

## **ECE661: Homework 4**

**Fall 2016**

**Deadline : September 27, 2016 , 1:30 pm**

Turn in typed solutions via Blackboard. Additional instructions can be found at [I]

### **1 Introduction**

This homework deals with interest points detection in images and with establishing correspondences between interest points of two images of the same scene.

Specifically, you will implement the Harris corner detection algorithm and test either OpenCV or Matlab implementations of SIFT or SURF algorithms. You will also implement SSD and NCC similarity metrics to establish correspondences.

### **2 Tasks**

#### **2.1 Harris Corner Detector**

You are provided with several pairs of images. Each pair contains images of the same scene.

1. Extract interest points using the Harris Corner detector that you implemented. You can refer to the last section of Lecture 9 and the sample solutions to the previous years' homework for understanding the steps involved.
2. Use the NCC(Normalized Cross Correlation) and the SSD(Sum of Squared Differences) metrics to establish correspondences between the interest points in the two images of the same scene.
3. Apply the Harris Corner detector for at least 4 different scales. Which interest points do you observe to be detected across all these different scales ? Your implementation should allow for any suitable scale as input, however you can show results on a minimum of 4 different scales.

#### **2.2 SURF or SIFT**

Use the OpenCV or MATLAB implementation of the SIFT or SURF operator to find interest points and establish correspondences between the images. In this case you can directly compare the feature vectors of interest points.

## 2.3

1. Compare the quality of the correspondences obtained from the two tasks above.
2. Show output on at least 1 set of images taken with your own camera as well.

## 2.4 Notes

1. You can find the provided images on the course website [I].
2. Draw lines to indicate the selected correspondences.
3. You can use the OpenCV SURF or SIFT functions for the second task. If you are a MATLAB user, you can use the VLFeat library at [II]. However you cannot use the built-in cornerHarris function. The implementation of Harris corner detector for the first task must be your own.

## 3 Submission

1. Turn in a typed pdf of your report via Blackboard.
2. Your pdf must include
  - A description on your implementation of the Harris corner detector and the SIFT/SURF algorithm with relevant equations.
  - A description on how you used the NCC and SSD metrics to establish correspondences with relevant equations.
  - The input and output images for each task. **Illustrate clearly the correspondences by drawing lines between the interest points.**
  - Your observations on the interest points detected at various scales, using the Harris Corner Detector.
  - Your observations on the relative performance of the two methods.
  - The parameters that you chose for best feature extraction and matching.
3. You are permitted to look at sample solutions from previous years to get an understanding of how to solve the problems. **Your final report must be your own.**
4. Your source code.

### References

[I] <http://web.ics.purdue.edu/~sakbar/ECE661/>

[II] <http://www.vlfeat.org/>