Assignment 6: Extended Kalman Filter using Landmark Data

Mar. 11 , 2020

Objectives

- To understand how to apply the Extended Kalman Filter (EKF) to a practical problem
- To learn how to compute the necessary Jacobians to linearize nonlinear system dynamics

You are provided with a sequence of measurements of known landmark locations in a given area, as well as a sequence of IMU data that measures how the vehicle is moving in the workspace. Your objective is to fuse these two datastreams using an EKF to estimate where the vehicle is in the workspace. The measurement model maps the position of the landmarks to a range and bearing relative to the vehicle, similar to how a LIDAR scan would capture the landmark location. Further details of the problem are given in the Jupyter notebook, which you will complete and submit.

Resources and Instructions

There are 3 TODO sections to complete in the given Jupyter notebook:

1. Write the measurement_jacobian() function, which should compute the measurement Jacobian for a given landmark location and the current state of the vehicle,
2. Write the measurement_update() function, which performs the necessary update to the state and the covariance estimate using a landmark's true location as well as its LIDAR range and bearing estimate.
3. Complete the main Kalman filter loop, which will recursively estimate the state of the vehicle as it progresses through the workspace.

Deliverables

HTML output: In the Jupyter Notebook, go to File > Download as > HTML (.html). Submit a ZIP file containing the HTML output and the PDF file.

Run all code blocks before downloading the HTML.

Please follow the naming convention for your zip file: a6_<user_id>.zip .

Due Date

11:59 PM, Friday Mar. 26, 2020.
No late submissions will be accepted. There will be no extensions.

Marking Scheme

Assignments are marked on a 0-10 point scale.
2 point will be given for the measurement_jacobian() function,
4 points will be given for the measurement_update() function, and
4 points will be given for the main Kalman filter loop.
Points will be deducted if the estimated trajectory is far off from the ground truth trajectory.
See tutorial slides for sample output.

Policies

Collaboration
You can discuss the problem with peers, but you must design and implement your own solution independently.

Use of online resources
You may consult online resources for inspiration, but you must develop your own code.