Homework 3

Part 1

The purpose of this Part 1 of the homework is to implement in C or MATLAB the Harris corner detector and the normalized cross correlation (NCC) based matching that will be used in Part 2.

Here are the specific steps your homework must implement:

First you must take two pictures of the same scene with your personal camera/cell phone (make sure that the scene is mostly planar). The second picture is of the same scene as the first picture except that the camera is rotated by a small angle. For example, see the Figure below.

Then you will apply the Harris corner detector to both images to extract two set of corner points.

Next, you will compute potential correspondences between the set of extracted corners in the first image and the ones in the second image by comparing image neighborhoods around the corner points. (For each corner point in each image, specify a search neighborhood in the other image.) The similarity between the image neighborhoods is measured by using normalized cross correlation (NCC) whose value is always in the range -1 to 1. The value of 1 means that the two neighborhoods are identical. Show putative correspondences between the corner points by drawing lines connecting the corresponding corners in the two images.

Part 2

Using the RANSAC algorithm for robust estimation, extend Part 1 to automatically compute the homography between a pair of images of the same scene. Your implementation should closely follow the first three steps outlined in the algorithm presented in class (ref: Algorithm 4.6 on page 123 of the Hartley & Zisserman's book). For the fourth step, use all inlier correspondences for refining the previously obtained estimate for the homography. Also make sure that you use the recommended data normalization before computing the homography. The data normalization should be carried out as also mentioned in class (ref: Algorithm 4.2 on page 109 of Hartley & Zisserman's).

Show the final consensus set of the correspondences by drawing lines connecting the corresponding feature points in the two images. Demonstrate the accuracy of the calculated homography by showing a three-panel display of images consisting of the domain image, the range image, and the transformed range image.
For example, assuming that the output of your program for Part 1 shows putative correspondences between the corner points by drawing lines connecting the corresponding corners in the two images:

The output of the RANSAC algorithm should eliminate outliers, leaving a more accurate set of correspondence:

The same RANSAC algorithm, will provide a homography, which if applied to the image on the left side would lead to the following transformed image:

By reevaluating the homography using all inliers from RANSAC, we obtain: