

SMALL AFFORDABLE USVS FOR HYDROGRAPHIC DATA GATHERING

SeaRobotics Corporation

SeaRobotics Corporation was formed in 1999 to commercialise technology developed by the US Navy's Office of Naval Research (ONR). After working with Autonomous Underwater Vehicle (AUV) technology and developing numerous communication systems utilising ad hoc networking for the transportation community, SeaRobotics continued its quest to develop autonomous systems for the hydrographic and oceanographic survey community. Extensive experience developing AUVs, ROVs and oceanographic instruments has led to the development of a growing family of Autonomous and Unmanned Surface Vehicles (USVs) and other marine robotic products in Florida, USA.

During the last few years, significant interest in autonomous and unmanned vehicles has developed within the survey community. USVs are being considered for tasks such as data gathering in waters considered too shallow for manned vehicles and in areas presenting hazardous operating conditions. In many cases, limited access to the desired measurement site hampers river and stream flow measurements; a problem solved by USVs. Additionally, USVs provide improved economic efficacy in many applications, especially at sites requiring periodically repeated measurements. In many applications, USVs provide significant advantages when compared with AUVs. Improved communication bandwidth, precise navigation data, long endurance, the use of commercial off-the-shelf sensor suites, as well as much lower operating costs make USVs the logical choice for most survey tasks. AUVs remain the appropriate choice for survey work requiring immunity to certain surface motions or the clandestine presence necessary during various military operations.

The Company

SeaRobotics Corporation operates as a privately held small business, well staffed for USV development and the development of various marine robotic systems. Our location in South Florida provides varied opportunities for testing in fresh and salt water, and exposure to operating conditions including varying water currents, depths and bottom composition. Pond testing is used for development and burn-in, the Intra-Coastal Waterway (ICW) is used for tests in light currents, with stronger tidal currents found in the local ocean inlets to the ICW. The warm water and co-operative weather allow for testing 12 months of the year, with short breaks during hurricane season. After sustaining direct hits from Hurricanes Wilma, Jeanne and Francis during the last year, our recovery procedures have been well tuned.

What are USVs?

SeaRobotics's USVs are small surface vehicles, which are portable by one or two people and carry a number of hydrographic or oceanographic survey sensors. The boats can weigh as little as 16kg and as much as 120kg, and typically range in Length Overall (LOA) from 1.5 to 5 metres. A typical system comprises the sensing suite, GPS, Radio Frequency (RF) communication system, hull structure, propulsion, energy source and Operator Interface System (OIS). Based on an advanced, wave-piercing, welded aluminium hull, SeaRobotics's USVs provide high efficiency hulls designed to minimise surface motions in mono-hull, catamaran and trimaran configurations. Roto-molded hulls are available for cost-sensitive applications. Various "Commercial Off-The-Shelf" (COTS) sensors have been integrated in the USVs including: single-beam echosounders, Acoustic Doppler Current Profilers (ADCPs), side-scan sonars, sub-bottom profilers, Conductivity-Temperature-Depth sensors and Transmissometers (CTD&T), sensor winch, as well as video cameras. In addition to the incorporation of numerous COTS sensors, various navigation and communication subsystems have been implemented. Differential GPS as well as RTK navigation solutions work in conjunction with Doppler-based bottom-tracking solutions to provide sub-metre positioning accuracy at 5 to 10 updates per second. High-bandwidth RF communications allow operator interaction for data monitoring and validation, navigation and control, or alternatively the USV can be operated in a totally autonomous mode. Mission plans are developed using SeaRobotics's own mission-planning tools or through a comprehensive planning and data-analysis package from HYPACK. This combination of sensors, position accuracy and communications make USVs a powerful yet affordable tool for the hydrographic data-gathering community.

Stream Gauging Project

Working in conjunction with the US Geological Survey (USGS), the US Army Corps of Engineers (USACE) and Water Survey Canada (WSC), SeaRobotics is completing the development and testing of two USVs that are designed to carry ADCPs for the stream gauging process. A trimaran, the USV-1000, has been designed to meet the USGS requirements for man-portable remote-controlled boats to operate in high currents and shallow water while transporting a Teledyne RD Instruments Rio Grande ADCP. The USV-1000 weighs 40kg, has an LOA of 3.3 metres and operates in 0.33 metres of water at currents up to 4 metres/second. At the request of WSC, the USV-1000 hull is designed with a mid-hull joint allowing easy disassembly and transport to remote locations in a helicopter basket.

The requirements for USACE for a one-man portable USV capable of operating in 0.15 metres of water at currents up to 3 metres/second were met with the USV-600 catamaran. The USV-600 carries the SonTek Mini-ADP or the recently introduced Teledyne RD Instruments Explorer class ADCP. With an LOA of 1.2 metres and a weight of 16kg, the USV-600 is easily transported and launched by one person.

US Naval Oceanographic Office (NAVO) Project

SeaRobotics has delivered the USV-2600 general-purpose catamaran to NAVO's Fleet Survey Team (FST) in support of their mission of Autonomous Tactical Hydrographic and Littoral Warfare Environmental Data Gathering in Shallow, Very Shallow Water and Surf Zone Environments to support surface and subsurface navigation. The USV-2600 referred to as HUSCy (Hydrographic Unmanned Survey Craft) by the NAVO FST has an LOA of 3.3 metres, weighs 100kg and has a maximum speed of 3 metres/second. The HUSCy carries an impressive reconfigurable suite of hydrographic and oceanographic instruments. The hydrographic sensor suite includes two single-beam echosounders at 200 and 235kHz, and a 300-kHz Marine Sonics side-scan sonar, along with GPS and other navigation sensors. The oceanographic sensor suite includes a 600-kHz Rio Grande ADCP, both echosounders and a sensor deployment winch used in conjunction with a CTD&T. Both sensor suites can also be run simultaneously. The HUSCy was demonstrated and logged extensive survey time at AUVFest 2005, sponsored by the ONR and the Naval Sea Systems Command (NAVSEA).

USGS Survey Project

As a result of the successful development of the HUSCy system, a USV-2600 has been built for USGS projects requiring shallow-water hydrographic survey work. The baseline system is similar to the HUSCy; however, an EdgeTech FS-4200 dual-frequency (120/410kHz) side-scan sonar with integrated sub-bottom profiler (4"24kHz) has been integrated along with the ADCP, single-beam echosounder and a low-cost heave-sensing system. The system is scheduled for delivery in early 2006 and will be employed on a USGS/National Oceanic and Atmospheric Administration (NOAA) project to survey oyster beds in the Apalachicola Aquatic Preserve.

HullBUG System Development

SeaRobotics is working with NAVSEA and the ONR to develop an autonomous underwater hull-cleaning system. The system is small, inexpensive and capable of persistent cleaning of ships at dock. Through frequent cleaning, the HullBUG (Hull Bio-mimetic Underwater Grooming) system will maintain hulls with minimal fouling, thereby decreasing the need for aggressive cleaning and reducing the dependence on environmentally damaging antifouling coatings. Use of the HullBUG system will enable widespread use of the next generation of environmentally friendly hull-coating systems.

Markets Served

SeaRobotics's USVs have been placed with lead users in military and non-military government markets, as well as in the local state water management districts performing both hydrographic and oceanographic data gathering. Applications have varied from coastal oceanographic surveying to stream gauging in small, very shallow streams. Improved efficiency and safety associated with the stream gauging process will drive the acceptance of USVs for this application. Coastal and inland application requiring extensive surveying in shallow waters (0.5"3 metres) makes the USV an ideal choice. The addition of one or many USVs used in conjunction with manned vehicles can provide a substantial economic advantage for many applications. As USV-based survey tools become better established, numerous varied applications ranging from traditional survey tasks to mobile station-keeping buoys and persistent ocean monitoring will be filled by USVs.

Future Plans

SeaRobotics will continue to improve USV operations allowing users to focus on the sensors and data products acquired, while expanding our market presence to include security, surveillance and law-enforcement market segments. Emphasis will be placed on developing reference accounts in the commercial survey markets as we develop an international representation network to further promote our products. Current interest in the use of affordable USV technology will provide an exciting period of growth for USV products in the near future.