MEAM 620 Project 2 Phase 1

Due: Friday, March 22, 2013

For this assignment you will implement a vision based 3-D Pose estimator. For this phase you will compare your pose estimates to ground truth provided by the vicon.

1 Vision Based Pose Estimation

1.1 Environment

The provided data for this phase was collected while a Nano+ flew a prescribed trajectory over a mat of April tags [1] each of which has a unique ID which can be found in `parameters.txt`. A **pdf** of the April tag mat is included. The tags are arranged in a 12 x 9 grid. The top left corner of the top left tag should be used as coordinate (0, 0) with the X coordinate going down the mat and the Y coordinate going to the right. Each tag is a 0.152 cm square with 0.152 m between tags. With the exception of the space between columns 3 and 4, and 6 and 7, which is 0.178 m. Using this information you can compute the location of every corner of every tag in the world frame.

1.2 Calibration

The intrinsic camera calibration matrix and the transformation between the camera and the robot center are given in `parameters.txt`. Two photos (`top.jpg` and `side.jpg`) are included to visualize the camera-robot transform. You will need to transform your camera-based pose estimation to the robot center, such that you can compare it against the Vicon ground truth.

1.3 Pose Estimation

The data is provided in two `mat` files. `vicon.mat` contains vicon data at 100 Hz and it will serve as ground truth. The format of Vicon is the same as project 1, phase 4. `data.mat` contains all of the data necessary to do pose estimation. Inside `data.mat` there are a series of packets each containing

1. Time stamp
2. ID of every April tag that is observed in the image.
3. The four corners of every April tag in the image. The corners are given in the following order (counterclockwise, bottom left, bottom right, top right, top left) and expressed in image coordinates.
4. Rectified image
5. IMU data (Euler angles, angular velocity, and linear acceleration)

Note that for some packets, no tags are observed, you therefore do not need to compute the pose for those packets. The rectified images and IMU data are not necessary for this phase, we keep them for the sake of data format consistency. Using the camera calibration data, the corners of the tags in the frame, and the world frame location of each tag you can compute the pose of the Nano+ for each packet of data.

2 Submission

You need to submit a written report detailing the formulas and methods used to compute the pose for each packet of data. You also need to provide plots and analysis of the performance of your estimator compared to the Vicon. Please make sure to label all axes and explain all plots clearly. Please generate (at least) following plots:

1. 3D trajectories of your pose estimate and the Vicon ground truth.
2. Compare your pose estimate against Vicon in six separate plots, one for each degree of freedom (x, y, z, roll, pitch, yaw). Please also provide the error standard deviation.

Send a zipfile called `LASTNAME-FIRSTNAME-proj2-phase1.zip` to meam620@gmail.com with "Project 2, Phase 1" in the subject line. The archive should contain:

1. A **PDF** of your writeup.
2. A **README** file containing instructions to run your code.
3. All the code you used for this phase of the project.

References

[1] April Tags, http://april.eecs.umich.edu/wiki/index.php