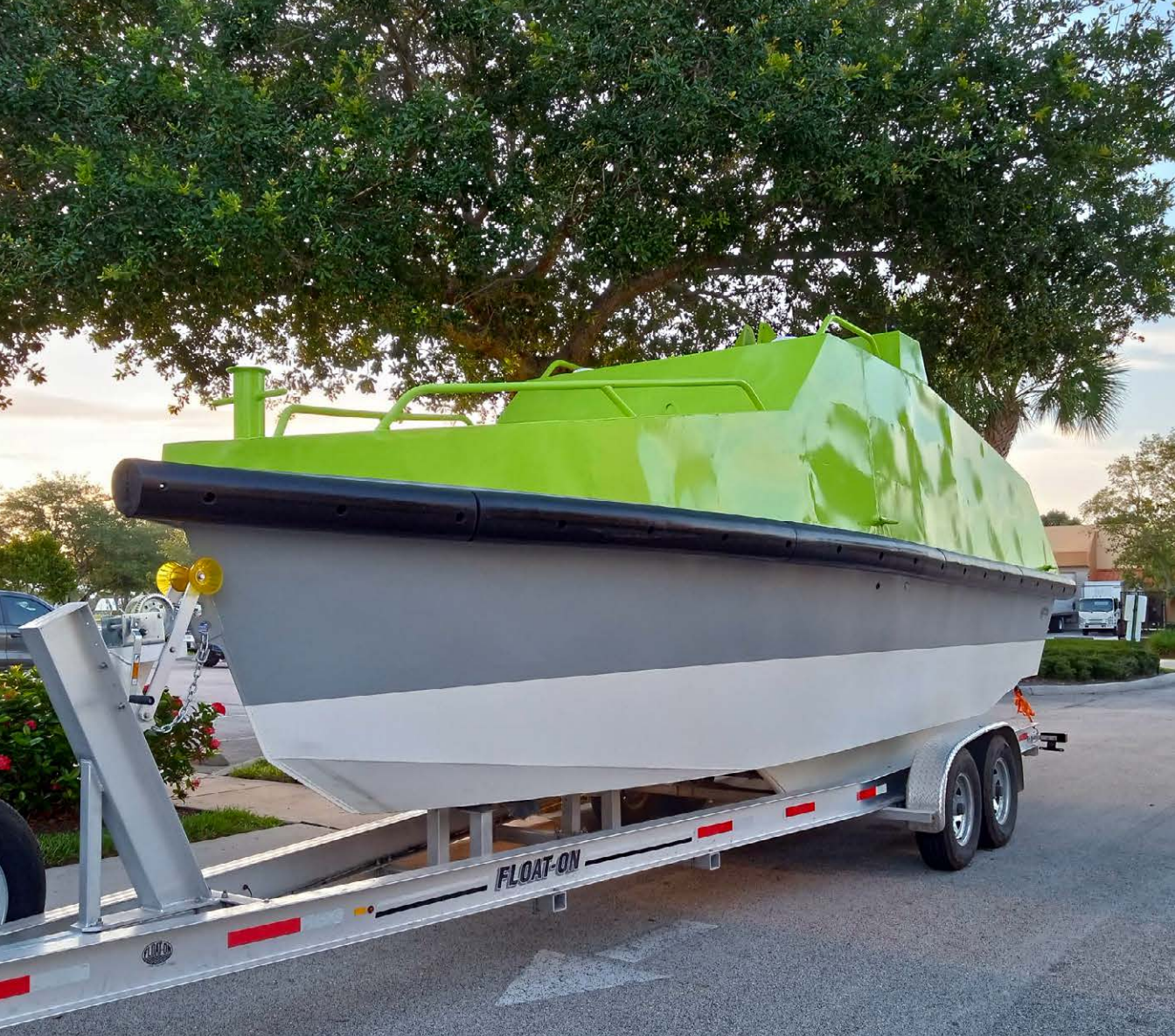
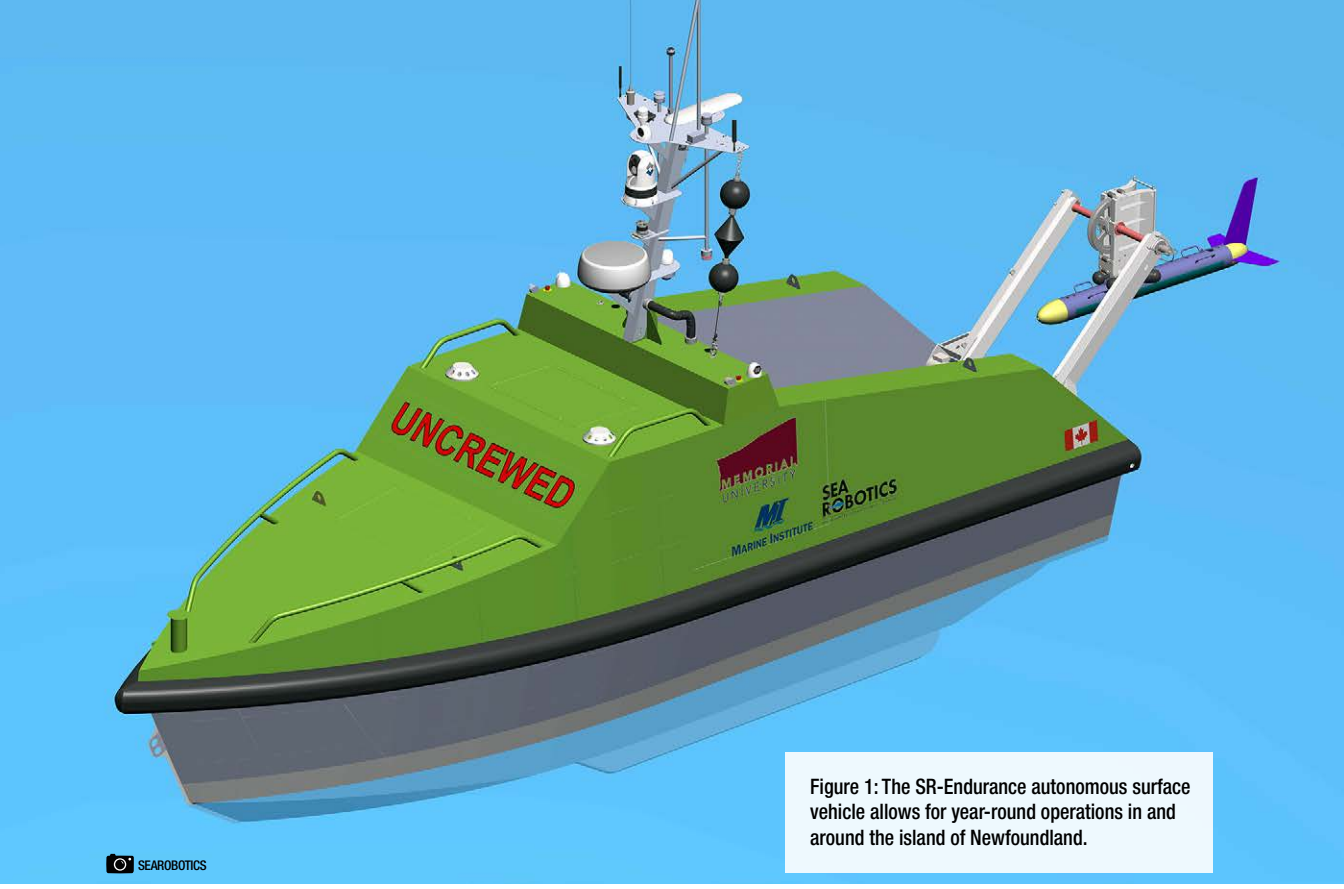


Marine Institute's Latest Asset: 8 m Autonomous Surface Vehicle

by Bethany Randell

SEAROBOTICS



SEAROBOTICS

Figure 1: The SR-Endurance autonomous surface vehicle allows for year-round operations in and around the island of Newfoundland.

Asked and Answered

The Marine Institute (MI) issued a request for proposals to acquire an autonomous surface vehicle (ASV) to support the broad swath of activities undertaken by the School of Ocean Technology. Among other requirements, MI wanted a vehicle that would be suitable for year-round operation in and around Newfoundland. This tender was answered by SeaRobotics of Stuart, Florida, and its new SR-Endurance 8.0 (Figure 1).

Meet the SR-Endurance 8.0

Measuring 8 m from bow to stern, the SR-Endurance 8.0 comes equipped with an optional A-frame over-boarding assembly for launching equipment and sensor packages weighing up to 100 kg, and two moon pools for deploying equipment such as acoustic modems, acoustic Doppler current profilers, multibeam echo sounders, and sound velocity profilers. The vehicle is powered by a single screw, inboard diesel-electric hybrid system. The hybrid nature means the system has a battery bank that allows for extremely quiet operation, a significant benefit when conducting acoustically sensitive work, such as sonar research or marine mammal monitoring. The diesel engine only cuts in when power requirements demand it. While the maximum speed tops out just under 10 knots, the vehicle can operate continuously for nine days at its cruising speed of 5 knots. SR-Endurance 8.0 is designed with a self-righting aluminum monohull, is capable of operating in Beaufort Wind Scale 7, and surviving Beaufort Wind Scale 9. The ASV can be controlled remotely from nearly 8 km or operate fully autonomously. Through its VHF radio, data can be transmitted back to shore from more than 30 km.

The SR-Endurance 8.0 is designed to accommodate a suite of interchangeable sensor payloads, depending on the type of mission it is undertaking. However, it comes equipped with several built-in sensors that allow it to operate with situational awareness and avoid collisions. Using a combination of radar, LiDAR, and received automatic identification system data, the ASV can detect possible collisions or unsafe paths. Using software from the same folks

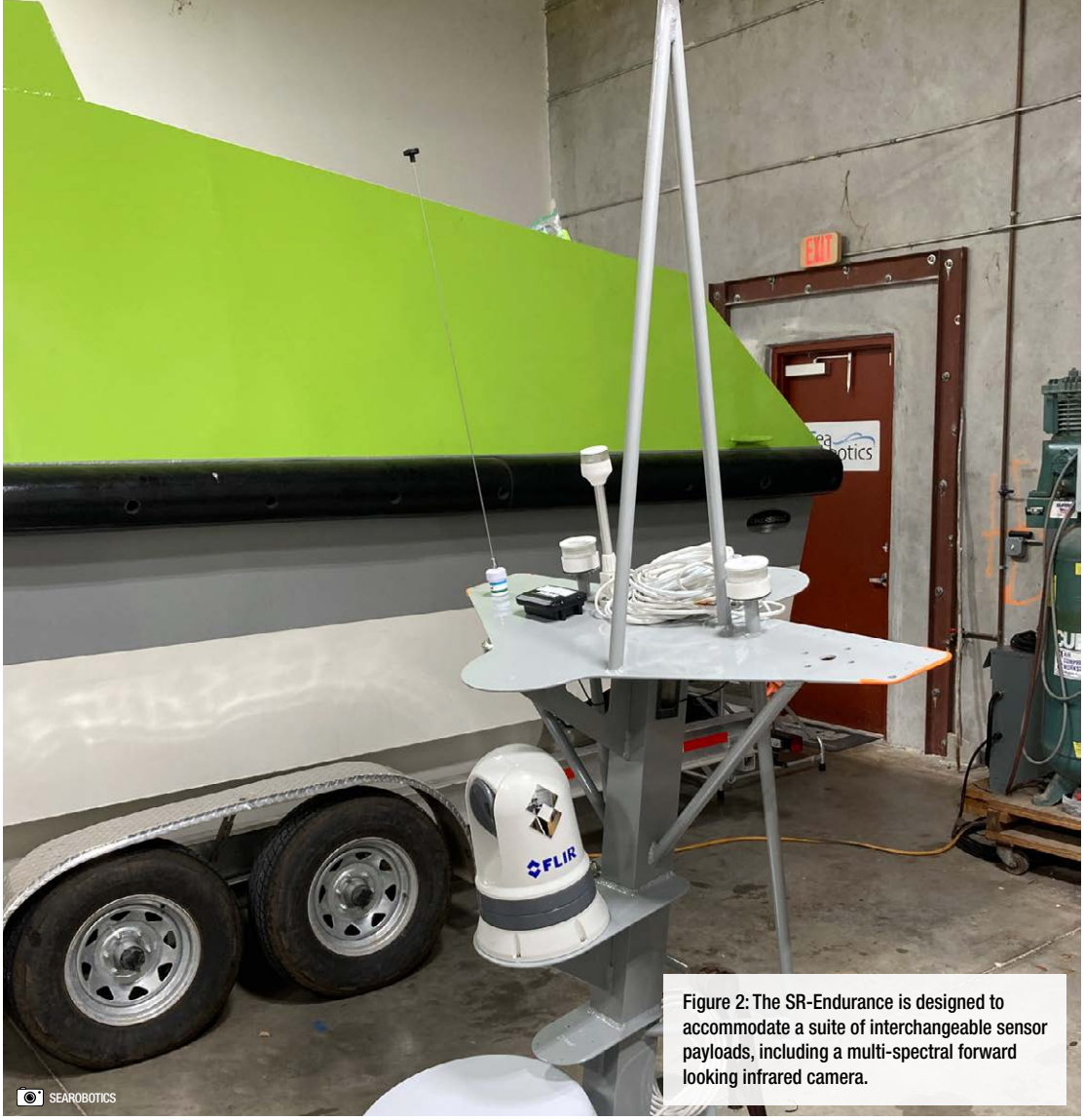


Figure 2: The SR-Endurance is designed to accommodate a suite of interchangeable sensor payloads, including a multi-spectral forward looking infrared camera.

who designed the autopilot for the Mayflower autonomous ship, the ASV will change its route and behaviour to obey collision regulations and avoid collisions, while still attempting to accomplish its mission. Also on board are six cameras, including one multi-spectral forward looking infrared camera, providing a 360° view of the vehicle's surroundings (Figure 2).

Uses

The SR-Endurance 8.0 represents many opportunities for the Marine Institute, from research projects to student education.

Data Collection

Since the ASV is a platform that can carry a wide variety of payloads, it will be an important asset for MI to collect a wide variety of data. Possible uses include helping MI to contribute to Seabed 2030, the initiative by the Nippon Foundation-GEBCO to map the entire ocean floor by 2030. This large ASV can serve as a force multiplier when tasked with collecting ocean data, able to be sent on round-the-clock data collecting missions in collaboration with a crewed survey vessel or with a fleet of other autonomous vehicles, both above and below the sea surface. When equipped with an acoustic modem, the ASV can act as a communication hub by relaying information from subsea assets, such as autonomous underwater vehicles (AUVs). This means AUVs could surface less often to provide status updates or accept new commands, keeping their precious batteries for more mission time at depth.

Research Projects
As well as being a platform to collect data for research, the vehicle itself and its operation can be the subject of research. Parking assistance already exists in many models of terrestrial vehicles; can self-docking be implemented in autonomous watercraft? What about self-guidance onto a trailer? While collision regulations are the "rules of the road" for water-going craft, there are plenty of times human operators do not always obey those rules to the letter. How can autonomous vehicles be trained to react safely when interacting with non-robots? What about the operators who are now far-removed from the vessel, operating in an office building instead of a wheelhouse? How can we best prepare future operators for the new challenges that arise, from the technical, like lost connectivity, to the non-technical, like a more sedentary lifestyle in front of a screen? All these challenges represent opportunities for research and innovation in a field that will only become more important in the future.

Education
From a student perspective, this ASV will provide the opportunity to learn and train on truly cutting-edge technology: one of the largest ASVs in Canadian waters. MI students in the School of Ocean Technology will learn how to operate and maintain the vehicle, including how to equip it with sensors to collect specific datasets, how to create appropriate mission paths, and how to troubleshoot problems when they arise. This will ensure that graduates of Marine Institute will be well prepared to work in the growing field of autonomous marine vehicles.

Regulatory Considerations
Regulations for autonomous surface vehicles, or maritime autonomous surface ships, are governed by the Marine Safety and Security branch of Transport Canada through Publication TP 13585 – Policy – Oversight of Small Maritime Autonomous Surface Ships (MASS). These regulations apply to any vehicle that is less than 12 m in length, is untethered, and does not carry a seafarer (crew or passenger). This policy is recognized as an "interim framework" while organizations like the International Maritime Organization develop more detailed regulations.

The policy lays out the requirements not only of the vehicle itself, but also its operators. All ASVs greater than 2 m in length must be controlled by a remote operation centre with a safety management system in place and staffed by qualified operators. Further, the operators must have rapid response emergency resources available while ASV operations are ongoing. Any ASV operation must first be approved by a marine technical review board and must include a detailed risk assessment. Operators must also contact the Canadian Coast Guard and any appropriate harbour authorities in advance of a mission so appropriate warnings can be issued. These are but a few of the requirements that must be met before the SR-Endurance 8.0 gets out on the water.

Fortunately, the Marine Institute is well equipped to handle all the requirements set by Transport Canada. A remote operation centre has been established at The Launch, MI's new, state-of-the-art facility in Holyrood, N.L. Through The Launch, MI has the qualified people and equipment necessary to ensure the safe operation of MI's latest technological asset.

Bethany Randell, P.Eng., is currently living her dream job as a project engineer with the Centre for Applied Ocean Technology at the Fisheries and Marine Institute of Memorial University. Always fascinated with the ocean and eager to solve problems, she turned her hobby of building ROVs for competitions into a career when she graduated from Memorial as an electrical engineer and went to work for Kraken Robotics. During her eight years with Kraken, she worked on all of Kraken's products, including the KATFISH, and was made lead electrical engineer of its AUV program. Since joining the Marine Institute (MI) and being stationed at The Launch in Holyrood, she has completed the first phase of MI's Remote Operation Centre through which, in partnership with the Norwegian University of Science and Technology, she was able to operate ROVs and an ASV located in Norway.