CPS 843 (CP 8307) Problem Set 5

(25 points)

Purpose

- Familiar with the algorithm in computer vision
- Understand the basic concepts of two-view geometry and 3D reconstruction

Requirements

- The assignment is due on Monday, December 6th @ 11:59 pm. Late submissions will not be accepted.
- Submit all your work in one PDF file through D2L, including the source code (multiple submission is allowed, but only the last submission will be kept and evaluated).
- Highly recommend using IEEE double-column format. The Word and LaTeX template can be found at http://www.ieee.org/conferences_events/conferences/publishing/templates.html
- Please resize all images properly in line with the text of your report.
- Submit the source code, if any, along with the report of each part in one PDF file.
- You can directly use available functions or software packages of Matlab in your work.
- Complete the report by yourself. We will use Turnitin® for similarity check.

Software:

The Structure from Motion Package of the Computer Vision Toolbox for Matlab as outlined in the following link
https://www.mathworks.com/help/vision/examples/structure-from-motion-from-two-views.html

Work to do:

1. Calibrate the camera using the Single Camera Calibration App in Computer Vision Toolbox: https://www.mathworks.com/help/vision/ug/single-camera-calibrator-app.html . Follow the workflow of the app to calibrate your camera and export the parameters to an object.
2. Using the calibrated camera, take a pair (or more pairs) of stereo images of a rigid object or static scene from two different viewpoints.
3. Carefully read and follow the steps in the Structure from Motion Package, and perform the following steps: 1) read images; 2) load camera parameters; 3) remove lens distortion (optional); 4) find correspondences; 5) estimate the essential matrix; 6) compute the camera pose; 7) 3D reconstruction; and 8) display the reconstructed 3D points cloud.
4. You can directly use the given packages for calibration and reconstruction. You can make some necessary modifications based on your needs and understanding.

Report requirements:

- A brief technical overview of the theory for 3D reconstruction we taught during class (in about one page).
- Following each step (except for the sphere fitting step), give a brief description of what that step is used for, and the results of that step, such as the camera parameters, essential matrix, matching results, etc.
- Analysis. A necessary analysis and discussion of your results based on what you have learned and your understanding.

Available resources

- Reconstruction package:
  https://www.mathworks.com/help/vision/examples/structure-from-motion-from-two-views.html

- Calibration App:
  https://www.mathworks.com/help/vision/ug/single-camera-calibrator-app.html

- Structure from motion:
  https://www.mathworks.com/help/vision/structure-from-motion.html