EECS 568 Final Project Proposal: In-EKF Localization using IMU and GPS

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Robot localization is the process of determining the pose (*i.e.*, position and orientation) of a mobile robot being given a map. Localization is a fundamental building block for an autonomous robot as the knowledge of where the robot is on the map is essential for decision making about future actions. Existing approaches to solving robot localization can be broadly classified into two categories, filter based methods and optimization based methods. Optimization based algorithms are often advocated for its superior accuracy but at the cost of intensive computations. Filter based methods like the extended Kalman filter (EKF) based solutions are still extensively used mainly as a result of their efficiency and simplicity. In any filter based sensor fusion framework, estimators are required to achieve convergence to zero of the state estimation error. An emerging methodology to accomplish this goal is the Invariant EKF (In-EKF) built on the symmetry-preserving observer theory [1].

This project aims to implement an In-EKF based localization system and compare it against a particle filter based localization system and a GPS-alone dataset. We will use the UM North Campus Long-Term Vision and LIDAR dataset [2], an autonomy dataset for robotics research collected on the University of Michigan North Campus. It consists of data from several sensors including planar lidar, omnidirectional camera, IMU, and GPS.

The goals of this project are as follows:

- Recent research work [3] [4] [5] being done in the field to create a baseline for the results anticipated from the project.
- Develop an In-EKF filter model for pose estimation on the IMU sensor data from The UM North Campus Long-Term Vision and LIDAR Dataset and using GPS sensor data to implement a correction model.
- Develop a particle filter based pose estimation model using IMU and GPS (for correction) data.
- Compare the proposed In-EKF based localization system with particle filter based localization, only GPS data and the ground truth poses provided by the dataset.

References

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