Computer Vision: Lab 4

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Image alignment

The first part of the assignment two similar images have to be aligned. The alignment has to be done in such a way that the best transformation of the image is found, and each point of the to align image is transformed in the correct way. The transformation matrix is calculated with the help of RANSAC.
RANSAC, RANdom SAmple Consensus is a technique that selects at random a set of possible Alignment points in both images and tries to match most of the points with the help of a transformation matrix. The goal is to find the transformation matrix with the maximum inliers, that are close to their estimated location.
To ensure that the sampling of the transformation points has a good chance of locating the correct transformation matrix, a minimum amount of trails has to be done. If p is the probability of the validity of the corresponding points, S is the amount of trails, and P is the total succes of the trail. given that the likelihood of all random samples k is equal to p^k.
Then the minimum amount of trails is given by:

$$S = \frac{log(1-P)}{log(1-p^k)}$$

To attain an average good score of 0.99 correct, with 6 random samples, at least 293 trails have to be done to achieve it.

Figure 1: Found important points for the possible alignment.

Figure 2: Aligned images next to each other

The first step in the algorithm is to match the important points in both the images and map these to each other, see figure 1. In this figure, the 50 most noticeable feature points are matched with their counterpart. These feature points are then used to calculate the corresponding transformation matrix x.

$$x.T = \begin{bmatrix} m1 & m2 & m3 & m4 & t1 & t2 \end{bmatrix}$$

This matrix is then used to transform the image to the correct rotation and translation. As seen in figure 2.

Figure 3: The different matches of both the images, mapped together.

Image stitching

The second part of the assignment is the stitching of two images. These two images are a part of a larger image and have both a part of the image that can be mapped together. The goal is then to find the transformation that is needed to map both images together and then stitch these two images together. The part that overlaps is then averaged out and put together in one image.

The transition has to be as smooth as possible, as the flow of the image has to flow from the first image into the next image. It is therefor important that the images can be mapped accordingly to their feature points.

In figure 3 is seen how the two parts of the images are mapped together. It is noticeable that there are many feature lines that can be matched correctly with only one transformation. But some features do not match the features on the other image and these features should not be used to calculate the transformation matrix. The problem is that it is very hard to remove the incorrect features and use the correct features. It is therefor necessary to use multiple trials to find the correct homograph matrix.

When the homograph is found the next step can be taken. The two images have to be matched up and stitched together. With the help of the homograph matrix the correct location of the second image can be calculated in respect to the first image. At the location where both images have a value the average of both values is taken. This controls the fact that the image will smooth over from the first image to the second one.

Figure 4: Images of the tram stitched together.

To make sure the image isn't to small the boundaries have to be set on max value of the x and y values of both images combined and than subtract the lines that have no values in them.

In figure 4. The complete stitched image is found. As you can see both images could be matched together with the help of the RANSAC algorithm, as the most dominant transformation is the correct transformation.