1 Shape from Silhouettes

For the bounding box we defined minX, minY, minZ as 0.25, -0.25 and -2. For maxX, maxY and maxZ we used 2.25, 1.25 and 2.5. The silhouette threshold was set to 100 and the volume resolution is set to $256 \times 256 \times 512$. Using an optimized loop when filling in the voxels this only takes around 1-2 minutes of computation and uses around 3-5 GB of memory. Please note that due to the size restriction of the submission the included .fig file of the 3D model was created using a lower resolution of $64 \times 64 \times 128$.

The algorithm works as follows. We first compute the silhouette of the images by checking if a given pixel in the original image is above the silhouette threshold, if this is the case we set the corresponding silhouette pixel to 1, else to 0. We then define the transformation matrix from volume to world coordinates and the transformation matrix from world to image space. Using these two transformations we can transform the position of a voxel in volume space into a pixel in image space. This is already done for the eight bounding box corners. We then compute the visual hull, this was first done naively by having four interleaved loops, three for the dimensions and one for the number of cameras. For each image we transform every voxel in our bounding box volume into a pixel in the image and check whether the silhouette matrix at that pixel location is zero or one, if it is one, we add this as a contribution to the voxel which we are currently considering. The optimized implementation of this step only needs to loop over the number of cameras as it can compute the voxel to pixel transformation for all voxels in one pass, the approach is very similar to the one already implemented for the bounding box corners.

A couple of improvements we could make: First off we could color the statue using a voxel coloring algorithm, secondly, by using more images coupled with a higher resolution of the bounding box volume we would get a better looking 3d model. In case this becomes computationally infeasible, we could smoothen the 3d model by applying a gaussian kernel with a small variance.

Figure 1: using silhouette threshold equals to 100.

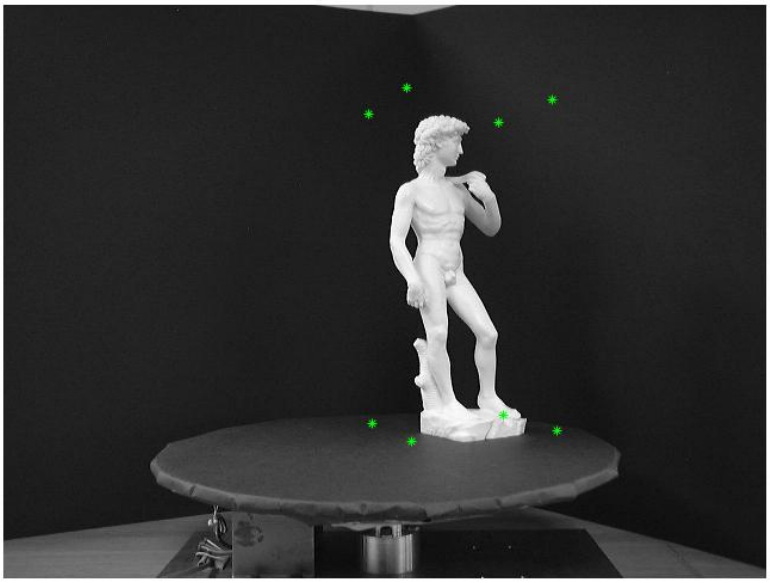

Figure 2: green dots represent corners of bounding box.

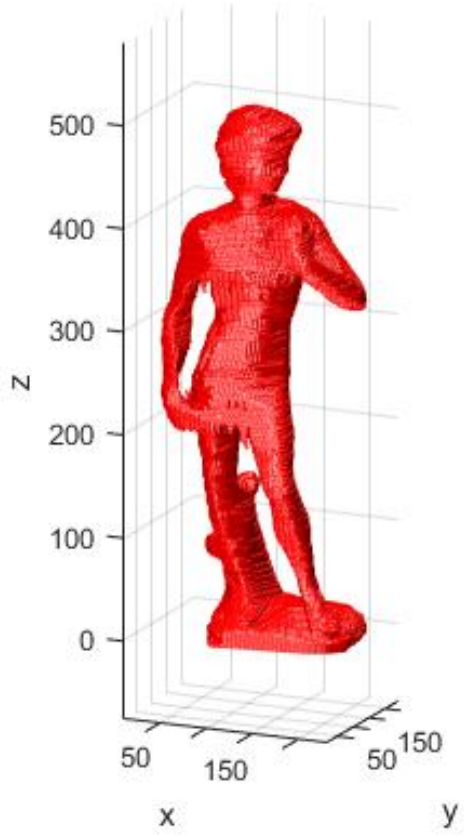

Figure 3: 3d model with 256x256x512 resolution.