Robot vision - assignment 6

kjetiskr

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task 1

task 1a

We want to find a matrix T such that

$$\begin{bmatrix} \hat{u}_i \\ \hat{v}_i \\ 1 \end{bmatrix} = \mathbf{T} \begin{bmatrix} u_i \\ v_i \\ 1 \end{bmatrix} \tag{1}$$

The coordinates $\hat{u}_i$ and $\hat{v}_i$ must be such that the centroid of the points lie at the origin, and that the average distance of a point from the origin is equal to $\sqrt{2}$. Formulated mathematically this is equivalent to

$$\sum_{i=1}^{n} \hat{u}_i = \sum_{i=1}^{n} \hat{v}_i = 0 \quad \text{and} \quad \frac{1}{n} \sum_{i=1}^{n} \sqrt{\hat{u}_i^2 + \hat{v}_i^2} = \sqrt{2} \tag{2}$$

Ensuring this through the transformation matrix T involves knowing the centroid of the original points. We then translate by negative of this for each point. We then find the average magnitude of the new points in u- and v-direction. Then we divide each point by this length so the magnitude criterion is satisified. This can be written in matrix form as

$$\boldsymbol{T} = \begin{bmatrix} s & 0 & -\frac{s}{n} \sum_{i=1}^{n} u_i \\ 0 & s & -\frac{s}{n} \sum_{i=1}^{n} v_i \\ 0 & 0 & 1 \end{bmatrix} \tag{3}$$

where s is some scaling factor. For this case it is defined as

$$s = \frac{\sqrt{2}}{n} \sum_{i=1}^{n} \sqrt{u_i^2 + v_i^2} \tag{4}$$

2c

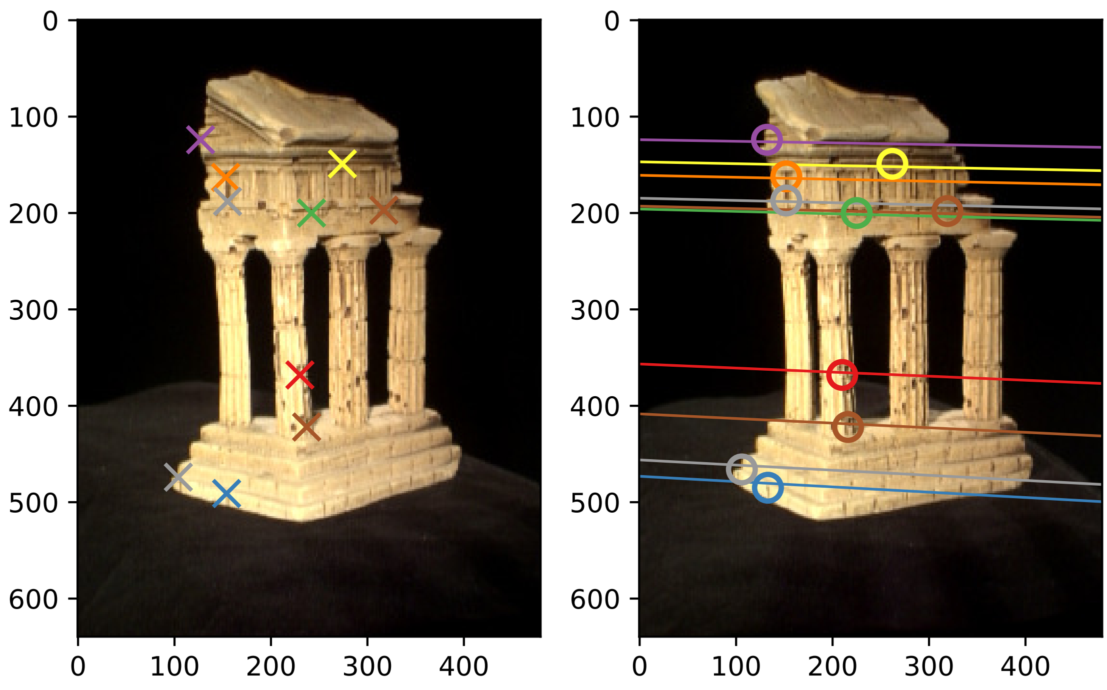

Figure 1: Lines from fundamental matrix after constraint enforcement and normalization/denormalization

3e

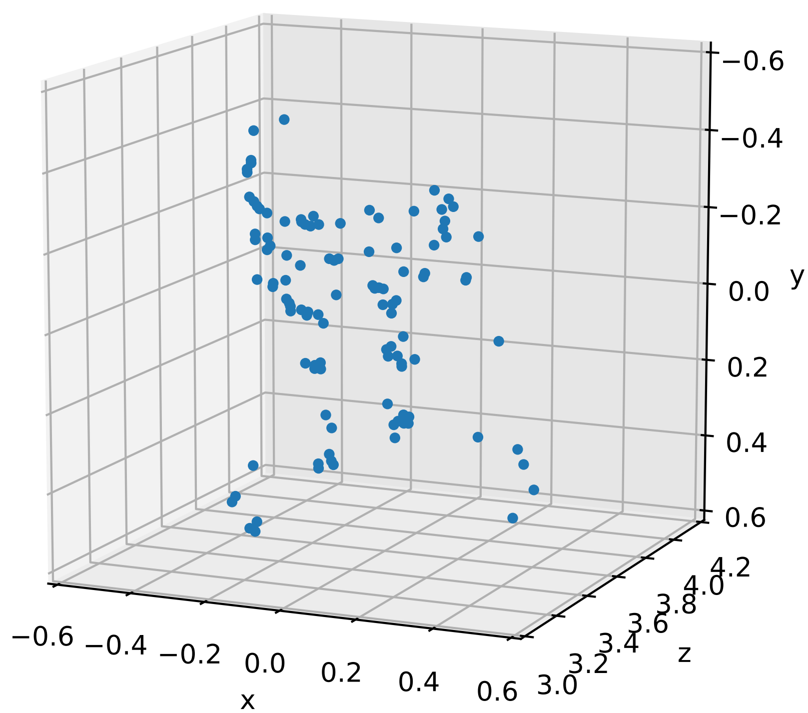

Figure 2: Triangulated points plotted in 3D

4b

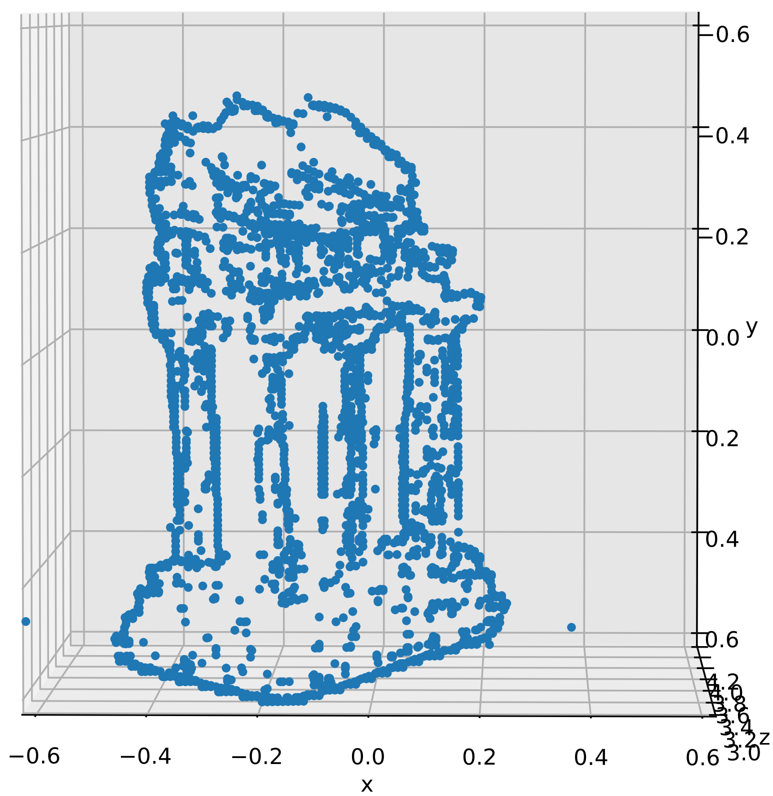

Figure 3: object triangulated to 3D space from stereo vision

Figure 4: image of actual object

Comparing the two images above we clearly see they are of the same object.