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Motion Tomography: Converting Marine Vehicle Trajectories to Ocean Flow Map

ABSTRACT:

This talk addresses the path following behaviors of marine vehicles under the guidance of spatially distributed modeled ocean flow, which is motivated by experimental work on navigating ocean gliders. Experimental data consistently suggests that the navigation error is caused by unknown ocean flow. The method of motion tomography (MT) is proposed to identify the unknown ocean flow from the navigation error along the vehicle trajectories. The method fuses the data collected by multiple marine vehicles along their paths to formulate an “inverse problem” that has been the core problem underlying medical CT imaging. By solving this inverse problem, a high-resolution spatial map of ocean flow in the volume traversed by the vehicles can be reconstructed. Motion tomography provides a “directly measured” spatial map of ocean flow, which can be leveraged by path following controllers on-board marine vehicles to reduce the navigation error. However, due to the limited spatial resolution of the flow map, the tracking performance of the marine vehicles are bounded by a smallest possible error.

BIOGRAPHY:

Dr. Fumin Zhang is Professor in the School of Electrical and Computer Engineering at the Georgia Institute of Technology. He received the B.S. and M.S. degrees from Tsinghua University, Beijing, China, in 1995 and 1998, respectively. He received a PhD degree in 2004 from the University of Maryland (College Park) in Electrical Engineering and held a postdoctoral position in Princeton University from 2004 to 2007. His research interests include mobile sensor networks, maritime robotics, control systems, and theoretical foundations for cyber-physical systems. He received the NSF CAREER Award in September 2009 and the ONR Young Investigator Program Award in April 2010. He is currently serving as the co-chair for the IEEE RAS Technical Committee on Marine Robotics, associate editors for IEEE Journal of Oceanic Engineering, IEEE Transactions on Automatic Control, and IEEE Transactions on Control of Networked Systems.



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