4th Assignment 776: "Computer Vision", Fall 2016

Due date: Nov 2nd , 11:59 pm (by e-mail to jmf@cs.unc.edu)
Data: http://frahm.web.unc.edu/files/2016/10/Assignment_4_data.zip

What should you turn in: A single pdf file with all solutions and a discussion of your solution. Along with the pdf file you should provide a link for your results and code.

1. Feature Detection

The goal of the assignment is be able to compute the features of an image and to compute a correlation of these features

a) Implement the Harris corner detector for a gray value image. You should implement different functions to compute the image gradients first. Then use the gradient images as input for a function that computes the structure tensor for each pixel. Next compute the cornerness of each point. The final feature selection will then pick the 1000 strongest points as the features of the image. Execute this detector on the images *.pgm in the data subdirectory wall.
b) As you can observe in step one typically the selected features cluster. To avoid this behavior implement a non-maxima suppression of radius 10 for the final selection process. Execute the corner detector again on the images *.pgm in the data subdirectory wall.
c) Compute the distance (SSD and also NCC) of every feature in im1 to every feature in im2 and plot the corresponding distance matrix as image. The distance matrix contains at position (i,j) the distance between feature i in image im1 and feature j in image im2. Compare this to the distance matrix between image im1 and image im6. Explain your observation.

2) Image Alignment

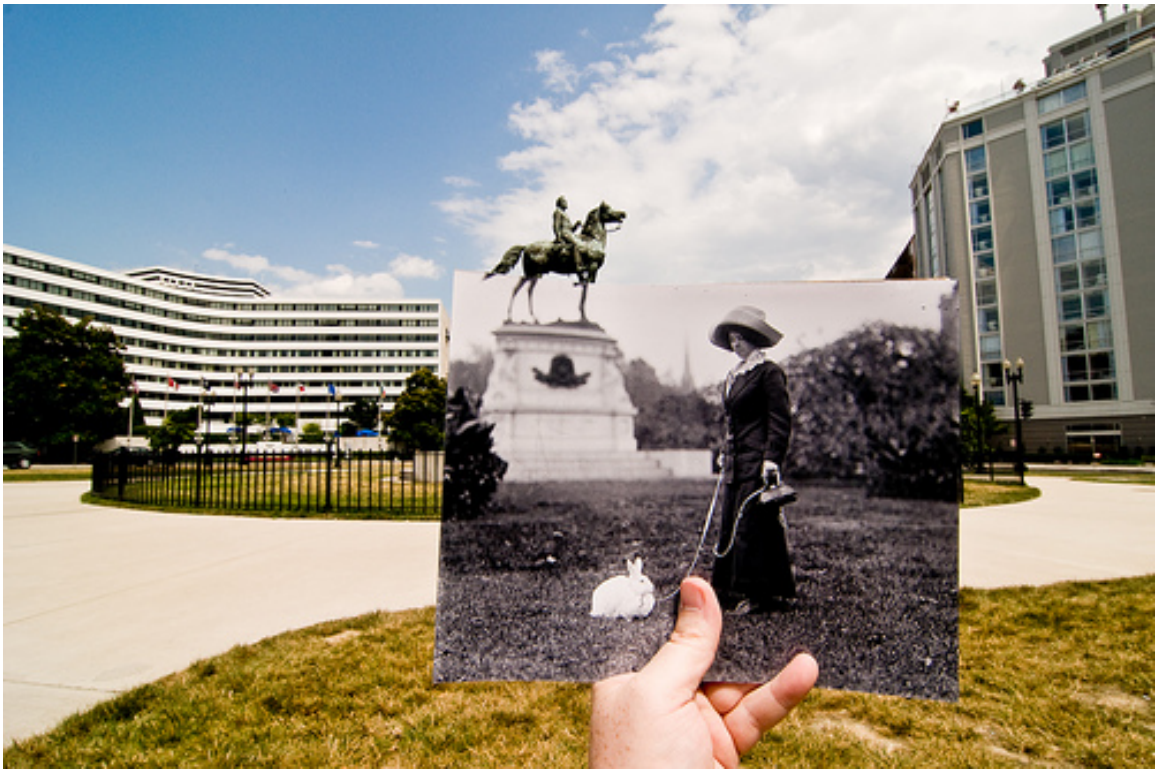
In this assignment the goal is to align images into a panorama.

a) Implement a RANSAC based method (use the RANSAC from assignment 3) to estimate an affine transformation between two images and in addition implement the same procedure to estimate the homography between two images.
b) Estimate the affine transformation and the homography between image im1 and im2 as well as between im1 and im6.
c) Warp one image onto the other using the estimated transformation. To do this, you will need to learn about maketform and imtransform functions. Do this for the affine transformation and

d) Create a new image big enough to hold the panorama and composite the two images into it. You can composite by simply averaging the pixel values where the two images overlap. Again execute this for the affine transformation and the homography for each of the two pairs from b).

For Bonus Points (adapted from S. Lazebnik):

a) Experiment with very "difficult" image pairs – like the aligning a modern and a historical view like shown below.



Or try to find two views of the same location taken at different times of day, different times of year, etc. Another idea is to try to register separated by an extreme transformation (large rotation, scaling, etc.). For the latter you will need to use SIFT features instead of Harris corners.