CSE152 homework3

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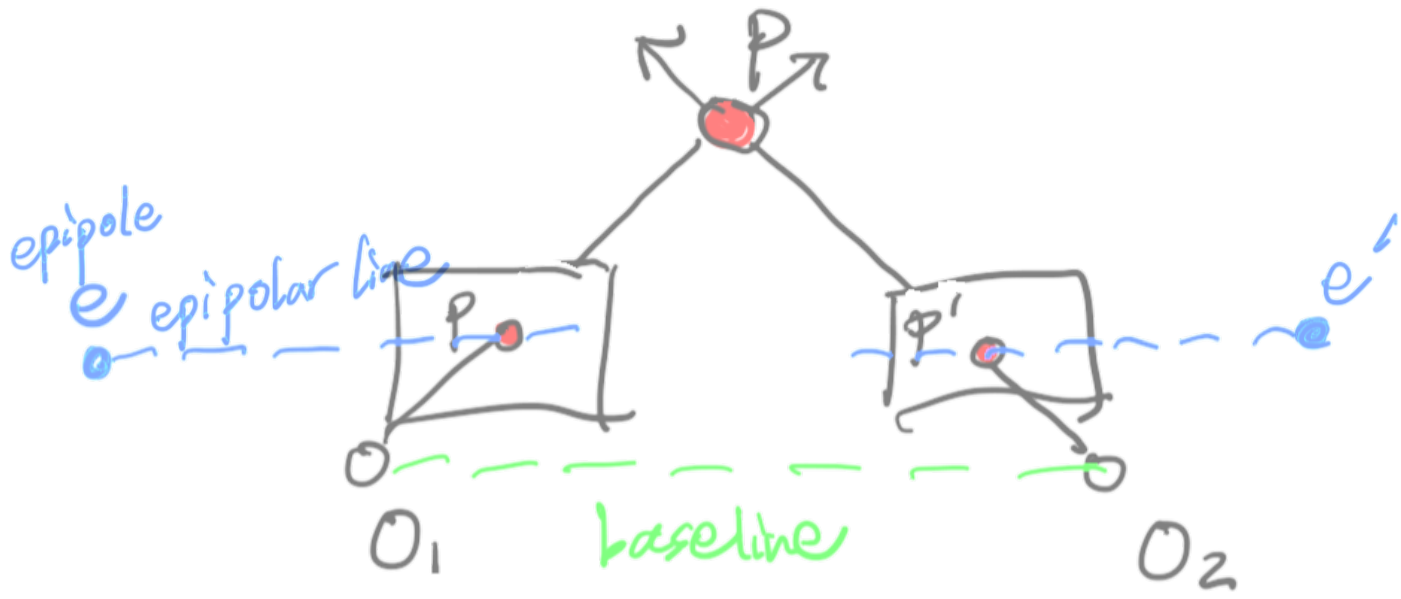
1.1 (14 points.) Consider the case of two cameras viewing an object such that the second camera differs from the first by a pure translation parallel to the image plane. Show that the epipolar lines in the two cameras are parallel.

By the definition of epipoles e, e': intersections of baseline with image planes, we know two epipolar lines I, I' and baseline are on the same plane (epipolar plane).

And since second camera differs from the first by pure translation $T=\begin{bmatrix} x \\ y \\ 1 \end{bmatrix}$, two image plane differs by pure translation too. And the epipolar line intersects base line at infinity, we can know since parallel image planes.

Since I, I', baseline are on the same plane and epipolar line I, I' both intersects base line at infinity, we can know both I, I' are parallel to baseline, and I, I' are parallel to each other.



2. (15 points.) Suppose two cameras fixate on a point P (see figure 1) in space such that their principal axes intersect at that point. Show that if the image coordinates are normalized so that the coordinate origin $(0, 0)$ coincides with the principal point, the F_{33} element of the fundamental matrix is zero.

$q = Tp = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$ $q' = Tp' = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$

$q^T F_q q' = 0$

F_q

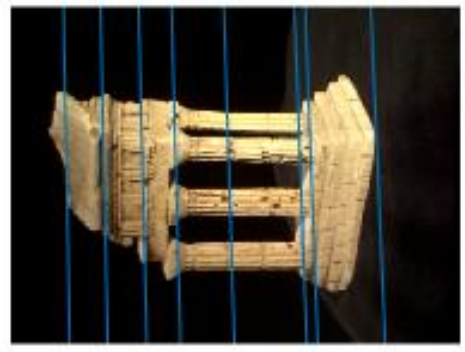
$$\begin{bmatrix} 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} F_{11} & F_{12} & F_{13} \\ F_{21} & F_{22} & F_{23} \\ F_{31} & F_{32} & F_{33} \end{bmatrix} \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} = 0$$

$$\begin{bmatrix} F_{31} & F_{32} & F_{33} \end{bmatrix} \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} = 0$$

$F_{33} = 0$ #

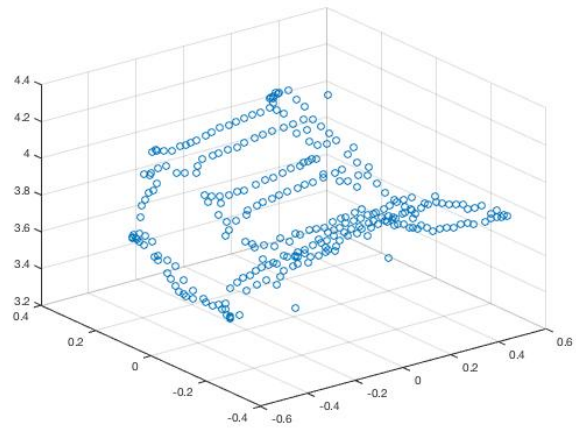
2.1

Select a point in this image
(Right-click when finished)



Verify that the corresponding point
is on the epipolar line in this image

2.2


4.4
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3.8
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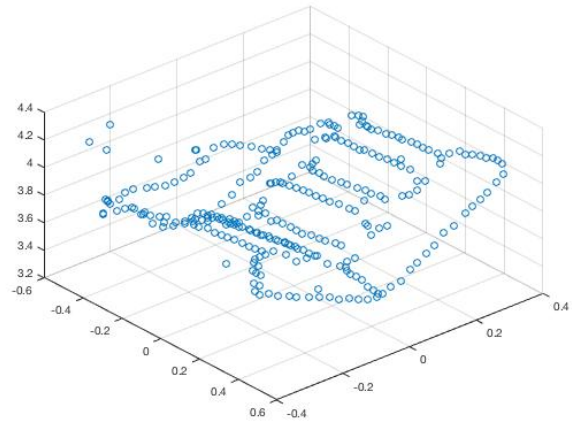
4.4
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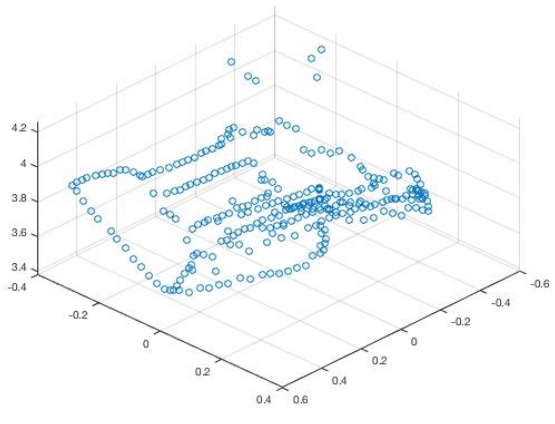
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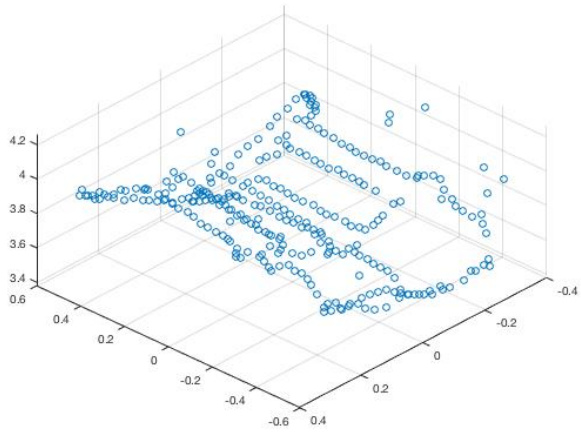
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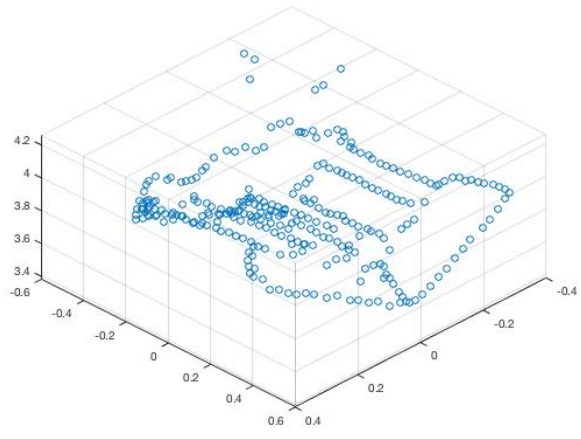
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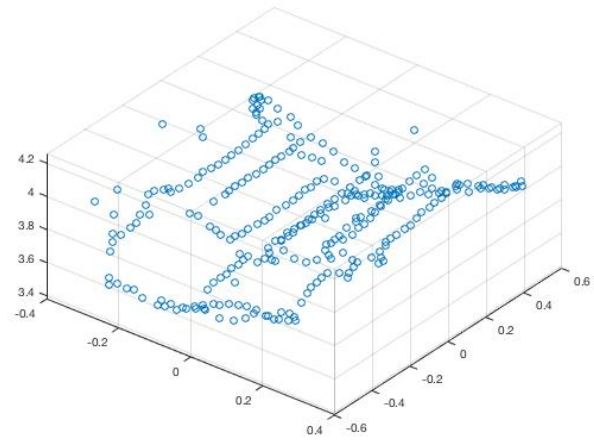
4.2
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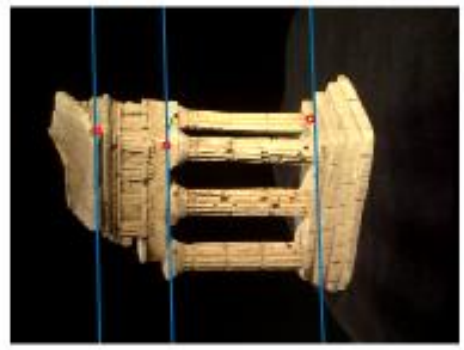
-0.4
-0.6

2.3

Select a point in this image
(Right-click when finished)



Verify that the corresponding point
is on the epipolar line in this image

3

10 hours