

COMP 6341 Computer Vision

Assignment 2 Report

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1. Description for each of the steps

Step #1. Feature Detection

Procedures:

- 1) Compute derivatives I_x^2 , I_y^2 and $I_x I_y$ at each pixel and smooth them with a 5×5 Gaussian
- 2) Compute the 3 elements in Harris Matrix H

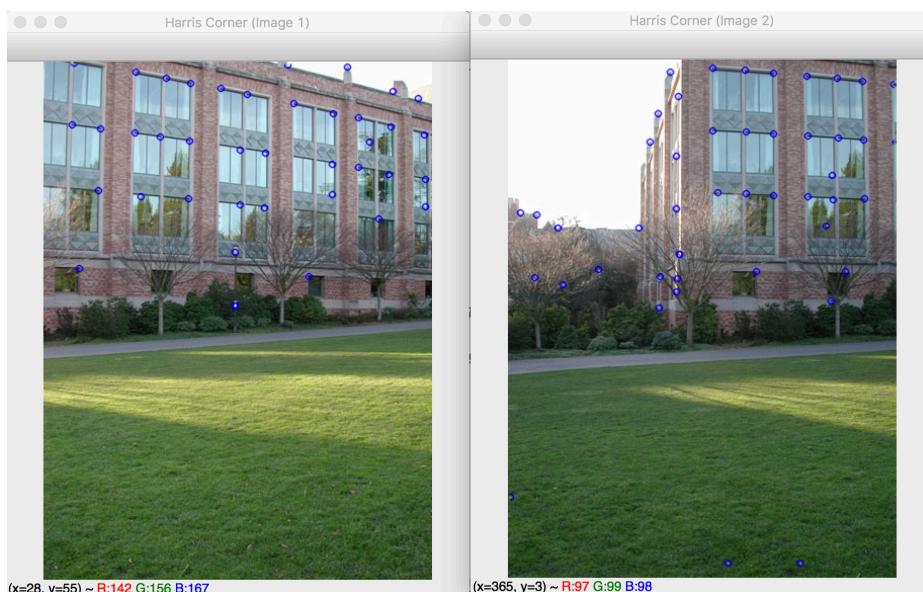
$$\begin{bmatrix} \langle I_x^2 \rangle & \langle I_x I_y \rangle \\ \langle I_x I_y \rangle & \langle I_y^2 \rangle \end{bmatrix}$$

- 3) Compute corner response function R for each pixel initialize the height and width and the response matrix R

$$c(H) = \frac{\text{determinant}(H)}{\text{trace}(H)}$$

- 4) normalize R to 0 ~ 255 because values in R may be huge leading to large variation
- 5) Threshold R on all pixels' response values
- 6) Find local maxima of response function for each pixel in 3×3 neighborhood (a.k.a adaptive/normal non-maximum suppression)
 - Option 1: adaptive non-maximum suppression (by default in code)
 - Option 2: normal non-maximum suppression

Results of Harris Corner Detection:



Step #2. Feature Descriptor

Procedures:

- 1) Define a descriptor class which is a template of each descriptor
- 2) Set the 18x18 window in the descriptor
- 3) compute the magnitude and theta for each pixel in 16x16 window
- 4) compute the orientation histogram for each 4x4 grid cell
- 5) Threshold normalize the descriptor (contrast invariant)

Step #3. Feature Matching

Procedures:

- 1) For each descriptor in image 1, I iterate all descriptors in image 2 and calculate the SSD distance
- 2) Threshold on SSD distance
- 3) Record the best match and the second beset match
- 4) After the iteration on all descriptors in image 2, I calculate the ratio of $\frac{\text{best_SSD_distance}}{\text{second_best_SSD_distance}}$
- 5) If the ratio is larger than the threshold, it mean in image 2, there are at least 2 feature descriptors that are very similar to the descriptor in image 1, so we ignore finding the matching for that descriptor
Otherwise, I created a DMatch object and append the 2 corresponding matching interest points to 2 lists

Results of descriptor matching:

