

Q4.

4. Suppose there are three images I_1 , I_2 and I_3 , and if \mathbf{F}_{13} describes the fundamental matrix between images I_1 and I_3 and \mathbf{F}_{23} describes the fundamental matrix between images I_2 and I_3 . Now, let's assume that you are given points \mathbf{x}_1 and \mathbf{x}_2 in images I_1 and I_2 respectively. Derive the expression for corresponding point \mathbf{x}_3 in image I_3 .

Solution:

In I_3 for each of the other two cameras we have an epipole e_1 and e_2 . The projection \mathbf{x}_3 in I_3 forms an epipolar line with each epipole:

$$e_1 \times \mathbf{x}_3 = l_1$$

$$e_2 \times \mathbf{x}_3 = l_2$$

since both lines go through \mathbf{x}_3 we also have:

$$l_1 \times l_2 = \mathbf{x}_3$$

The epipolar lines l_1 and l_2 can also be computed through the Fundamental matrices:

$$l_1 = F_{13}^T \mathbf{x}_1$$

$$l_2 = F_{23}^T \mathbf{x}_2$$

This gives us the expression for \mathbf{x}_3 :

$$\mathbf{x}_3 = F_{13}^T \mathbf{x}_1 \times F_{23}^T \mathbf{x}_2$$