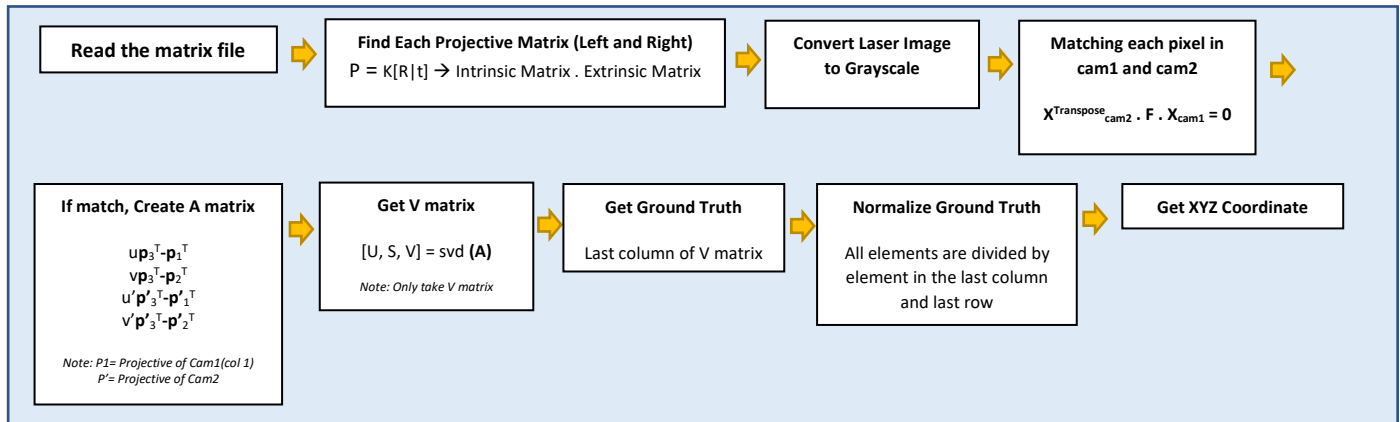# Objective:

Reconstruct 3D from stereoscopic images and colorize the result.
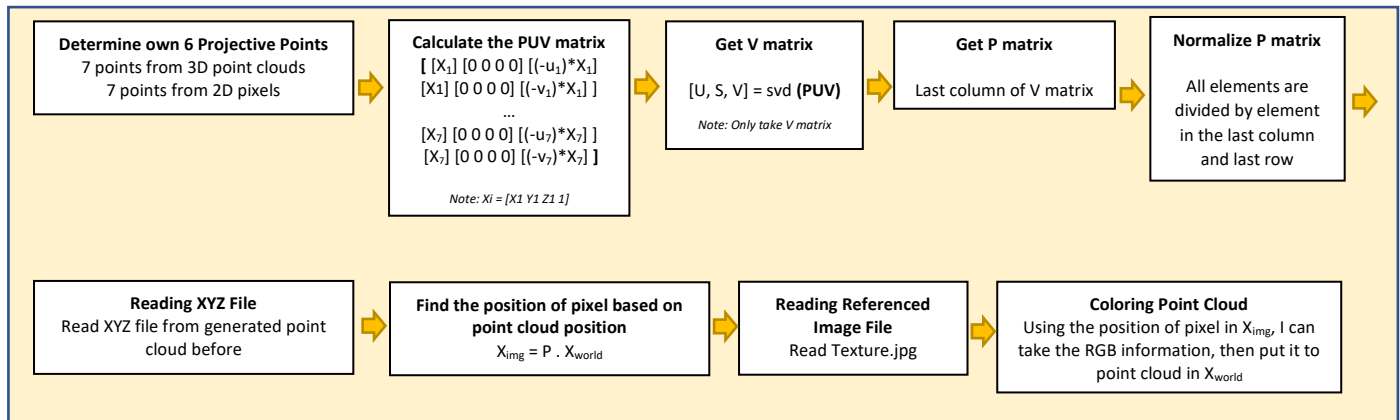
The Flowchart of process:

I split the programs become 2: Generating Point Cloud and Coloring Point Cloud
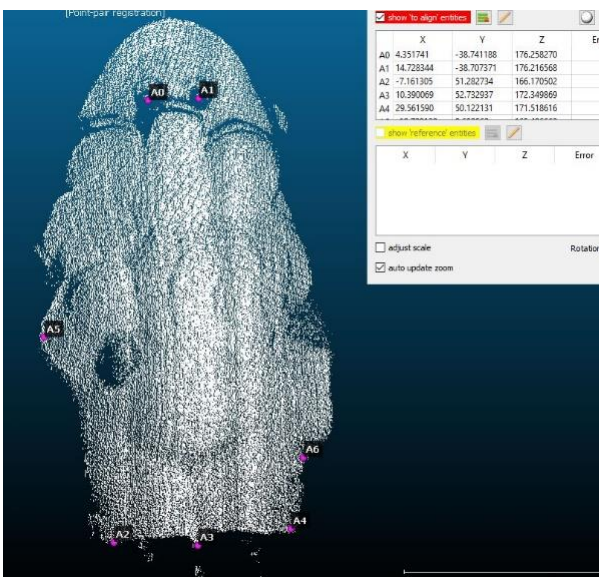
Generating Point Cloud

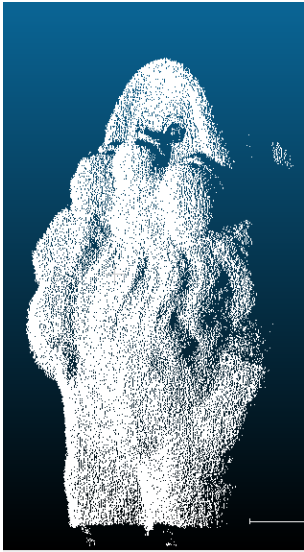| Read the matrix file | → | **Find Each Projective Matrix (Left and Right)** $P = K[R|t] \rightarrow$ Intrinsic Matrix . Extrinsic Matrix | → | **Convert Laser Image to Grayscale** | → | **Matching each pixel in cam1 and cam2** $X^{Transpose}_{cam2} . F . X_{cam1} = 0$ | → |

| **If match, Create A matrix** $u p_3^T - p_1^T$ $v p_3^T - p_2^T$ $u' p'_3^T - p'_1^T$ $v' p'_3^T - p'_2^T$ *Note: P1= Projective of Cam1(col 1)* *P'= Projective of Cam2* | → | **Get V matrix** [U, S, V] = svd **(A)** *Note: Only take V matrix* | → | **Get Ground Truth** Last column of V matrix | → | **Normalize Ground Truth** All elements are divided by element in the last column and last row | → | **Get XYZ Coordinate** |

Coloring Point Cloud

| **Determine own 6 Projective Points** 7 points from 3D point clouds 7 points from 2D pixels | → | **Calculate the PUV matrix** [$[X_1]$ [0 0 0 0] $[(-u_1)*X_1]$ $[X1]$ [0 0 0 0] $[(-v_1)*X_1]$] ... $[X_7]$ [0 0 0 0] $[(-u_7)*X_7]$ $[X_7]$ [0 0 0 0] $[(-v_7)*X_7]$] *Note: Xi = [X1 Y1 Z1 1]* | → | **Get V matrix** [U, S, V] = svd **(PUV)** *Note: Only take V matrix* | → | **Get P matrix** Last column of V matrix | → | **Normalize P matrix** All elements are divided by element in the last column and last row | → |

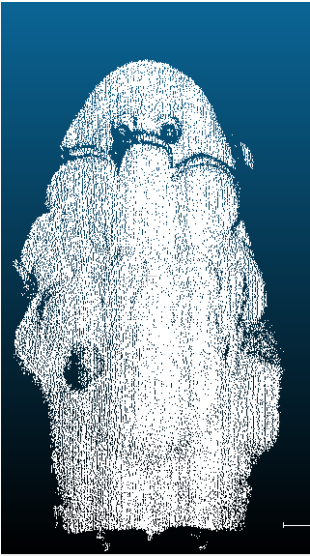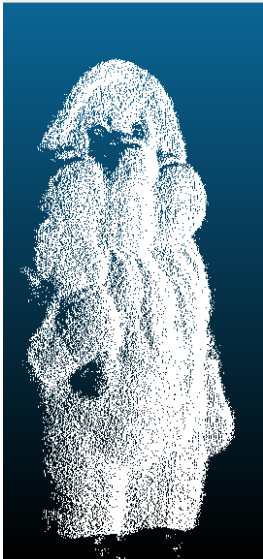| **Reading XYZ File** Read XYZ file from generated point cloud before | → | **Find the position of pixel based on point cloud position** $X_{img} = P . X_{world}$ | → | **Reading Referenced Image File** Read Texture.jpg | → | **Coloring Point Cloud** Using the position of pixel in X_{img}, I can take the RGB information, then put it to point cloud in X_{world} |

The 6 chosen projective points:

Result:

I. Generate Point Cloud

Left View	Front View	Right View

Top View	Bottom View

II.   Coloring the Point Cloud

Left View	Front View	Right View

Top View	Bottom View	Reference image

Observation:
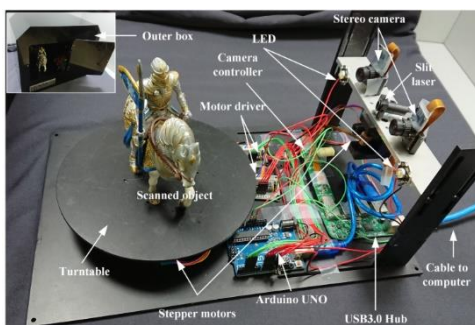
In my observation, the inaccurate result of colored point clouds is because of Professor took the picture just from one view, that's why the top of the nose of statue has eye. I think if the camera is put on the slit laser position will give better result.