Introduction to Computer Vision
Homework 4

Due in two weeks in class. All renderings should be done in Matlab, saved as some form of scalar vector graphic (such as ps, eps, or pdf) and included in your final .pdf report (typeset in LaTeX).

1. Get the data and code:
   (a) Download and compile VLFeat
   (b) Run vl_demo_sift_match – read the code.
   (c) Download sequence of images from: https://arpg.colorado.edu/wp-content/uploads/cityblock.zip
   (d) Compile calibu's matlab camera model wrapper (run ccmake in calibu and enable matlab code)
   (e) Add calibu's matlab directory to your matlab path; e.g., addpath(<path_to_calibu_mex_library>)
2. Write a matlab program `StereoVisualOdometry.m` that
   (a) Use matlab command calibu_rig('cameras.xml') to load the camera rig extracted from cityblock.zip
   (b) Loads a list of all the left and right images; e.g., something like limages = dir('left*'); rimages = dir('right*');
   (c) Loop over all stereo pairs extracting SIFT features and matching them between left and right images; draw the correspondences
3. Triangulation
   (a) Triangulate all correspondences; draw the 3D points and draw the camera poses.
4. Tracking
   (a) Find correspondences between current and previous frame for all triangulated 3D points from the previous frame; Display a 2x2 grid of images, current images on the top row, previous frame on the bottom row, left images in the left column, right images in the right column. Draw all correspondences.

5. Motion Estimation: given triangulated positions of landmarks from the previous frame and correspondences in current frame

   (a) Write a residual function that predicts the measurement of the 3D points in the current frame and computes the difference between tracked features locations (measurements)

   (b) RANSAC

      i. Write a sub-routine `[Tab,inliers] = RANSACMotion( z, m, p, sigma )`, that takes the tracked features, z, the corresponding 3D landmarks, m, the desired probability of finding the inliers, p, and the inlier standard deviation, sigma.

         A. Compute the number of RANSAC iterations to find inlier model

         B. Select a minimal subset of landmarks – how many are needed?

         C. Compute the motion of the stereo cameras given the minimal subset

         D. Score the computed motion model; count inliers; save the estimate

         E. Return the motion estimate with the most number of inliers

   (c) Using the inliers found Compute the 6DoF motion of the left camera

6. Visual Odometry

   (a) Find the trajectory the camera followed; what is the final pose?

   (b) Draw the full trajectory and plot it from above