Assignment 2: Feature Extraction and matching Vision and Image Processing

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This is the second mandatory assignment on the course Vision and Image Processing. The goal for you is to get familiar with image feature extraction and feature matching.

This assignment must be solved in groups. We expect that you will form small groups of 2 to 4 students that will work on this assignment. You have to pass this and the other 3 mandatory assignments in order to pass the course. If you do not pass this assignment, but you have made a SERIOUS attempt, you will get a second chance of submitting a new solution.

The deadline for this assignment is Monday 19/12, 2016 at 20:00. You must submit your solution electronically via the Absalon home page. For general information on relevant software, requirement to the form of your solution including the maximal page limit, how to upload on Absalon etc, please see the first assignment.

1 Detecting interest points (Features)

In the first part of the assignment you should implement a feature detector, apply it on a few images (see later) and illustrate that it works.

We recommend that you use either a blob detector, such as either Difference of Gaussians (DoG) or the Laplacian of a Gaussian (LoG), or the Harris corner detector. You are allowed to use any kind of library function that you find useful. This includes routines that directly gives you the point detections. Alternatively, you may implement the detection yourself, using filter responses as obtained in assignment 1. **The less you program yourself, the more you are expected to show and explain the performance of the applied routine as function of the parameter setting for the routine**.

To visualize your results, draw the detected points on top of the image (see later) at the detected locations and include these images as figures in your report. Remember to comment your results: What should I see where in the images, how do the images differ, etc. **Do not expect me to see what you see**. In your report you also have to explain the choices you made in your solution as well as non-trivial details of your solutions.

Advanced solutions may include considerations of how to extend your solution to a multi-scale detector. However, this is only recommended for enthusiasts.

2 Simple matching of features

The second part of the assignment is to establish matches/correspondences between different images of the same physical scene. First, for each extracted point you attribute a descriptor. Then, you select matches as the pair of interest points that have most similar descriptors.

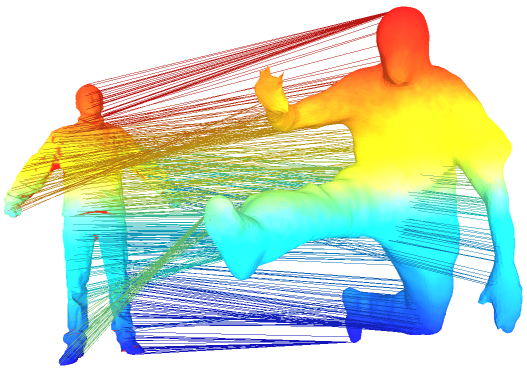
For the descriptor you should extract a small square patch, with side length N, of intensity values centered at the detected point. For dissimilarity measure you should use **The sum of squared intensity differences**. A low value signals a good match. You should report the matching success as N is varied, say from 5 over 7 or 9 to 13 or even larger.

To select a correspondence between a point in image A and points from image B, you should pick the point pairs with the smallest dissimilarity measure. However, you may choose not to accept this if:

1. The ratio of dissimilarity between the best and the second best match is too close to 1 (say above 0.7).
2. If the best B-image match y to an A-image point x has a best A-image match z such that $x \neq z$ (thus left-to-right matching and right-to-left matching must agree).

In your report you should argue for your choice of match acceptance and show that your approach works.

In your report you should show images and statistics of your results. A popular approach to illustrate interest point matches between two images, is to put the two images beside each other and then draw lines between the matching interest points. Please illustrate the performance of your implementation using this approach and comment on your results.



The typical relevant statistics include the number of detected interest points in the two images, the number of initial and accepted correspondences, and

the mean and standard deviations of the dissimilarity measure for the accepted matches.

For your report, you may conclude what patch size and matching acceptance criterion you found that gives the best results. Also, you may consider if some image patch normalisation could improve the robustness of the feature matching.

At the Absalon course page you may find 3 images `img001_diffuse`, `img002_diffuse` and `img009_diffuse` all showing the same object from slightly different view angles. Also, you will find smaller gray scale versions of these images. We recommend that you work on the latter images. The images are taken from the DTU robot data set `http://roboimagedata.imm.dtu.dk/`.

As part of the assignment you should first detect and match interest points in the images `img001_diffuse` and `img002_diffuse`. Next, you should repeat the experiment by matching `img001_diffuse` with `img009_diffuse`. Explain why your performance on this pair of images changes.