CS 482 Homework 3 (Due Oct 14)

J. Košecká

1. (3) Test the `edge` function in MATLAB and hand in images of edge maps under two different choices of threshold (as those shown in the lecture slides) and report what the thresholds are. Discuss why the choice of threshold is important.

2. (5) **Corner detector.** In this problem you will use Matlab implementation of the Harris corner detector which you can download from http://cs.gmu.edu/∼kosecka/cs482/code-examples/harris corners.m. This includes comments on the input parameters and how to run the detector. Your task is to run this corner detector on two sample images provided in http://cs.gmu.edu/∼kosecka/cs482/code-examples/, namely house1.jpg and house1-rotated.jpg visualize the results and answer some questions below. Here is a set of Matlab commands demonstrating its use.
   $>>$ `im = rgb2gray(imread('house1.jpg'));`
   $>>$ `corners = harris_corners(im, 7, 1.5);`
   $>>$ `imshow(img); hold on;`
   $>>$ `plot(corners(:, 1), corners(:, 2), 'r+')` This reads the image from file house1.jpg, runs the corner detector using a gaussian filter of width 7 pixels and standard deviation 1.5. The last three commands display the image and the detected corners superimposed on it.

   (a) For fixed parameter values, run the detector on house1.jpg and house1-rotated.jpg. The latter image is a rotated copy of the former. If we rotate the input image, do the detected corner positions rotate by the same amount ? Justify your answer based on your observations.

   (b) If we scale down the input image, are all the detected corner positions scaled accordingly ? You can test this experimentally by comparing the corner detection on the images house1.jpg, house1-2down.jpg, house1-4down.jpg. Each image in this sequence is half the size of its predecessor. Justify your answer based on your observations.

   (c) As part of this problem you had to compute derivatives $I_x = \frac{\partial I}{\partial x}$ and $I_y = \frac{\partial I}{\partial y}$ of an image. Upon completion hand in also the following four images: I_x, I_y, gradient magnitude, and gradient orientation.

3. (7) **Harris Point Correspondences.** Use the Harris corner code from the previous exercise, select the features in the first image and find the corresponding points in the second image. Carry out the experiments on the stereo pair of images of the images of the house1.jpg and house2.jpg (both available in the same directory) Implement the correspondence using SSD (sum-of-squared-differences) similarity measure.

   Submit the code (of SSD experiment), the image with the overlayed result of the feature detector and the image pair with corresponding points in two views (to visualize the result make a new image putting the two images side-by-side and connect the corresponding features by plotting lines originating in one view and finishing in another. This is done easiest in Matlab in 3 lines of code). Function appendimages.m to make a composite image is available on the web site.

4. **SIFT Correspondences** Use the SIFT detector code from http://www.vlfeat.org/. Use the image files from the previous exercise, Detect the features in the a) house1.jpg and house2.jpg and run the matching algorithm; b) house1.jpg and house1-rotated.jpg; c) house1.jpg and house1-2down.jpg and house1-4down.jpg.

   For this exercise you simply have to run the demo described in the following tutorial
   http://www.vlfeat.org/overview/sift.html and answer following two questions.

   (a) Describe in words the algorithm for matching the descriptors (also described in the original SIFT paper).

   (b) Comment on the differences in the performance