ENGG5104 – Image Processing and Computer Vision

Assignment 3 — Local Feature Matching

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Task 1: Interest point detection

In this task, we are required to finish the function ‘get interest points’ to find the interest points between two images, using Harris corner detector. Two methods of implementation are provided: step-by-step implementation of Harris corner detector and using packages in OpenCV. In the final result, the second method using packages in OpenCV are chosen to obtain a good performance, which is around 70% accuracy on the Notre Dame pair. While the other personal implementation of Harris corner detector is around 30% accuracy.

For the first method using Harris corner detector, following the steps in lecture notes, we have a window to detect the second order gradients (Hessian matrix) of each pixel. Then we obtain R by computing the trace and determinant of this matrix, key points are chosen according to the comparison between R and threshold.

Task 2: Local feature description

In this task, we are required to finish the function ‘get features()’ to extract a feature representation for each key-point detected before in task 1. This method is a step-by-step implementation of SIFT-similar algorithm, provided by the assignment specification.

After initialization, the new image is obtained by using ‘cv2. GaussianBlur’ to convolve. Then we can get the gradients dx and dy for each pixel by subscribing the neighbor points. Hence, magnitude and orientations for each point can also be obtained by dx and dy.

In the next step, we divide the nearest 16*16 pixels of each key point into 4 cells, for each cell it contains 4*4 pixels. Now for each cell, we sum up the magnitudes for each pixel according to 8 difference directions to get the feature vectors for each key points.

Task 3: Feature matching

In this task, we are required to finish the function ‘match_features’ to match the local features of image pairs using ‘ratio test method’. After finishing task 2, the feature vectors of image 1 and image 2 are obtained. Then we start from points in image 1.

For each key points in image 1, the Euclidean distances of features are measured between this key point in image 1 and every key point in image 2. Then the first and the second smallest distances are chosen to compute the ratio and confidence. After sorting the confidence in ascending order, we can find the match points with the highest 100 confidence.