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# 學術報告

# Bio-inspired Underwater Robots Enabled by Electro-active Polymer Artificial Muscles


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***Biography***: Dr. Zheng Chen is a Bill Cock assistant professor in the Department of Mechanical Engineering at the University of Houston. He received B.E. degree in Electrical Engineering, M.E. degree in Control Science & Engineering from Zhejiang University, China in 1999 and 2002, and Ph.D degree in Electrical Engineering from Michigan State University (MSU) in 2009. Dr. Chen joined the Department of Mechanical & Aerospace Engineering at the University of Virginia as a research associate in Sept. 2009. In July 2012, Dr. Chen joined Baker Hughes as a research & development engineer specialized in control systems. From August 2013 to May 2017, Dr. Chen was an assistant professor in the Department of Electrical Engineering and Computer Science at Wichita State University. His research interests include electroactive polymer artificial muscle, bio-inspired underwater robots, underwater cyber physical systems, control of hydraulic fracturing equipment, and renewable energy systems. Dr. Chen served in several NSF panels in 2016 and 2017. His current research is supported by NSF and Baker Hughes. Dr. Chen received many prestigious awards, such as NSF CAREER Award in 2017, Kansas NSF EPSCoR First Award in Climate Change and Energy in 2015.


Autonomous underwater robots are highly demanded in environmental monitoring, intelligent collection, and deep water exploration. Recent years have witnessed significant effort in development of bio-inspired underwater robots to mimic aquatic animals, such as robotic fish, robotic jelly fish, and robotic manta ray, to achieve high energy propulsion efficiency and maneuvering capabilities. Novel actuating materials, which are light, soft, and capable of generating large flapping motion under electrical stimuli, are highly desirable to build such bio-inspired robotic fish. Electroactive polymers (EAPs) are emerging smart materials that can generate large deformations under electrical stimuli. As an important category of ionic EAPs, Ionic Polymer-Metal Composites (IPMCs) can work under wet condition with low actuation voltages, which shows their great potential in bio-inspired underwater robots. A systems perspective is taken in this research, from modeling, control, fabrication, and bio-inspired design. This presentation will be organized as follows. First, a physics-based and control oriented-model of IPMC actuator will be discussed. Second, a speed model of bio-inspired robotic fish propelled by an IPMC caudal fin will be presented. Third, a bio-inspired robotic manta ray propelled by two IPMC pectoral fins will be demonstrated. Fourth, a 2D maneuverable robotic fish propelled by a servo/IPMC hybrid tail will be presented. Last, advantages and challenges of using IPMC artificial muscles in bio-inspired robots will be concluded.


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