CSE252B – Computer Vision II – Assignment #2

Instructor: Prof. Serge Belongie.

`http://www-cse.ucsd.edu/classes/sp07/cse252b`

Due Date: Tue. May 1, 2007.

1. 2D Projective Transformations.
   (a) Implement MaSKS Algorithm 5.2 (The four-point algorithm for a planar scene), p. 139.
   (b) Use the four-point algorithm with $n \geq 4$ hand-clicked correspondences to remove the projective distortion from three images: `building.gif`, `floor.gif`, and one image of your own choice.
2. MaSKS Exercise 5.19 (Two physically plausible solutions for the homography decomposition), p. 163.
3. Prove MaSKS Corollary 5.23 (From essential matrix to homography), p. 142. Show how to solve for $\boldsymbol{v}$. (Hint: you will need this for problem 8.)
4. MaSKS Exercise 5.11 (Four motions related to an epipolar constraint), p. 161.
5. Reconstruction from Two Calibrated Views.
   (a) Implement MaSKS Algorithm 5.1 (The eight-point algorithm), p. 121.
   (b) Run the script `make_scene.m` to produce two views of a synthetic scene, $\{\boldsymbol{x}_i^j\}_{j=1}^n$, $i = 1, 2$. Use the eight-point algorithm to estimate the four possible decompositions $(R, \widehat{T})$ for E.
   (c) Estimate the depths of the points and the global scale factor by solving for $\vec{\lambda}$ in MaSKS Equation (5.21), p. 125 (Linear triangulation). Record the values of R, $\boldsymbol{T}$ and γ for which all the depths are positive.
   (d) Plot the estimated 3D coordinates of the pointset relative to each camera frame.
   (e) Compute the reprojection error using MaSKS Equation (5.23), p. 127.
6. Implement Hartley normalization as defined in MaSKS Equation (6.77), p. 212. Demonstrate it on a set of 100 random 2D points distributed uniformly on the rectangular area $[1, 128] \times [1, 192]$.
7. Epipolar Geometry for Uncalibrated Views.
   (a) Implement MaSKS Algorithm 6.1 (The eight-point algorithm for the fundamental matrix), p. 212, with Hartley normalization.
   (b) Run your code on the stereo pair of `desk1.gif` and `desk2.gif` with $n \geq 8$ hand-clicked correspondences. Plot the epipolar lines $\boldsymbol{\ell}_1$ and $\boldsymbol{\ell}_2$ for at least three points in the first view, and verify that they pass through the corresponding points in the second view.
   (c) Solve for the coordinates of the epipoles $\boldsymbol{e}_1$ and $\boldsymbol{e}_2$.
   (d) Repeat the above two steps for another stereo pair of your own choosing.
8. Stereo Rectification.
   (a) Implement MaSKS Algorithm 11.9 (Epipolar rectification), p. 406.
   (b) Demonstrate your code on the image pair `blocks{1,2}.gif`.