MTRN4110 – Project 2

Part1: Estimating 3D attitude by processing the gyroscopes' measurements

In this part of the project you are required to estimate the 3D attitude of the platform (3DoF), by integrating the three gyroscopes provided by the IMU. The equations to be applied for that process are explained in the document ***"AngularRates3D.pdf".*** based on applying the approach which you used in Project1.PartA, you can evaluate the offset (bias) that affect each of the gyros. The removal of bias is necessary to improve the estimated attitude. You can assume that at the initial time the platform's attitude is (0,0,0).

Hint: During the test, the hexapod closed a loop, following an almost square path; always turning to the right (*); completing a rotation of approximately +360 degrees. The coordinate frame convention of the IMU measurements is as defined in document ***"AngularRates3D.pdf"***; which means that a positive change in yaw corresponds to the platform turning right.

(*) this can be also appreciated by inspecting the sequence of depth and 3D images. The provided IMU data and camera data were acquired simultaneously. The IMU was aligned with the Hexapod's body.

Part 2: Estimate roll and pitch by processing 3D images

Using the implementations that you developed in Project1.PartB, you are required to estimate the Pitch and Roll of the platform, at the sample times of the images (because you can detect the floor, based on those images).

Hints: You can assume that at the initial time (t=0) the platform attitude is (0,0,0); consequently, at that initial time, the relative inclination of the floor, respect to the camera coordinate frame, is totally due to the inclination of the camera respect to the hexapod's body. This camera's angle is not modified during the rest of the experiment (the camera is rigidly fixed to the platform). In subsequent images (in particular when the hexapod is walking) the estimated angles are also affected by the Roll and Pitch of the hexapod's body.

(note: you already solved a relevant part of this problem, in Project1.PartB.)

Part 3: Detection of Poles

The context of operation, where the test took place, contained a set of vertical poles (which are useful for future navigation purposes). However, those poles need to be inferred from the raw 3D images. You are required to propose and implement an approach for detecting that type of objects. The process must provide the 2D position, (x,y), of each detected pole (in a given depth/3D image), expressed in an aligned local coordinate frame (*).

(*) A 2D coordinate frame that is aligned with the floor, and whose x-axis is parallel to the hexapod's heading (Yaw), and whose point (0,0) corresponds to the position of the camera. We will discuss about this and other details, during the lecture on week 5.

Part 4: Using the Points Cloud for obstacle detection

Based on the set of 3D points generated by the camera, we can perform some basic obstacle detection process.

1) Detect the points that may be a risk for the platform, e.g. those that are nearby ahead the platform, at a level between 10 and 50cm high (respect to the floor).

2) Show those "dangerous" points in a salient color, e.g. in red (and the rest of the points of the 3D cloud shown in blue).

Relevance

This project gives you 20% of the total mark of the practical component of MTRN4110.

The relevance of the components of this project (expressed as a percentage of Project) are:

Item 1: 15%, Item 2: 15%, Item 3: 45%, Item 4: 25%

Demonstration and submission

This task must be solved during weeks 5 and 6. You will give a demonstration of your program, on week 7 (during your lab session) and submit your program by the end of the same day (time 23:55). The submission will be done electronically, via Moodle. Instructions about the format of the submitted files will be given before week 6.

If you have questions, please ask via the Forum in Moodle or by emailing the lecturer (j.guivant@unsw.edu.au)