(Gliding) Robotic Fish: Swim or Not

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Friday, February 13, 2015
3:30 – 4:30 pm • 1500 EECS

ABSTRACT: Autonomous robots are playing an increasingly important role in surveying and monitoring underwater environments. In this talk I will present a new type of underwater robots, termed gliding robotic fish, which adopts the salient features of both underwater gliders and robotic fish. Like underwater gliders, it is capable of energy-efficient, buoyancy-driven rectilinear gliding; on the other hand, it can swim and maneuver with an actively controlled tail fin. In particular, I will focus on how the tail is used in concert with the gliding mechanism to realize novel, energy-efficient spiral motion in the three-dimensional space, a useful application of which is the sampling of water columns. Modeling and feedback control of the spiral motion will be presented, along with experimental results including those from sampling harmful algae in Wintergreen Lake, Michigan. Finally, I will briefly discuss two ongoing multi-investigator projects that use schools of gliding robotic fish to monitor and understand harmful algal blooms, and to track the movement of acoustically tagged live fish in the Great Lakes, respectively.

Bio: Dr. Xiaobo Tan is an Associate Professor in the Department of Electrical and Computer Engineering and Department of Mechanical Engineering (by courtesy) at Michigan State University. He received the B.Eng. and M.Eng. degrees in automatic control from Tsinghua University, Beijing, China, in 1995 and 1998, respectively, and the Ph.D. degree in electrical and computer engineering from the University of Maryland, College Park, in 2002. His research interests include electroactive polymer sensors and actuators, modeling and control of systems with hysteresis, biomimetic robotic fish, mobile sensing in aquatic environments, and collaborative control of autonomous systems. Dr. Tan directs an NSF Research Experiences for Teachers (RET) Site on Robotics Engineering at MSU. He serves on the editorial boards of Automatica, IEEE/ASME Transactions on Mechatronics, and International Journal of Advanced Robotic Systems. He served as the Program Chair of the 2011 International Conference on Advanced Robotics, and is currently serving as the Finance Chair of the 2015 American Control Conference. He has (co)authored one book (Biomimetic Robotic Artificial Muscles) and over 150 peer-reviewed journal and conference papers, and holds one US patent. He is a recipient of the NSF CAREER Award (2006), MSU Teacher-Scholar Award (2010), and several Best Paper Awards.