INFORMATION

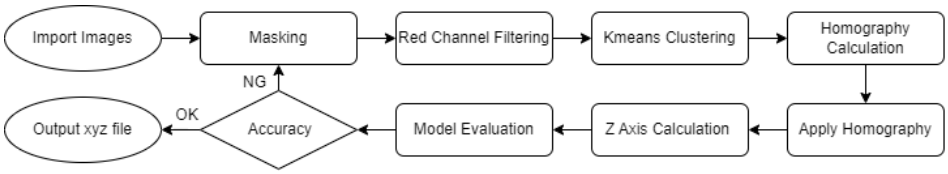
Course Name：Computer Vision and Applications

Student Name：Zheng-Lin, Wu

Student ID：R12522636

Subject：Midterm project

SOLUTION FLOW



METHODOLOGY

1. **Masking:** Using rectangular masks to separately block the model and the outer cubic frame. This facilitates the subsequent extraction of red points on the cubic frame and laser scan data points.

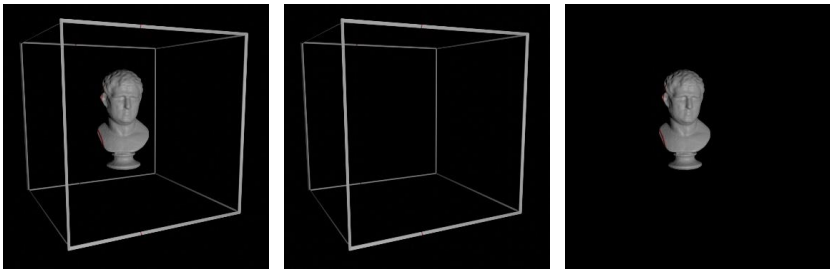


Figure 1: The left image shows the original image. The middle image displays the application of a mask to isolate only the outer cubic frame of the model. The right image exhibits the application of a mask to isolate only the model, leaving out the outer cubic frame.

2. **Red Channel Filtering:** After separately reading the images processed by masking, applying simple mathematical morphology operations facilitates the subsequent filtering of red points in the images. Following this, the images are converted from BGR channel to HSV channel, and a threshold is set to filter out the red pixels in the images.

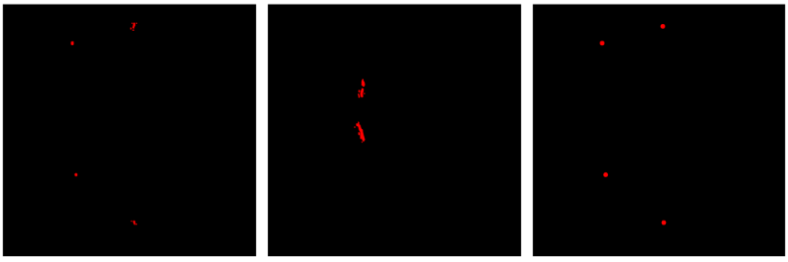


Figure 2: The left image displays a cluster of red points on the outer cubic frame. The middle image shows a cluster of laser scan points on the model. The right image depicts four approximate pixel points on the outer cubic frame, obtained through kmeans clustering of the red points.

3. **Kmeans Clustering:** Utilize the sklearn kmeans algorithm to approximate four points for the filtered cubic points.
4. **Homography Calculation:** Transform all four points of the images to the coordinates [98.5, 98.5], [-98.5, 98.5], [-98.5, -98.5], [98.5, -98.5] through homography.
5. **Apply Homography:** Apply the calculated H matrices to the pixels of the red scan line model extracted from the images.
6. **Z Axis Calculation:** Select the pixel coordinates of the left and right boundaries from the images, and interpolate along the x-axis. In this project, the interpolated values of all four boundary points are averaged to obtain the Z-axis coordinates.

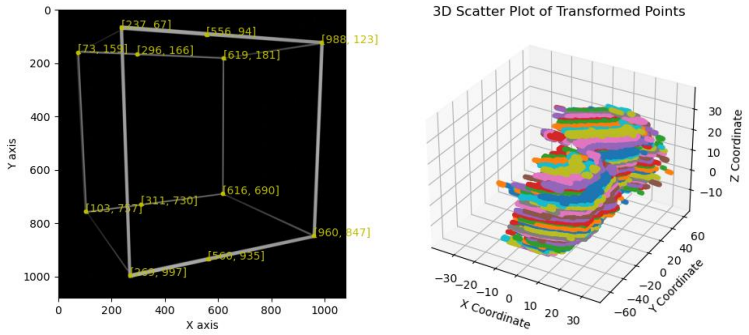


Figure 3: The image on the left confirms the visualization before interpolation calculation. The image on the right demonstrates the use of matplotlib to plot a three-dimensional array in the program.

7. **Model Evaluation:** Export xyz files and import them into meshlab for evaluating the reconstruction accuracy.

CONCLUSION & COMPARISON

If possible, areas with larger deviations should be identified, and the causes of these discrepancies should be assessed. Consider improving parameter settings during the scanning process.

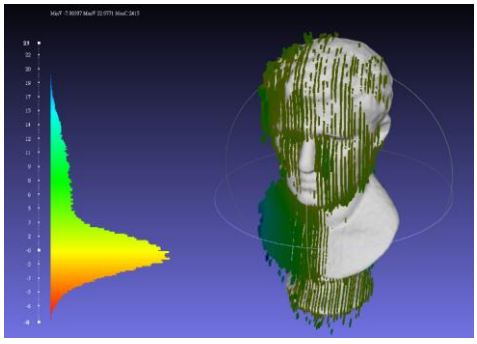


Figure 4: The 3D facial reconstruction comparison between the reference model (STL) and measured data (XYZ) shows consistent maximum deviations (22.977mm), with a low average discrepancy (1.659mm) and a higher RMS value (5.037mm). Some areas may require refinement, indicated by larger variances, to enhance the reconstruction accuracy.