Introduction to Computer Vision

Problem Set 4 Report

Computer Engineering

Mert Can Cakmak
64160002

13 December 2019

I read my two input image from input file and to find features easily, I converted them to gray scale.

Input 1

Input 2

Then to calculate the feature of the images, which are key points and descriptors I selected SIFT, SURF and ORB methods.

Input 1 Sift Keypoints

Input 2 Sift Keypoints

Input 1 Surf Keypoints

Input 2 Surf Keypoints

Input 1 Orb Keypoints

Input2 Orb Keypoints

Brute-Force Matcher takes the descriptor of one feature in first set and is matched with all other features in second set using some distance calculation. And the closest one is returned.

I took the best matches with thresh hold number = 0.5 for Sift

Best Sift Matches

I took the best matches with thresh hold number = 0.5 for Surf

Best Surf Matches

I took the best matches with thresh hold number = 0.75 for Orb

Best Orb Matches

To calculate repeatability I found correct matches using given homography matrix and found ground truth points with this formula and if the difference between x prime and x is smaller than two pixel I counted as a correct match.

$$\begin{bmatrix} x_1 \\ y_1 \\ 1 \end{bmatrix} = H \begin{bmatrix} x_2 \\ y_2 \\ 1 \end{bmatrix} = \begin{bmatrix} h_{00} & h_{01} & h_{02} \\ h_{10} & h_{11} & h_{12} \\ h_{20} & h_{21} & h_{22} \end{bmatrix} \begin{bmatrix} x_2 \\ y_2 \\ 1 \end{bmatrix}$$

To implement ransac method, I found 4 random points to calculate the homography.Then I determine thresh hold with 0.9. If it did not pass the thresh hold inliner count then I looped again the same procedure. I found the final homography which have most inliers in it.

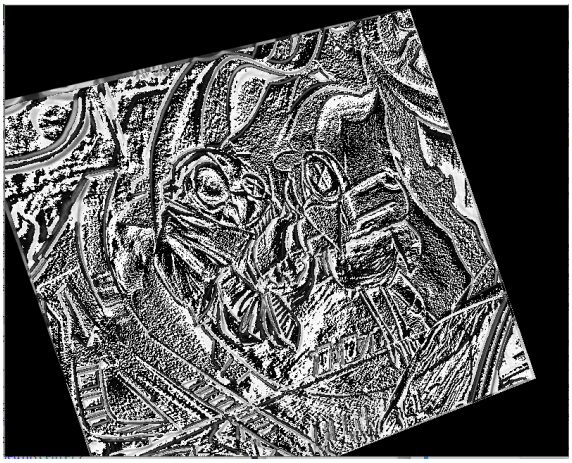
To calculate homography matrix I use SVD method

$$\begin{bmatrix} x_1 & y_1 & 1 & 0 & 0 & 0 & -x'_1 \cdot x_1 & -x'_1 \cdot y_1 \\ 0 & 0 & 0 & x_1 & y_1 & 1 & -y'_1 \cdot x_1 & -y'_1 \cdot y_1 \\ x_2 & y_2 & 1 & 0 & 0 & 0 & -x'_2 \cdot x_2 & -x'_2 \cdot y_2 \\ 0 & 0 & 0 & x_2 & y_2 & 1 & -y'_2 \cdot x_2 & -y'_2 \cdot y_2 \\ & & & & \vdots & & & \\ x_n & y_n & 1 & 0 & 0 & 0 & -x'_n \cdot x_n & -x'_n \cdot y_n \\ 0 & 0 & 0 & x_n & y_n & 1 & -y'_n \cdot x_n & -y'_n \cdot y_n \end{bmatrix} \begin{bmatrix} h_{11} \\ h_{12} \\ h_{13} \\ h_{21} \\ h_{22} \\ h_{23} \\ h_{31} \\ h_{32} \end{bmatrix} = \begin{bmatrix} x'_1 \\ y'_1 \\ x'_2 \\ y'_2 \\ \vdots \\ x'_n \\ y'_n \end{bmatrix}$$

$$H = \begin{bmatrix} h_{11} & h_{12} & h_{13} \\ h_{21} & h_{22} & h_{23} \\ h_{31} & h_{32} & 1 \end{bmatrix}$$

Given homography Warpped Image

Ransac homography Warpped Image



Difference between Given homography Warpped Image and Ransac homography Warpped Image