AAS - MTRN4010

Advanced Autonomous Systems

Project 1

This project involves the implementation of a localizer based on the Extended Kalman Filter (EKF). The project is divided in 3 parts. All the parts are relevant and will be used in Project 2, for the on-line version of the EKF localizer.

Part 1

Modify the program *DemoEKF_2016.m* for properly setting the Q matrix, by considering the statistical properties of the noise which pollutes the process model inputs. The currently provided version of the program does not consider that the main source of uncertainty, in the process model, is due to the noise which corrupts the measurements from the speed and angular rate sensors.

Part 2

a) Modify the program (obtained in Part 1) for making it able to process ***bearing*** observations in place of ***range*** observations.

b) Modify the program (obtained in Part 1) for making it able to simultaneously process ***range*** and ***bearing*** observations (each observed landmark provides a couple of measurements, i.e. range and bearing). The formulation was presented in the lecture notes.

In addition to modifying the EKF code, you will also need to adapt the simulation components provided in *DemoEKF_2016.m,* in order to properly simulate the system (e.g. for simulating the bearing measurements).

Part 3

Implement a version of PartD.Task2, for operating in an on-line fashion, by reading the necessary measurements using the provided API (Application Program Interface). Examples about how to use the API, for on-line operation, are provided with the release of this project.

The solution of this part involves reusing functions you implemented in previous tasks (feature extraction, kinematic model, data association, etc.)

Recommendations for solving part 3

Your program should run in a periodic fashion, e.g. iterating every approximately 100ms (e.g. using “pause(0.1);”, read note 1 about this matter). Each time you program does “wake up” it reads the last arrived laser scan (see note 2) and all the recently arrived measurements from the gyroscope and speed sensors (see note 3). It will use the gyroscope and speed measurements for performing a prediction step to predict the state of the system at the time of the last laser scan. After that, it will perform the necessary steps for processing the laser data (as it was originally done in Task 2). After the processing of the laser data is performed, your program will go to “sleep” (i.e. pause), until the next iteration.

Note 1: The program needs to keep the loop periodically running, at approximately 10Hz. This matter is not critical; it could vary between 5 and 20Hz. This processing rate is adequate because the problem that we try to solve is the estimation of the pose of a relatively slow platform.

We expect to process approximately 10 laser scans / second. We do not need to process all the laser scans (that are produced at a rate ~40Hz, by the currently used sensor).

Note 2: Only the last arrived laser scan (one scan). Consequently we ignore some of them (depending on the frequency of the main loop of your program). This is related to the comments in note 1.

Note 3: This is possible because all the arriving measurements are buffered by the Possum System, and those are available to your program via the API. Your Matlab program does not need to run in "hard-real time" for dealing with all the measurements. All the API functions for reading sensors' measurements behave in similar way; they provide the measurements that have occurred since the last previous call to the same reading function.

Relevance of the project's components:

Part 1:	30%
Part 2:	35%
Part 3	35%

Deadlines for demonstrations and programs submission

Demonstration of Project 1:	week 11 (in your session time, see note (*))
Submission of programs:	week 11 (Friday, 11:59PM) (**)

(*) Your demonstration must take place during your session time, on week 11.
(**) Electronic submission will be via Moodle. Instructions about format and other submission details will be provided via Moodle, as well.

Questions
If you have questions about this project, those can be asked via Moodle's forum or by email to the lecturer, Jose Guivant: j.guivant@unsw.edu.au

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