TECHNISCHE UNIVERSITÄT WIEN
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# MV_Excercise2: Interest Points and Descriptors


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# 1 Harris Corners

## 1.1 Effect of sigma values for initial gaussian filtering on the output of the detector

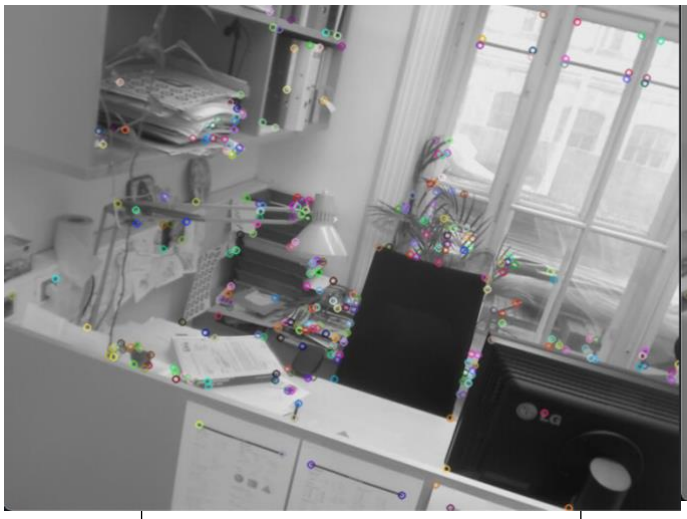

Fig.1: Harris Corner (sigma1 = 1)

Fig.2: Harris Corner (sigma1 = 3)

With the increase in the value of sigma used for the initial Gaussian filtering, the resulting Harris corners become more evenly spread out across the image. This is because a greater sigma value leads to a greater smoothening effect which reduces the intensity variations that the Harris detector identifies as corners. The effect is evident when comparing the above figures: Fig. 1 represents the Harris corners detected with sigma1 = 1, the corners are more localized, and Fig. 2 shows the Harris corners detected with sigma1 = 3, more dispersion in the corners can be noticed.

## 1.2 Harris detector is not scale invariant.

Fig.3: Harris Corners after 2X downscaling

Fig. 4: Harris Corner with the original

The above figures show the results of applying the Harris corner detection to images at different scales. Figure 3 displays the corners identified in an image that has been downscaled 2X. while Figure 4 presents the Harris corners generated using the original image. Looking at the corners generated on the papers pinned on to the desk, it is evident that the Harris detector is not scale invariant.

# 2 Patch descriptors

## 2.1 Effect of patch size of the descriptors on accuracy of the matching

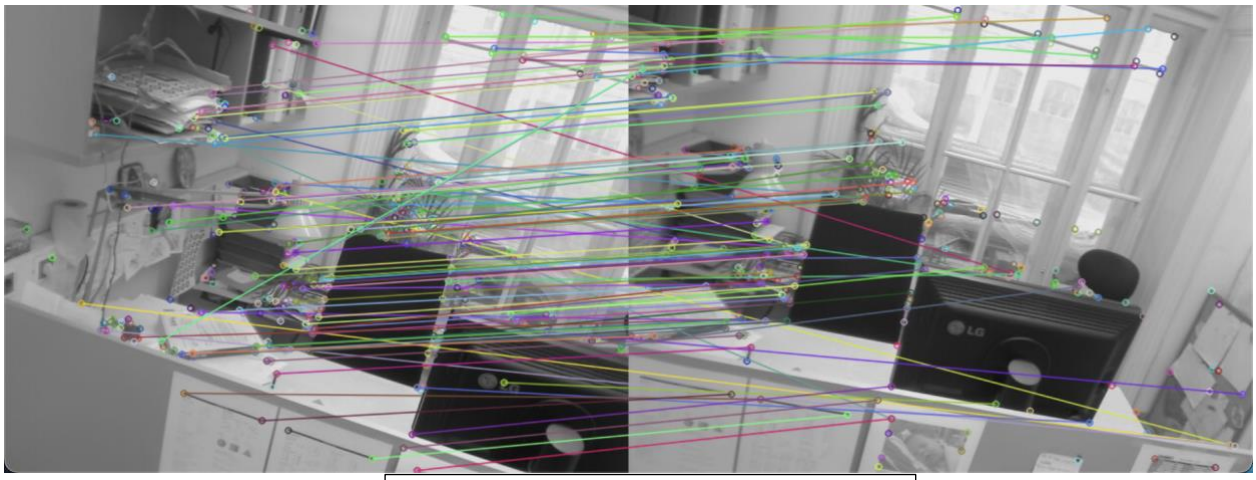

Fig. 5: Harris Matches (Patch_size = 5)

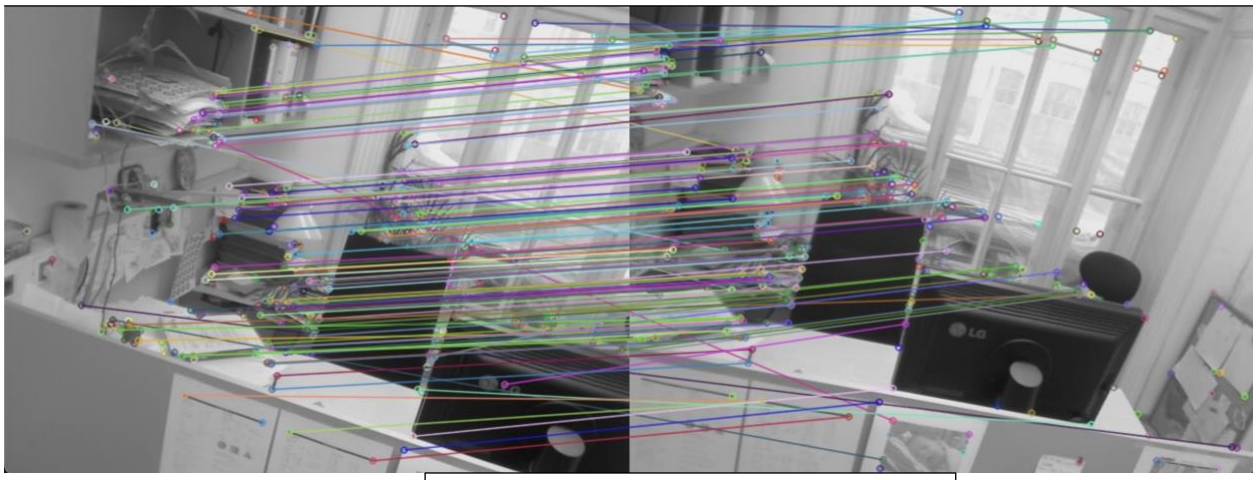

Fig. 6: Harris Matches (Patch_size = 10)

The Harris Matches were produced using the original parameters the matches were generated between the images “desk/Image-00” and “desk/Image-03”, the patch size was varied. As demonstrated by Fig. 5 and Fig. 6, enlarging the patch size increases the accuracy of the matches. This improvement can be attributed to larger patches capturing more information and thereby reducing the number of incorrect matches.

## 2.2 Effect of image properties and camera pose on the performance of image stitching.

Fig. 7: Image Stitching with varying magnification

When stitching together images with different magnification, using Harris corner detector can lead to distorted results as the features in each image may not align properly or be of similar size. Such errors can also be noticed when there's any translational movement during image capture. Figure 7 illustrates this issue, images with different levels of camera magnification were taken and tried to stitch together. The result can be seen above in the Fig. 7.

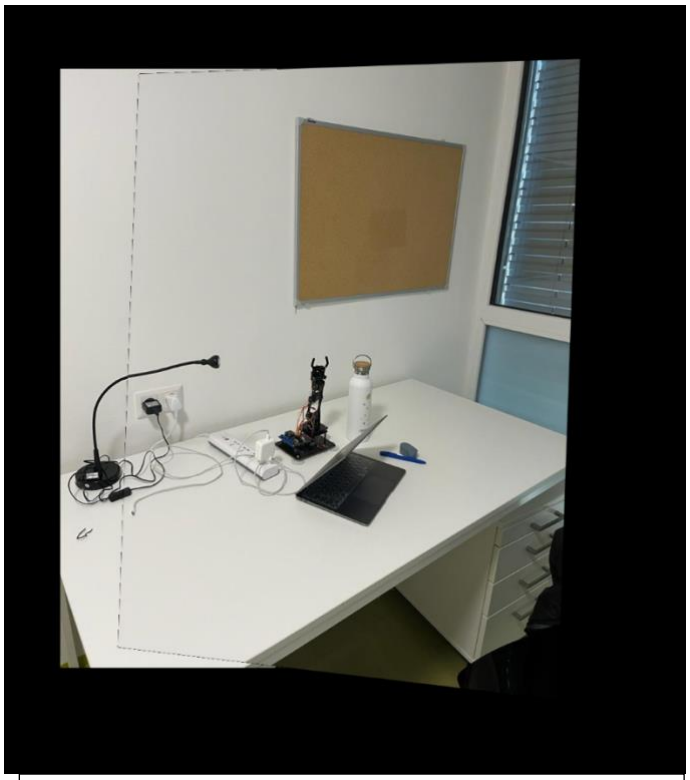

Fig. 8: Image Stitching with same lighting condition

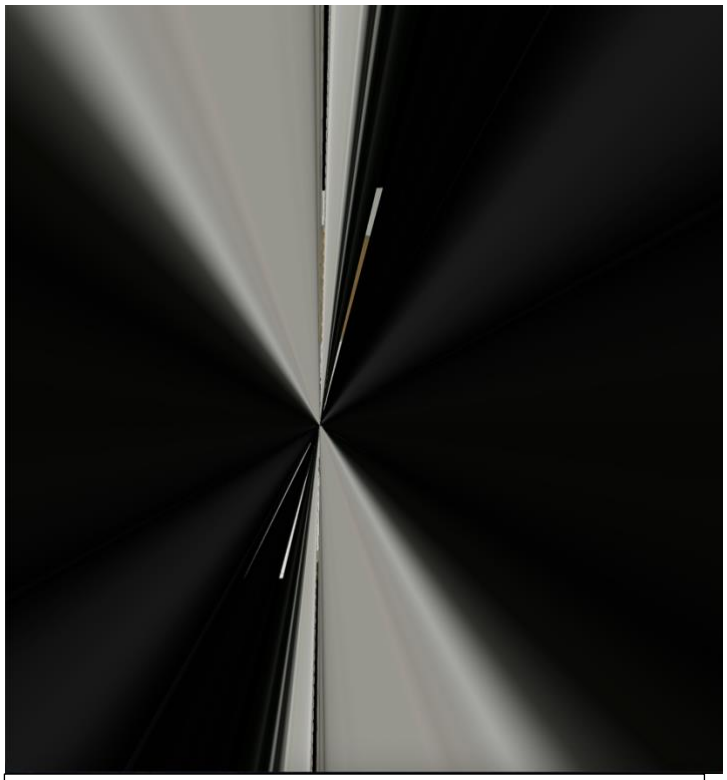

Fig. 9: Image Stitching with different lighting condition

When stitching together images with different lighting conditions, the stitching can become distorted as the Harris feature detection in the images is performed using the intensity values. Any changes in the lighting condition can significantly affect the intensity distribution in the Image. Leading to inconsistent feature detection. This effect is shown in the above figures 8 and 9. Images of my study table was taken under slightly different lighting conditions, Fig. 8 shows the stitched image generated using images taken under the same light condition, while the Fig. 9 shows the stitched image generated using images taken under different light condition.

Fig. 10(a): Image Stitching with less distinctive features

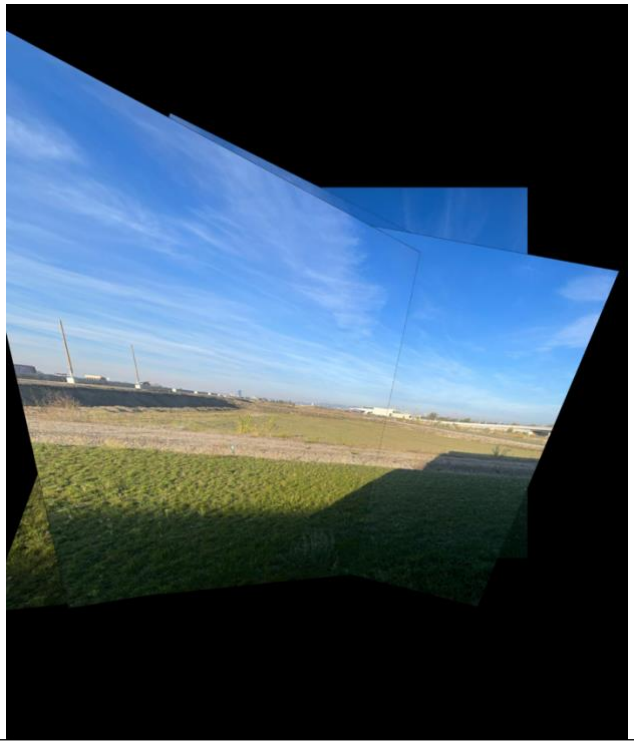

Fig. 10(b): Image Stitching with less distinctive features

Image stitching with the Harris corner detector is based on finding corners and distinctive features within the images. When images lack distinct features, it becomes challenging to locate unique matching points necessary for accurate stitching. Figures 10(a) and 10(b) shows two different stitched images generated using the same set of images and parameters but in consecutive iterations. Figure 10(b) shows the distorted image generated form the stitching process.

# 3 Homography

## 3.1 Estimating the homography with least-squares without RANSAC for object detection problem? Effect of Lowe ratio on match quality and homography.

Homography results from least squares approach without RANSAC can work well for object detection. However, in real world scenarios it can be problematic as there will be significant amount of noise, incorrect matches. The least squares approach doesn't take into account the incorrect correspondences and therefore can lead to incorrect homography results.

Fine-tuning the Lowe ratio can yield better results. As they can help retain only good matches (i.e, the matches having descriptor distance lower compared to the others). Having a lower lowe's ratio can reduce the number of wrong matches but might also discard the correct ones and having a higher lowe's ratio can increase the number of correct as well as wrong matches. The images 11(a) and 11(b) show two images generated using two different lowe ratios.


Fig. 11(a): Image generated using lowe's ratio of 0.75


Fig. 11(b): Image generated using lowe's ratio of 0.6

## 3.2 Effect of varying RANSAC parameters, confidence and inlier_threshold on the result and the number of iterations needed.

As the RANSAC confidence factor is reduced the number of iterations required to get a good fit of inliers increases but the confidence factor does not have any effect on the final result. This is because as the confidence decreases the average likelihood to have a good selection goes down and as a result will have to perform a greater number of iterations to succeed. If the inlier threshold is increased there is distortion in detection of the object as increasing the inlier threshold can lead to including outliers in the model and thereby reducing the accuracy of the result. The figure 12 shows the distorted result from object detection performed using an inlier threshold value of 25.


Fig. 12: Object detection using inlier threshold = 25