Robust state estimation for AUVs / ASVs

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This project aimed at designing a state estimator for an Autonomous Underwater Vehicle (AUV), for estimating position and trajectory of the vehicle in real time. The underlying motivation is to use the AUV for various environmental measurements using a suite of onboard sensors, and associate each measurement to a reasonably accurate position. In the long term, several such AUVs would be designed to operate in a team and collect environmental data. Since GPS doesn't work under water, the AUVs would have to take turns to surface at times to receive GPS position, and use inertial navigation between such GPS updates. Further, they can communicate to perform cooperative localization and refine their position estimates.

The state estimator designed in this project is robust in that it can incorporate sensor measurements into the state estimate as they arrive, instead of relying on them being reported at fixed intervals. Further, using independent measurement models for each sensor measurement makes it easier to integrate new sensors in future (depth sensor, relative range-bearing etc.).

Given the limitations in time and complexity in deploying the hardware in the field, the state estimator was tested on board an autonomous surface vehicle instead of an underwater vehicle. The additional advantage was the availability of GPS measurements, which could serve as ground truth to evaluate the estimated trajectory. Therefore, although the state estimator is designed for 3D trajectory estimation, it was tested only in 2D, on the surface of water.