Field Experiments for Exploration of the Oceanographic Features with Autonomous Vehicles

H. Zheng[1], B. H. Ooi[1], W. Cho[1,2], M. H. Dao[3], P. Tkalich[3], N. M. Patrikalakis[1,2]

[1] *Singapore-MIT Alliance for Research and Technology Centre*
[2] *Center for Ocean Engineering, Department of Mechanical Engineering, Massachusetts Institute of Technology*
[3] *Singapore-MIT Alliance for Research and Technology Centre*

Significant oceanographic features such as jets and vortices can be forecasted by numerical simulations but are often subject to high uncertainty from the models and operational data. A practical method to improve the accuracy of the ocean forecast is to use a data assimilation methodology to combine in-situ measured and remotely acquired data with numerical forecast models of the physical environment. However, these oceanographic features are difficult to measure and quantify as they have high spatial and temporal variability.

This paper discusses the design, implementation and result analysis of an experiment to identify and resolve such oceanographic features in Selat Pauh, in the Strait of Singapore. The design of our experiments were based on the oceanography forecast including the current speed, its gradient, and vorticity in a given region of interest for which permits for field experiments were secured and for time intervals that correspond to strong tidal currents. The deployment formation for multiple robotic vehicles (Autonomous Surface Craft - ASC), the measurement instruments, the algorithms developed in extracting oceanographic field variables and comparison of the forecasts with measurements are described. To investigate an unexpected behavior of one ASC, hindcasts with wind effects and simulation on a larger domain with more involved bathymetry were also carried out.

Keywords: Marine robotics; path planning; adaptive sampling; oceanographic features.

References

[1] W.C. Pang, P. Tkalich, and E.S. Chan, “Hydrodynamic forecast model for the Singapore Straits,” Proceeding of the XXX IAHR Congress, Thessaloniki, Greece, A: 9-16, August 2003.

[2] B. H. Ooi, H. Zheng, H. Kurniawati, W. Cho, M. H. Dao‡, J. Wei, P. Zemskyy, P. Tkalich, P. Malanotte-Rizzoli, N. M. Patrikalakis, “Multi-vehicle Oceanographic Feature Exploration,” Proceeding of ISOPE 2009, Osaka, Japan, June 2009.