Report Blatt 6

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1 Excecise 1

1a We were asked to use a Harris Edge Detector to locate key points in the images. We tried this, but as in sheet five already noted, the Harris Detector does not seem to work very well together with a SURF Feature Matcher. Therefore we decided to use a SURF Detector instead of the Harris Detector. The resulting keypoints and the good matches are shown in Figure 1.

1b With the matches obtained in 1a, two algorithms to find the fundamental matrix F were employed. Generally, given a set of matched points (x_i, x') following has to hold for F:

$$x'^T * F * x = 0 \quad \forall x \tag{1}$$

OpenCV provides the function findFundamentalMat, that given a set of matched points and will calculate F using a specified algorithms. The resulting F are shown below. They are similar, but not identical.

$$F_{8-point} = \begin{pmatrix} -9.27 & -4.45 & 0.006 \\ 5.31 & 3.47 & 0.09 \\ -0.008 & -0.09 & 1 \end{pmatrix}$$

$$F_{RANSAC} = \begin{pmatrix} -1.01 & -5.01 & 0.012 \\ 5.76 & 6.48 & 0.032 \\ -0.014 & -0.036 & 1 \end{pmatrix}$$

The 8-Point Algorithm will take all provided points into account and try to find a solution for F which will be optimal regarding the least-squares error. The RANSAC algorithm, on the other hand,differentiate between inliers and outliers and won't take outliers into accout for calculations. This can indirectly be observed by checking 1 for consitency. Doing this for all matches results in values relatively close to 0 for all x, but for the points considered outliers, it is still close to 0, but larger than for the other points (Data not shown).

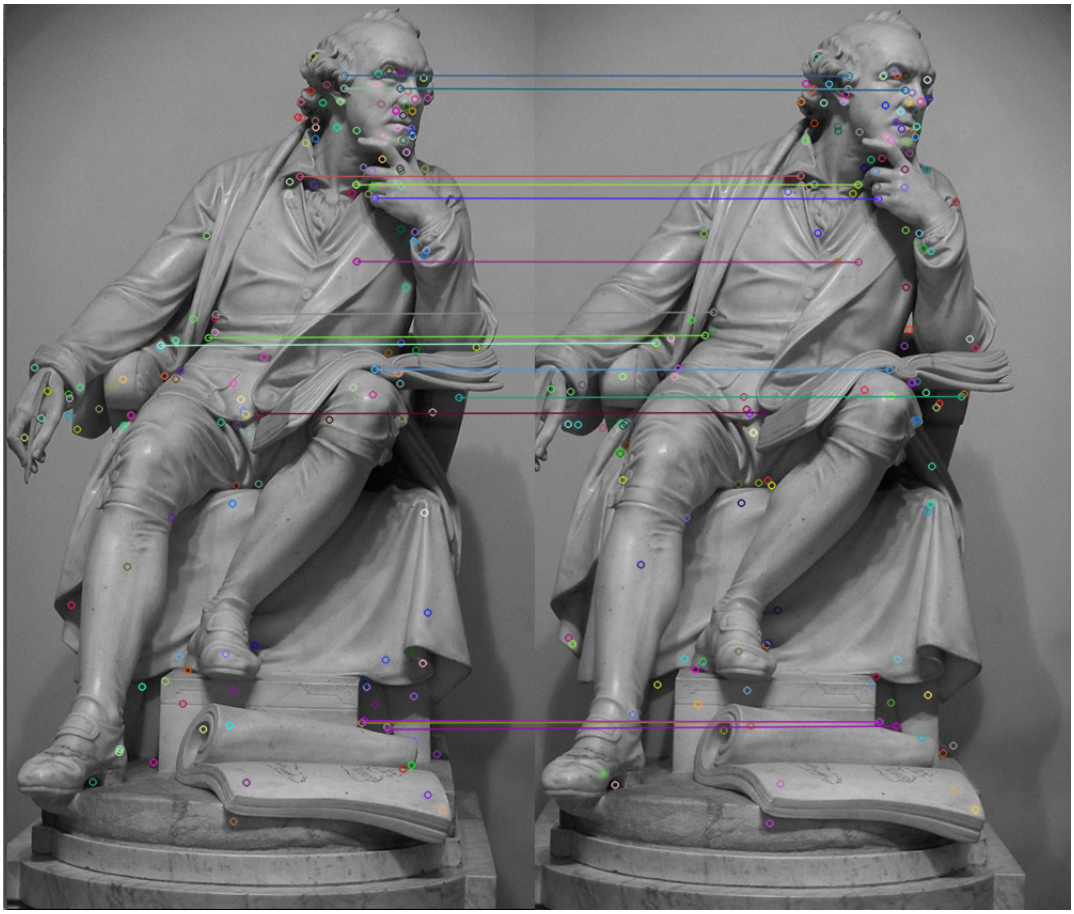


Figure 1: The two views of the John Hunter Statue with keypoints found and matched by the Surf Feature Detector and a Surf Point Matcher.

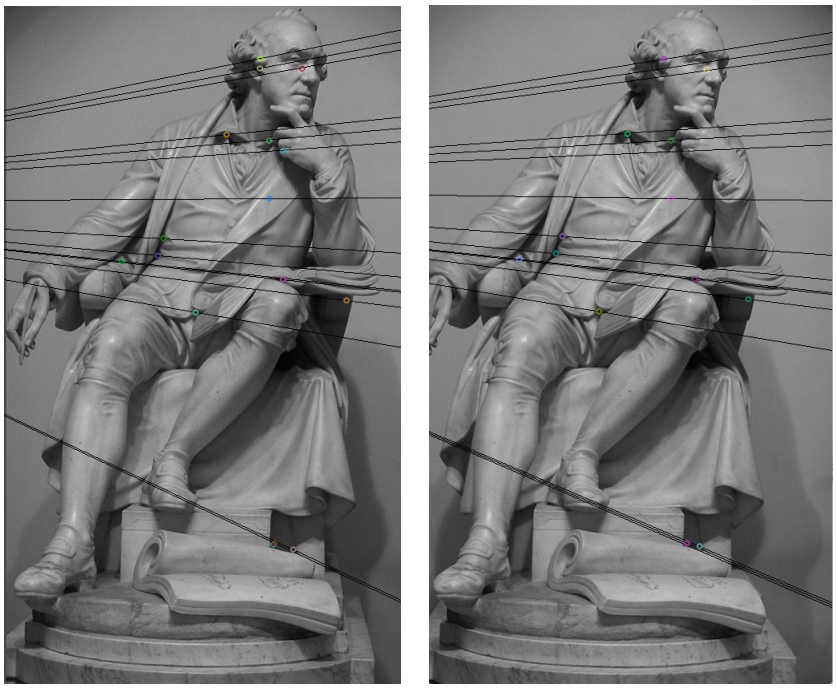
1c Usually, RANSAC only considers 2-3 points as outliers. This could indicate that the key point detection and matching works quite accurate.

2 Excercise 2

See Figure 2 for the epipolar lines. The vectors for the epipolar lines were obtained using the OpenCV function computeCorrespondEpilines, which calculates following equations:

$$l'_i = F * x_i \quad and \quad l_i = F^T * x'_i \tag{2}$$

where l'_i is the epipolar line connecting the epipole e' to x' on view 2 and vice versa. Additionally, the vectors are scaled such that $l_x^2 + l_y^2 = 1$.



(a) View 1 (b) View 2

Figure 2: The two views of the statue. Each view contains the matched points used for the calculation of F. Additionally, the epipolar line for each of these points is drawn. Most of the lines pass right through the points or are right next to them, indicating a good estimate of F

2b and c The distance d between a point x and its corresponding epipolar line l is then given by:

$$d = x^T * l \tag{3}$$

The average distance between the points and the epipolar lines in view two is 0.48 and in view one it is 0.49. So less than half a pixel. For inliers only, it is 0.32 in view two and 0.33 in view one. The average distance between point and corresponding epiline seems to be small, indicating again a good estimate for F and confirming the observation in Figure 2.