# CV Assignment: Problem 5

## Dhanush Dinesh

### SIFT

SIFT is an algorithm proposed by Lowe which solves the problem of image rotation, image affine transformation, viewpoint changing in matching features and image intensities.

There are 4 steps in calculating the SIFT point. The first one is to calculate the space scale extrema using the difference of Gaussian (DoG). Secondly, here we calculate the key point localization where the key points are located, and their intensity of the contrast is high hence removing low intensity points. Thirdly, orientation of the key point is generated based on the gradient of the local image. Finally, a descriptor is generated for each key point which describes gradient magnitude and orientation.

### SURF

In this algorithm first we calculate the space scale extrema using box filters as they are faster to calculate the convolution which can de calculate in parallel for different scales. SURF uses a BLOB detection which is based on Harris matrix to find the point of interest. for orientation they use wavelet response in both horizontal and vertical direction with correct gaussian weights. For the feature description also the same Wavelet response is used. A neighborhood around the key point is taken and divided into sub regions and for each sub region Wavelet response is calculated and represented to get SURF feature descriptor. The sign of Laplacian is used to calculate the underlying interest points. The sign of the Laplacian distinguishes bights the blobs on the black background from the reverse case. At the time of matching these descriptors are compared and matched.

### ORB

This is an algorithm which is a com bination of FAST and BRIEF descriptors which some modifications. In this algorithm first we calculate the key pints using the FAST algorithm, next it uses a BLOB detection which is based on Harris matrix to find the point of interest using the top N points. FAST however doses not computer the orientation and it is rotation invariant. It computes the intensity weighted centroid keeping the located corners at the center. the direction of the vector from the corner point to the centroid is the orientation of the vector. moments are computed to make the algorithm more rotation invariant. next we use the BRIEF descriptor, which is not rotation invariant, so we steer the image before we apply BRIEF descriptor.

### Comparison

While each of these algorithms have their strengths and weaknesses. Some of them outperform in most of the cases and the others perform extremally well for some particulate cases.

1. While ORB is the fastest algorithm it can also be called as a greedy algorithm.
2. SIFT performs well in most of the cases.
3. In special cases where the rotation is proportional to 90 degrees of the original image ORB and SURF performs best compared to SIFT.
4. In noisy images both ORB and SIFT algorithm perform equally.
5. In ORB the features are concentrated more in the center of the image which might not be good while matching images with only small part common.
6. While in the SIFT and SURF the key points are spread across the image

### Below is a screen shot of implementing SIFT descriptor

A picture containing text

Description automatically generated

In this we find that there are a few unknown matches such as in the bottom left corner the points at the edge of the road are matched with the center of the road on the right image but mostly it works fine. Another thing we can observe is that the key points are spread across the whole image.

### Below is a screen shot of implementing ORB descriptor

A picture containing text

Description automatically generated

In the ORB implementation was bad compared to SIFT. As a lot of incorrect matches were found as shown in the above figure some of the points which are not present are incorrectly match as shown in the red blocks. The green block indicated that area where there are not key points. As in ORB there are more key points towards to center of the image.