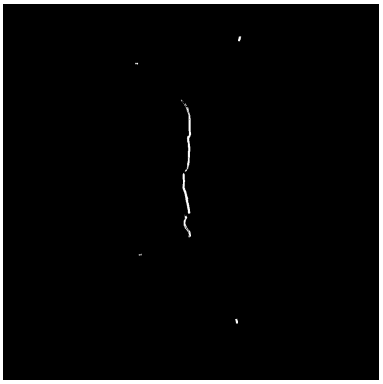
⇒ Determination of src/target range points required for homography.



Input Image

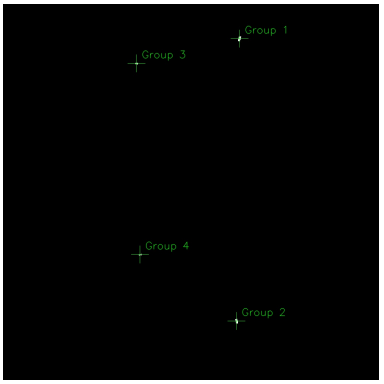


Reference Coordinate Map (Custom)



Binary Red Channel Thresholding

Removal of central statue area

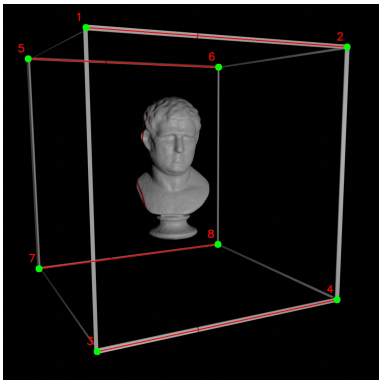


Retaining coordinates of four small regions on the frame where the laser is projected.

Calculation of equations for all coordinates and four frame edges, grouping coordinates based on proximity to an edge line equation, and averaging to obtain homography coordinate points for each slice.

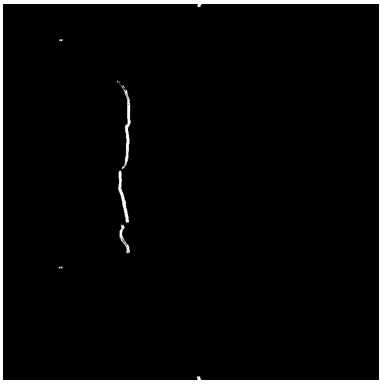
Part 2: Homography

⇒ Calculation and storage of result images for each slice as .jpg files for subsequent coordinate calculations.



Reference Endpoint Map

Mapping result to the “left” plane of the frame

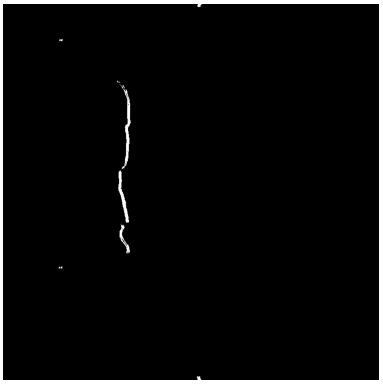


Mapping result to the “front” plane of the frame

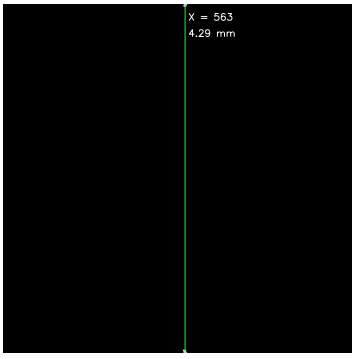
Part 3: Size Transformation and Point Cloud Generation

⇒ Sequential reading of .jpg image files, calculation of size transformations, outputting actual coordinates, and merging into a .xyz point cloud file.

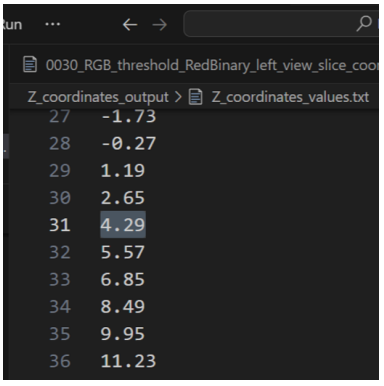
- Calculation of Z-direction displacement (same direction as laser translation).



"Front" plane used as input.



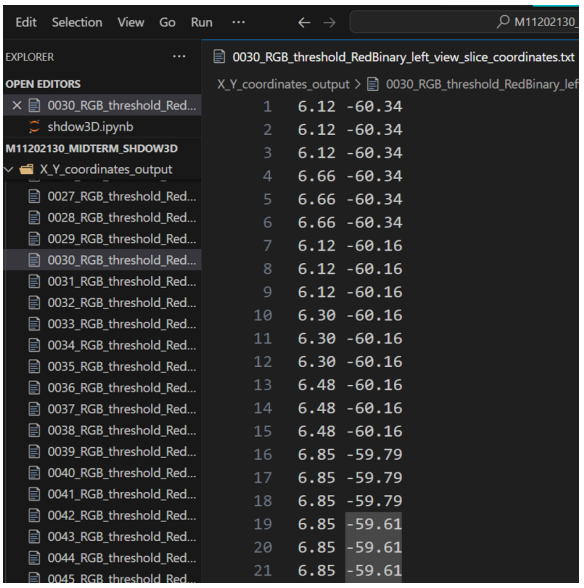
Taking two spots projected by the laser on the front frame, averaging their horizontal values to obtain Z-direction displacement.



Output: Z_coordinates.txt

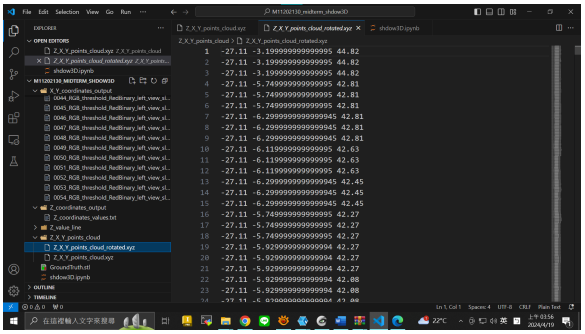
- Calculation of coordinates for each mapped slice on the sides.

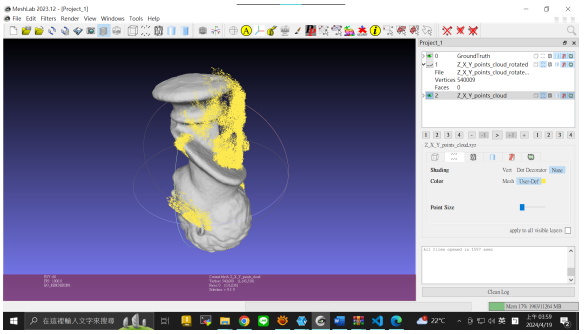
"Left side" plane used as input.



Output: XY_coordinates.txt

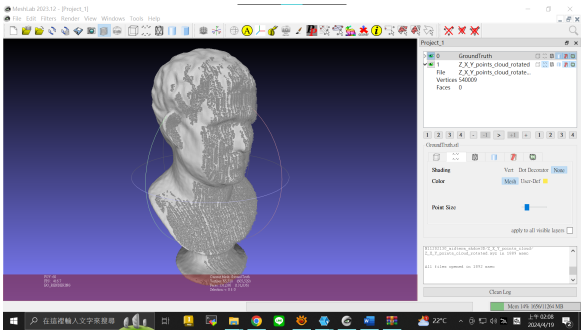
- Merging coordinates and saving as a point cloud .xyz, and addressing the order of operations and point cloud rotation issues.

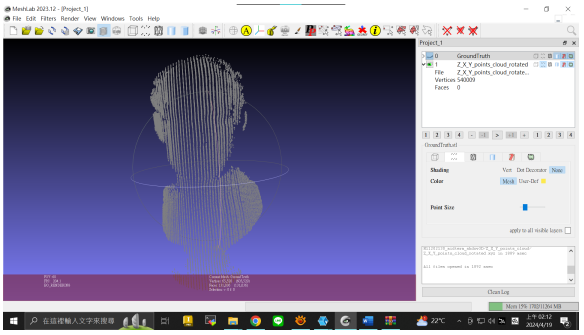




Results and Discussion

- Presentation and interpretation of results, including comparison with ground truth.





- Future work：

  There isn't much to say; the results are satisfactory and meet expectations.

  The only noteworthy point is that when I used the rotation feature in MeshLab, I noticed that the point cloud, which represents the scanned results, appears to be composed of overlapping slices. Attached is an overhead view. I'm not sure if this is a limitation of the laser.

  If modifications are necessary, besides increasing scanning precision or narrowing the displacement intervals, perhaps taking more shots from different angles (this time only one photography angle was provided) might produce a fused result that doesn't give the loose feeling of stacked slices.