Research Project: Remotely Operated Vehicle (ROV) and Unmanned Surface Vehicle (USV) Cooperation in Maritime and Port Environments

Abstract: There is a compelling need for safe and reliable robot autonomy in maritime environments, especially when robots must operate in close proximity to complex submerged structures, such as piers, bridges, ships, and offshore platforms. In these cases, comprehensive situational awareness is needed to inspect these structures and avoid collision. With that goal in mind, this project will involve a team-based effort to develop and test active perception capabilities for a VideoRay inspection-class remotely operated vehicle (ROV), which will deploy from a Wave Adaptive Modular Vessel (WAM-V), a class of unmanned surface vehicle (USV). The ROV, in use by Dr. Englot and his students for the past two years, has been equipped with advanced perceptual sensors and algorithms that allow it to perform simultaneous localization and mapping (SLAM) in cluttered port and harbor environments, where its sonar-based measurements of surrounding structures form the basis for navigation. Now that a reliable SLAM capability exists, we would like to close the feedback loop on this process and begin developing capabilities for autonomous maneuvering and control, so our robot can reliably inspect and explore submerged structures. The team will assist Prof. Englot and his graduate students in equipping the VideoRay with a Doppler velocity log (DVL) odometry sensor, and wrapping a position control loop around the robot's sensors, to allow improved station-keeping. The team will also put these techniques to use in field experiments where the ROV is tasked with autonomous 3D mapping and exploration of an unknown environment. In parallel, other members of the team will assist in the design of a launch and recovery system that will allow the ROV to be deployed from the WAM-V, improving the mobility of the ROV by allowing it to be delivered into the confined internal areas of complex structures from any location reachable by the USV. The WAM-V arrived in the lab in April, and is not yet instrumented with power, propulsion, or sensing systems. However, the designs produced by SRI team members for the WAM-V will be fabricated over the next few months.

Student Team:
Kyle Alvarado, Mechanical Engineering / Undergrad., University of Alaska - Anchorage
James Fredericks, Marine Operations / Undergrad., SUNY Maritime
Mathew Green, Naval Engineering / Undergrad., Stevens Institute of Technology
Victoria Kapp, Mechanical Engineering / Undergrad., Stevens Institute of Technology
Anthony Orrico, Computer Engineering / Undergrad., Stevens Institute of Technology
Max Panoff, Electrical Engineering / Undergrad., Stevens Institute of Technology

Faculty Mentor: Dr. Brendan Englot, Stevens Institute of Technology