Assignment 6
Due June 7, 2019 at 6:00 AM via ilearn Assignment-6 Submission folder

Independent Reading. SFM-Factorization: https://www.ri.cmu.edu/pub_files/pub3/kanade_takeo_1998_1/kanade_takeo_1998_1.pdf Additional Details for Implementations: http://www.cs.huji.ac.il/~csip/sfm.pdf

Problem 1. [3 pts] **Homography Estimation.** You will be using the images provided along with this Assignment, for this problem. Take a pair of images and estimate the Homography matrix H between them. You can use the `detectCheckerboardPoints` function in matlab to extract the corner points. Make sure that there is an one-to-one correspondence between the corner points in the two images. Report the homography matrix for image pair 1 and 9. Specifically, you need to estimate H, where $P_9 = HP_1$, where P_1 and P_9 are the extracted points in image 1 and 9 respectively.

Problem 2. [3.5 pts] For this problem, you will be implementing the factorization based Structure from Motion (SFM) method. The starter code is `StructureFromMotionExample.m`, which is a modified version of SFM example in matlab. You need to fill in Line 135 and write the function in Line 136. `get3DPoints` is a function which takes in a matrix of dimension $2F \times P$, F is the number of frames ($F = 2$ here) and P is the number of matched points. The output of this function should be a matrix of 3D points of dimension $P \times 3$. Go through the reading material for the algorithm and data format to be used. You can use functions related to linear equation solving and symbolic representations in matlab if needed.

Problem 3. [3.5 pts] **Fundamental Matrix Estimation.** In this problem, you will be using the stereo image pairs `viprectification_deskLeft.png` and `viprectification_deskRight.png`, available in Matlab. Load the images and detect the key-points along with their descriptors using SIFT. You can use the code from Assignment-2 to do this. Using the matched points, employ the 8-point algorithm to obtain the fundamental matrix. Use random subsets of 8 points to estimate a set of fundamental matrices. Then, for each fundamental matrix, compute the mean error on the rest of matched points using the Sampson distance. Report the fundamental matrix, which produced the least error and also report the mean error. **You should not use built-in functions to estimate the fundamental matrix**. Sampson distance is defined as: $\frac{(x^T F x')^2}{||F^T x||_2^2 + ||F x'||_2^2}$, where x and x' are the 2D points on the image plane in the image pair.