

CS 532 – 3D Computer Vision

Assignment 3

Overview

The assignment required us to construct a 3D point cloud given images of a dancer from all directions. The approach for the algorithm was to divide the voxel space into the number of voxels that we want to split into. Every voxel point was traversed, and projection matrices were used to project the voxel into 2D space. Voxels that projected into the silhouettes were chosen while the others were discarded.

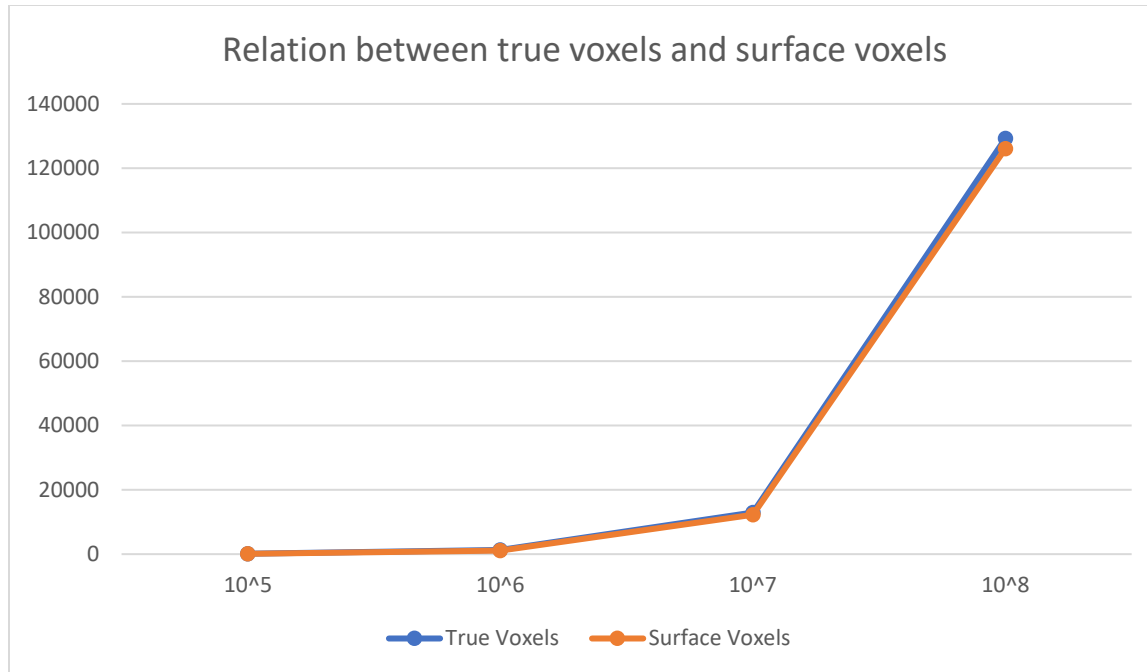
The number of voxels was chosen to be 10^8 as it provides good detail while not running for too long. However, I tested the range from 10^5 to 10^9 voxels and provided the PLY file for all of them. The table below lists the time of execution for each range. The execution time grows exponentially due to the time complexity of the algorithm being $O(n^3)$ where n is the number of voxels. A good number should be chosen for the number of voxels as increasing the voxels would result in a much more defined 3D point cloud.

Number of voxels	Execution time (in seconds)
10^5	0.562044
10^6	4.951686
10^7	49.983279
10^8	568.765283

In addition, the assignment asks us to find the ratio of true voxels with the total amount of voxels. The following table lists the total number of voxels with the true voxels and surface voxels detected. This could be seen as the number that shows with the corresponding variable in MATLAB in the Workspace window.

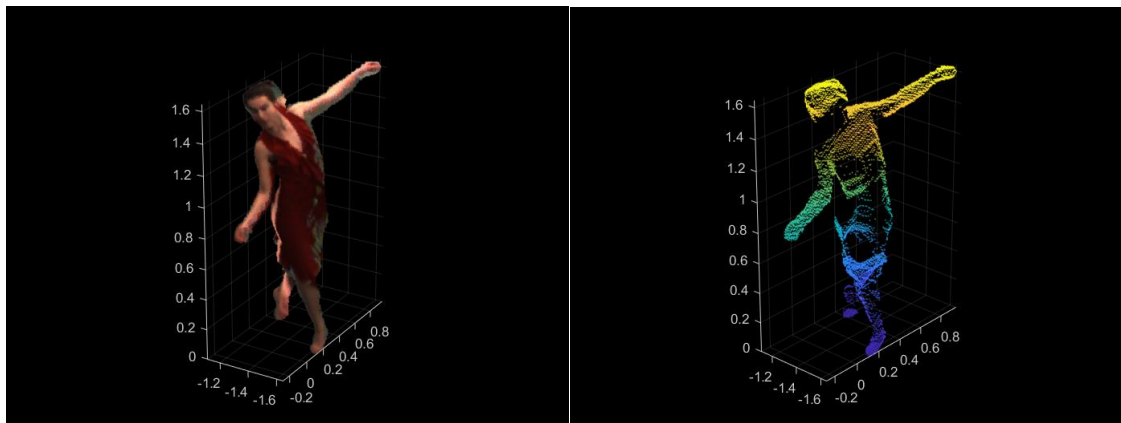
Number of voxels	Number of true voxels	Ratio of true voxels to total	Number of surface voxels	Ratio of surface voxels to total
105056 (10^5)	129	0.001227	103	0.00098
1021020 (10^6)	1287	0.00126	1145	0.001121
10059776 (10^7)	12941	0.001286	12264	0.001219
100522236 (10^8)	129257	0.001285	126109	0.001254

The chart below sums up the relationship. The ratio remains more or less the same which can be an estimate to calculate the number of true voxels and surface voxels given the voxel count.



Output

The following figure shows the 3D point cloud with voxel count of 10^8 . All the other PLY files are in the 'output' folder. The folder contains the color, non-color and surface point cloud images. To color the image, the last image from the camera was chosen.



The first image shows us the 3D point cloud with color.

The second image shows us the surface voxels.