

## Lab Assignment 7 - Structure from Motion

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### 1 Feature extraction and initialization with epipolar geometry

The first step is to extract SIFT features and match them. The `vl_sift` function is used to extract keypoints from the given images as shown in figure 2. The output format is  $[X; Y; S; TH]$  where  $X, Y$  is the center of the extracted frame,  $S$  is the scale and  $TH$  is the orientation. So, we will be interested in the first 2 rows of each column (i.e., the frame center coordinates) in order to get homogeneous coordinates that are usable by the RANSAC function. The latter is used to filter out outliers and get the fundamental matrix  $F$ . After that, we can calculate the essential matrix  $E = K^T F K$  where  $K$  is the calibration matrix (given in this exercise).

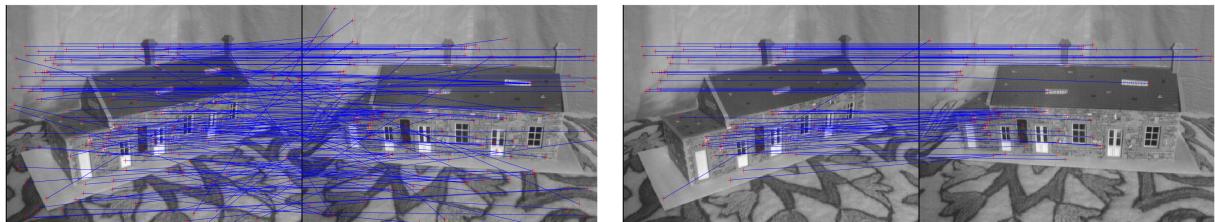


Figure 1: SIFT features and matches (images 1 and 4).

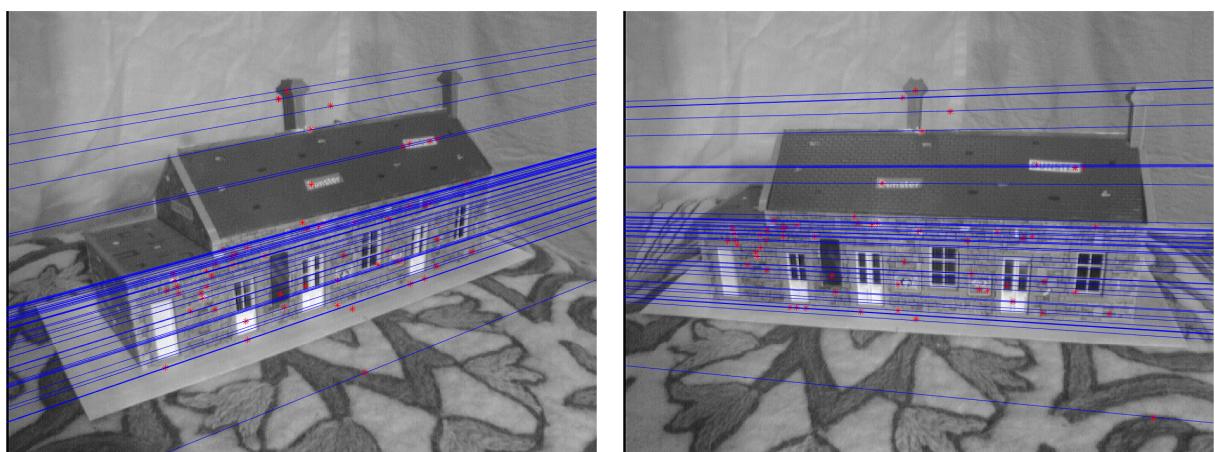


Figure 2: Epipolar lines (images 1 and 4).

## 2 Triangulation and adding new views

To add another view, we can redo the previous work, i.e., extract features from another view image and match them with one of the previous view (figure 3).

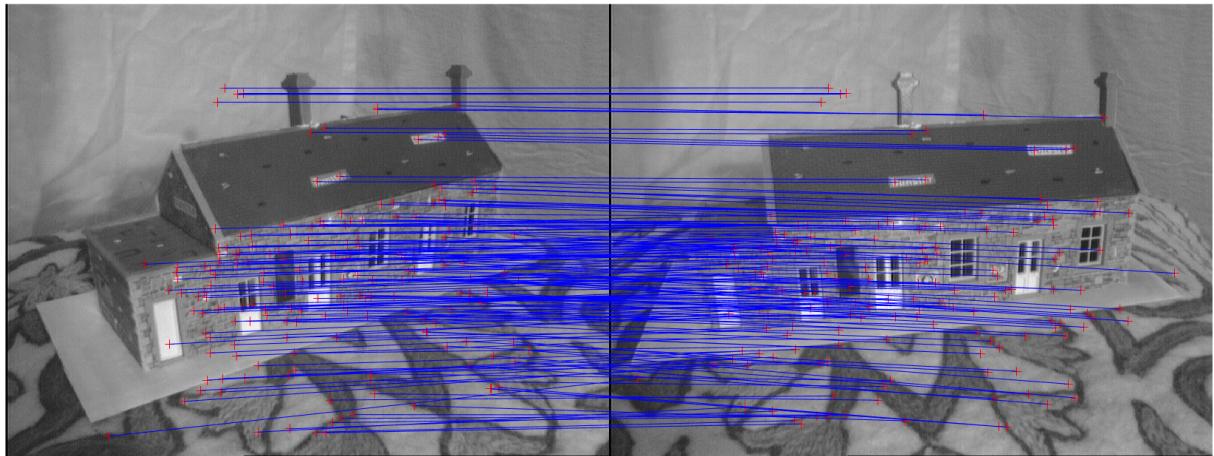


Figure 3: SIFT features and matches (images 1 and 2).

We can use the previously calculated projection matrix to get the 3D points coordinates using triangulation. We can add as many view as we want (up to 5 since we have 5 images).

## 3 Plotting

In this part, the extracted and matched points are plotted in 3D space as shown in figure 4. We can notice that there are points that do not perfectly match.

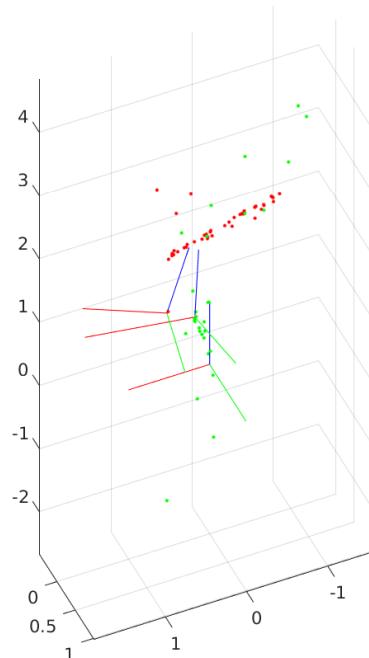


Figure 4: Triangulated points and camera directions.