CSCE 643 Project 4

The Perspective-n-point (PnP) problem is a very important problem in computer vision. We did not cover it in the course but this project is to let you learn this. You will need a checkerboard to provide point positions in world coordinates. You have to fix the checkerboard and the camera during steps 1-3.

1. Use the camera from project 3 which you know the K matrix. Once the camera the fixed, you can also obtain P, and hence recover R and t from P. Note that we use a 3D world coordinate system fixed w.r.t the checkerboard (origin at one of the corner). I assume that you have those from the previous project.
2. Please read the P3P section of this webpage: https://en.wikipedia.org/wiki/Perspective-n-Point
   Using the 3D points on checkerboard and the corresponding points image to solve P3P problems. The result will allow you to obtain R and t. Check if this is consistent with the result from 1.
3. Using the SolvePnP in opencv to conduct the same computation. It includes three different methods: **CV_ITERATIVE, CV_P3P,** and **CV_EPNP.** Please compare results.

Report requirement:

- Checkerboard configuration. All points in 3D as a ground truth [10pts].
- Images used to compute the 2 and 3 [5pts].
- Math about p3p result to R and t process [35pts]
- Matrices P, R, t.' from 1. And R and t from 2 and 3. [10pts]
- Results about comparing R and t from all three cases. How do you compare two rotation matrices? [20pts]
- Discussion about what you learn from the process [20pts]

This project has two challenge problems because we will not have challenge problems for project 5. The two challenge problems are to compose your first visual odometry algorihtm. For both challenges, you can capture a set of images first and perform computation on this set of image. No real time implementation is required.

**Challenge 1: Visual Odometry with Artificial Landmarks Using PnP. Please use the three checkerboard patterns to align them at the same height on the wall with about 2 feet apart. Let the world coordinate system to be attached to the first checkerboard in the same way as used in 1. Assume we do not know the relationship between checkerboards. We will have a calibrated camera to move around these checkerboard patterns. Note that we guarantee that no more than two checkerboards are in-sight at any**

**time, and you can identify which checkerboard is in-sight. Your task is to output R and t of the the camera with respect to the world coordinate system given the input images.**

**Challenge 2: Visual Odometry Using PnP. Similar to Challenge 1 but we will not have artificial landmarks. You can still use the checkerboard as scene setup but we will not directly use the points there. You will need to use SIFT feature and RANSAC to perform 2D-2D point matches. (http://www.vlfeat.org/overview/sift.html)**
**You need to estimate both 3D point positions, and the camera trajectory using PnP.**