ORE since 1966
OCEAN AND RESOURCES ENGINEERING
IN THE SCHOOL OF OCEAN AND EARTH SCIENCE AND TECHNOLOGY AT THE UNIVERSITY OF HAWAI'I AT MĀNOA

MECHANICAL ENGINEERING
UNIVERSITY of HAWAI'I at MĀNOA

# JOINT ORE/ME SEMINAR

## New Perspectives on the Localization and Coordination of Underwater Vehicles in Strong Geophysical Circulations


**Dr. Zhuoyuan Song**
**Assistant Professor in the Department of Mechanical Engineering at UH Manoa**


**Watanabe 112**

**Wednesday, September 19**
**3:30 - 4:30 pm Seminar**

## Abstract


**Small autonomous robots as environmental perception instruments are often severely constrained in actuation capability, navigation system accuracy, and on-board processing capacity. The presence of ubiquitous geophysical flows tends to exacerbate challenges associated with the control and state estimation of these mobile platforms. Conventionally, background flows are considered as adversarial factors to the mobility and navigation accuracy of mobile robots. I advocate a new perspective on the role of background flows as *ubiquitous navigation references* and *transportation "highways"* for independent and networked autonomous robots. The first part of the talk introduces a novel flow-aided navigation method for long-term, mid-depth autonomous underwater vehicles (AUVs). This method leverages the dynamics of spatiotemporally varying background flows as navigation references in mitigating the accumulative error of inertial navigation. The second part of this talk proposes a distributed, multi-robot flocking and flock guidance method by modeling robot swarms as continuous fluids. An implementation for nearly fuel-optimal guidance of large AUV groups in both artificial and real-world flow fields will be presented. Finally, I will discuss how these results have motivated future research directions including 1) the design of system middleware for consistent and secure collaboration between human supervisors and autonomous robot swarms; 2) long-term autonomy with concurrent flow-aided navigation and background flow dynamics learning.**