Advances in Underwater Robotic Vehicles for Oceanographic Exploration in Extreme Environments

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ABSTRACT: This talk reports recent advances in underwater robotic vehicle research to enable novel oceanographic operations in extreme ocean environments, with focus on two recent vehicles developed by a team comprised of the speaker’s group and his collaborators at the Woods Hole Oceanographic Institution. First, the development and operation of the Nereus underwater robotic vehicle will be briefly described, including successful scientific observation and sampling dive operations at hadal depths of 10,903 m on a NSF sponsored expedition to the Challenger Deep of the Mariana Trench – the deepest place on Earth. Second, development and first sea trials of the new Nereid Under-Ice (UI) underwater vehicle will be described. NUI is a novel remotely-controlled underwater robotic vehicle capable of being teleoperated under ice under remote real-time human supervision. The goal of NUI is to enable exploration and detailed examination of biological and physical environments including the ice-ocean interface in marginal ice zones, in the water column of ice-covered seas, at glacial ice-tongues, and ice-shelf margins, delivering realtime high-definition video in addition to survey data from on board acoustic, optical, chemical, and biological sensors. We report the results of NUI’s first under-ice deployments during a July 2014 expedition aboard R/V Polarstern at 83° N 6 W° in the Arctic Ocean – approximately 200 km NE of Greenland – in which we conducted 4 dives under the moving polar ice-pack to evaluate and develop NUI’s overall functioning and its individual engineered subsystems and under-ice scientific survey capabilities for biological oceanography and sea-ice physics.

Biosketch: Louis L. Whitcomb completed a B.S. in Mechanical Engineering in 1984 and a Ph.D. in Electrical Engineering in 1992 at Yale University. From 1984 to 1986 he was a Research and Development engineer with the GMFAnuc Robotics Corporation in Detroit, Michigan. He joined the Department of Mechanical Engineering at the Johns Hopkins University in 1995, after post doctoral fellowships at the University of Tokyo and the Woods Hole Oceanographic Institution. His research focuses on the navigation, dynamics, and control of robot systems – including industrial, medical, and underwater robots. Whitcomb is a principal investigator of the Nereus and Nereid Under-Ice Projects. He is former (founding) Director of the JHU Laboratory for Computational Sensing and Robotics. Whitcomb is presently Professor and Chairman at the Department of Mechanical Engineering, with secondary appointment in Computer Science, at the Johns Hopkins University’s Whiting School of Engineering. Whitcomb received teaching awards at Johns Hopkins in 2001, 2002, 2004, and 2011, was awarded a National Science Foundation Career Award, and an Office of Naval Research Young Investigator Award. He is a Fellow of the IEEE. He is also Adjunct Scientist, Department of Applied Ocean Physics and Engineering, Woods Hole Oceanographic Institution.