

## **An Analytical Framework for Predicting the Performance of Underwater Positioning**

By

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**MSB 114**

3:00-3:30 pm Coffee Hour

3:30-4:30 pm Seminar

Please join us for the coffee hour near the seminar venue a half hour  
before the seminar, 3:00 – 3:30 pm

### **Abstract**

Improvements in underwater navigation continue to expand of our ability to explore, understand and manage ocean resources. These advances take the form a variety of standalone instruments available to the vehicle designer. Today's underwater navigation systems employ several of these instruments concurrently and use fusion algorithms to estimate vehicle state. Because of the increasing complexity of these navigation systems, predicting the overall performance (precision and accuracy) of a particular configuration is a design challenge. However, the fundamental trade-offs can be understood with stochastic observation models and information-centric analysis.

We propose models for the most common underwater navigation modalities: absolute reference (e.g., long baseline (LBL) positioning) positioning), dead-reckoning speed over ground (e.g., Doppler velocity log (DVL) odometry) and heading observations (e.g., fiber-optic optic gyroscope (FOG) reference). We combine these simple models using the lower bound to predict both the precision and accuracy of common AUV positioning solutions. To demonstrate the utility of such predictions, we model the uncertainty of current solutions and emerging operational challenges such as long-term environmental monitoring, under-ice navigation and long-distance survey.

Finally, we substantiate the use of this framework by comparing model-based performance predictions to empirical evidence. The laboratory experiments use a novel precision acoustic ranging solution for high resolution positioning.