# Intro to Image Understanding (CSC420)

Assignment 3

Posted time: Oct. 17, 2018; Submission Deadline: 11:59pm, Oct. 23, 2018

Instructions for submission: Please write a document and submit a PDF with your solutions (include pictures where needed). Include your code inside the document and submit through MarkUS. For full marks you must show your work, not just your final answer.

## 1 Part A

[3.5 points] Take a A4 paper which is 210x297(unit: millimeter). Attach the paper on a door. Take a picture of the door such that all four corners of the door are visible on the photo. Take this picture in an oblique view, ie, the door is not a perfect rectangle but rather a quadrilateral in the photo. Using homography theory, estimate the width and height of the door from the picture. Show your derivation, captured image and final result.

## 2 Part B

[5.5 points] Take 3 images of yourself holding a hardcover book (which we call them im1.jpg, im2.jpg,im3.jpg). If you use a mirror, remember to flip the images horizontally. Try to make one of the images easy (little out of plane rotation; but do include in-plane rotations); one of the images somewhat more difficult (e.g. a bit further away from the camera and also include 30-40 degrees out of plane rotation; change the lighting a bit); and one of the images difficult (further away, or 40-60 degrees out of plan rotation, or drastically change the lighting). Also, find a picture of the book cover on Amazon or another website (which we call it bookCover.jpg). Finally, download a cover of another book from Amazon or another website (which we call it anotherBookCover.jpg). Reduce the image sizes so none is larger than 640x480 and save them in a compressed (jpg) format so your assignment file is not too large (MarkUs does not allow very large submissions).

(a) [1 points] use SIFT (or any other descriptor you like, e.g. SURF) to find point matches between each image (im1, im2, im3) and the book cover (bookCover). Visualize the matches between bookCover and each of the 3 images in a manner similar to slide #10 on lecture8-B. You can use any implementation of SIFT (or SURF or ...) in Python (OpenCV) or Matlab.

(b) [1 point] visually estimate the percentage of outliers in each case and compute the number of RANSAC iterations to recover the an affine transformation between bookCover and each of the images with a ¿=99% chance Similarly, estimate the number of iterations required to recover the projective transformation (homography).

(c) [1 point] using RANSAC (any open source implementation, or your own), find the affine transformation between bookCover and im1, im2, and im3. Use this transformation to paste bookCover onto each of the images. Explain when the method is successful and when it might fail.

(d) [1.5 point] use a homography (protective transformation) to do the same. Explain when the method is successful and when it might fail. Compare and discuss the differences.

(e) [1 point] use a homography to map the cover of the second book (another BookCover) onto each image. Discuss your results.

## 3 Part C

[3 point] Using your phone or any camera you have(select a specific resolution), estimate the internal parameter matrix K for your camera. Show your plan, formula derivation, captured picture and result. To be simple, assume there is no distortion and focal length is the same for both x axis and y axis. If you use libraries, you can get at most 1.5 points.

## 4 Part D

[Extra credit: 3 points] Use all provided landscape images to create the panorama. Read about Poisson blending (http://eric-yuan.me/poisson-blending/) and use it to make your panorama look better.