Systems Engineering for Autonomous Systems
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Distributed Mission Adaptive Navigation Systems for Autonomous Platforms

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Summary:

Using existing data fusion schemes and available error models for sensors, a balance of investment study is carried out to illustrate the navigation accuracy that results from fusion of different combinations of navigation sensor in different situations. Navigation performance of typical missions for single or multiple vehicles are analysed and the results can be used to configure the most effective sensors combination.

Aim

The aim of the project is to develop an adaptive navigation system that can be configured according to the accuracy and sample rate requirements of a mission and the number of vehicles in a swarm

Approach

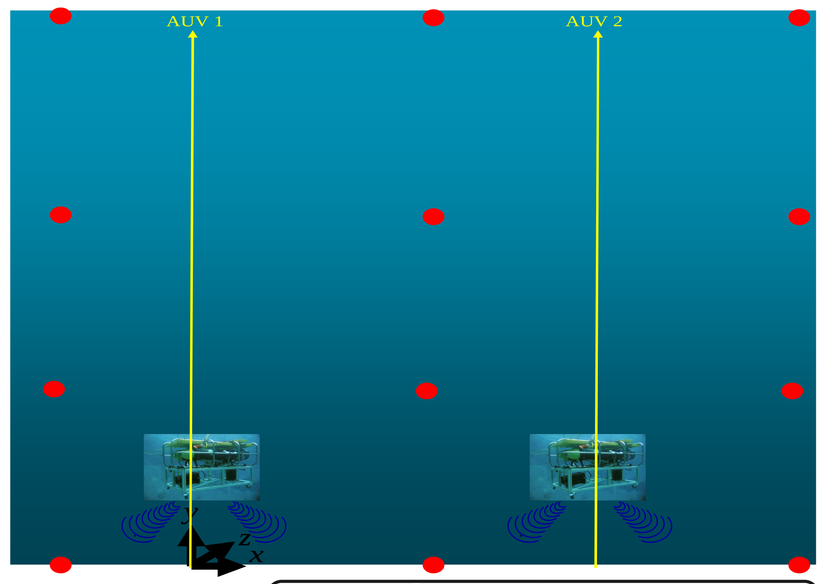
An SINS/SLAM structure and decentralized SLAM structures are implemented, using extended Kalman filter, information filter and interval analysis. A sensitivity analysis tool is used to find out the contribution of each sensor to the system performance in each SLAM structure

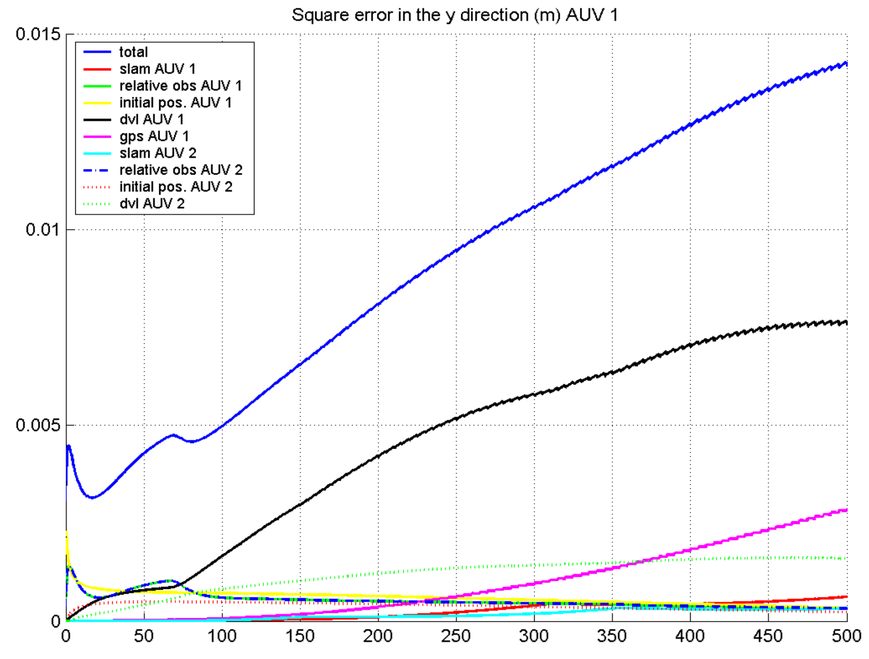
Outcomes

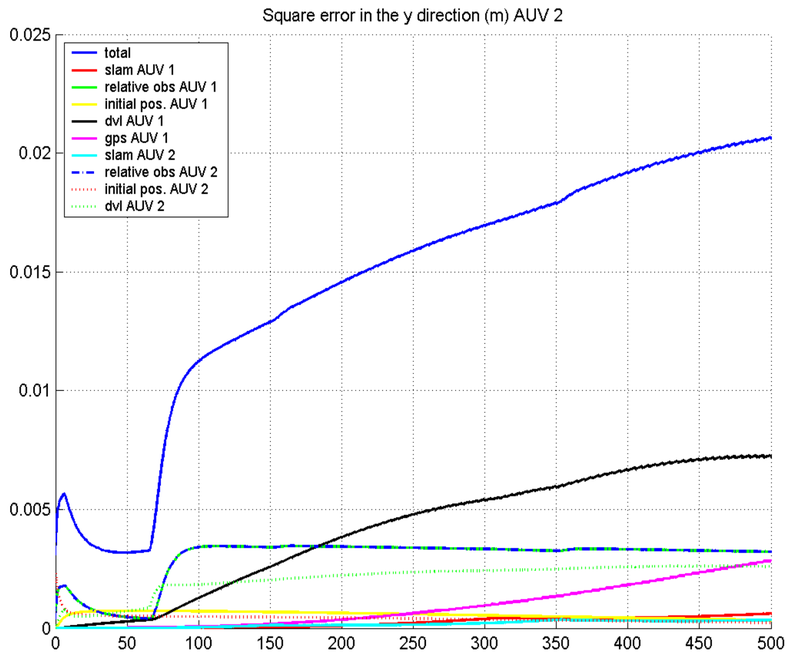
Simulation results indicate that low cost SINS can provide accurate navigation in long period mission aided by SLAM. The research also reveals the application potential of sensitivity analysis on predicting the navigation performance of a given sensors combination or configuring most effective navigation sensors for given requirement

Experiment

A simulated exploration mission and analysis results are presents here. In this mission the AUVs start from a known initial position with an offset distance in the *x* axis of 100m. The AUVs travel along the *y* axis. The AUV1 (fitted with DVL) remains on the surface during the entire mission and receives at regular intervals GPS fixes. The AUV2 moves in the sea surface a small distance *a* along the *y*-axis while receiving GPS measurements, after that the vehicle submerges a distance *h*. Once the vehicle has submerged it travels a distance *b* along the *y*-axis. Finally the AUV2 surfaces and travels a further distance *c* along the *y*-axis







Conclusion

The performance of AUV1 is determined by DVL and GPS. For AUV2, navigation error is mainly introduced by SLAM, observation of AUV1 and error of DVL equipped on AUV1. DVL is the critical sensor in this system. An upgraded DVL will improve the system navigation performance remarkably

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