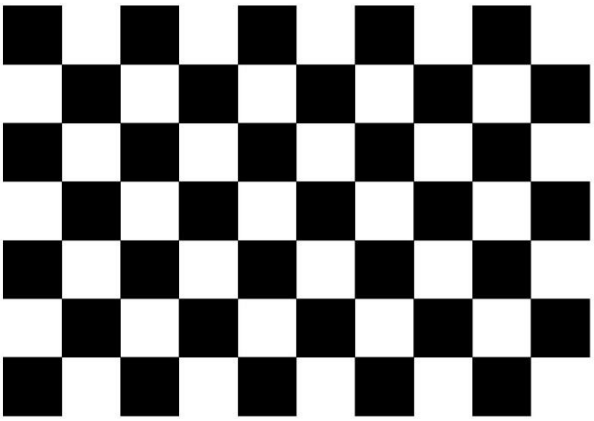
CS6550 Computer Vision Homework1 – Image Features

Due Date: 10/19 23:59

Part 1. Harris Corner Detection (50%)

With the Harris corner detector algorithm described in slides, mark the detected corners on the following two images. You should implement each of the following steps as separate functions.



A. Corner Detection:

a. Gaussian Smooth: Show the results of Gaussian smoothing for σ=5 and kernel size=5 and 10 respectively. (2 images)

b. Intensity Gradient (Sobel edge detection): Apply the Sobel filters to the blurred images and compute the magnitude (2 images) and direction (2 images) of gradient. (You should eliminate weak gradients by proper threshold.)

c. Structure Tensor: Use the Sobel gradient magnitude (with Gaussian kernel size=10) above to compute the structure tensor H of each pixel. Show the images of the smaller eigenvalue of H with window size 3x3 and 5x5. (2 images)

d. Non-maximal Suppression: Perform non-maximal suppression on the results above along with appropriate thresholding for corner detection. (2 images)

B. Experiments (Rotate and Scale): Apply the same corner detection algorithm to the rotated (by 30°) and scaled (to 0.5x) images. (2 images)

C. Discussion:

a. Discuss the results of blurred images and detected edge between different kernel sizes of Gaussian filter.

b. Difference between 3x3 and 5x5 window sizes of structure tensor.

c. The effect of non-maximal suppression.

d. Discuss the result from (B). Is Harris detector rotation-invariant or scale-invariant?

Part 2. SIFT interest point detection and matching (50%)

A. SIFT interest point detection:

a. Apply SIFT interest point detector (functions from OpenCV) to the following two images

b. Adjust the related thresholds in SIFT detection such that there are around 100 interest points detected in each image .

c. Plot the detected interest points on the corresponding images

B. SIFT feature matching

a. Compare the similarity between all the pairs between the detected interest points from each of the two images based on a suitable distance function between two SIFT feature vectors

b. Implement a function that finds a list of interest point correspondences based on nearest-neighbor matching principle

c. Plot the point correspondences (from the previous step) overlaid on the pair of original images

C. Discussion

a. Discuss the cases of mis-matching in the point correspondences

b. Discuss and implement possible solutions to reduce the mis-matches, and show your results.

Note

- You should not use any functions which can get the result directly in each steps.
- Your code should display and output your results so that we can judge if your code works correctly.
- You should provide a **README** file about your execution instructions.
- Please compress your **code**, **input images**, **result images**, **report** and **README** in a zip file named HW1_{Student-ID}.zip and upload it to eeclass.
- If you encounter any problem, let's **discuss on eeclass instead of email**.