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DEPARTMENT OF THE NAVY
SBIR/STTR TRANSITION PROGRAM
SPOTLIGHT
STP

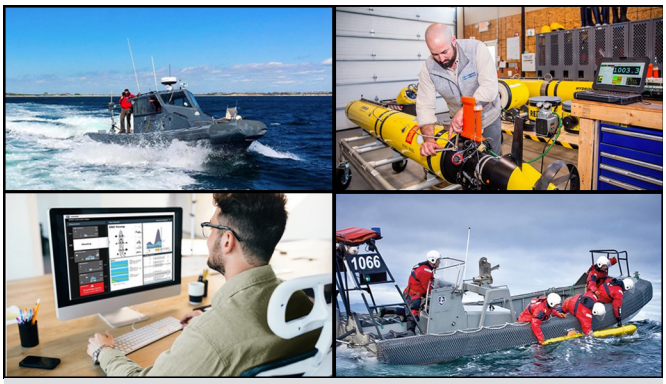
Moving Leading Edge Tech from Military to Mainstream

By Kimberly Brady and Karen Pfautz, Charles River Analytics

Charles River Analytics (Charles River) has been pushing at the edge of science and technology with Navy-funded SBIR projects for almost 30 years, winning their first in 1993, and over a hundred since. From the seeds planted with this funding, a variety of novel technology and products have grown, bearing cyber-physical systems fruit not just for the Navy, but for other government customers and within the commercial realm as well.

"Our Navy funding has allowed us to exercise our full range of science and tech expertise," said Rob Hyland, Director of Technology Transition at Charles River. "The Navy's investment in both near- and far-future tech has created some seemingly impossible breakthroughs, from human performance to sensor and autonomous vehicle intelligence."

As Charles River scientists and engineers pursued their work in autonomy, they found that to be truly autonomous UUVs need precise object detection—they must not only accurately identify an object, but also be able to precisely locate that object on the seafloor or within the water column. The unstructured and often-changing underwater environment makes this a challenge—GPS drops out, and the most commonly used sensors (sonar) deliver low-resolution images adversely affected by ocean currents as well as inhomogeneous distribution of pressure, noise, and reflections off both the water's surface and the seafloor.

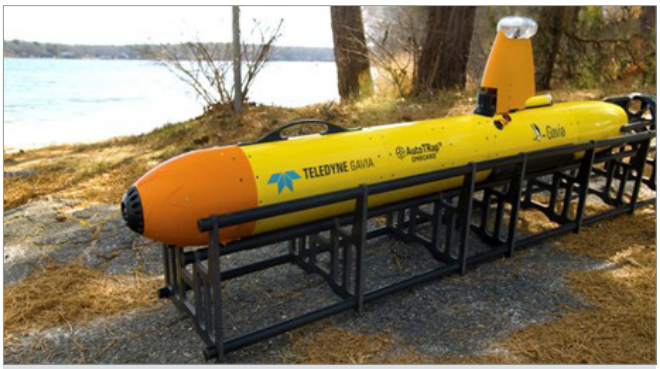


The location of Charles River's Cambridge headquarters—close to the Atlantic Ocean and Boston Harbor—and their Marine Systems Test Facility on Block Island Sound provide immediate, year-round access to Navy-approved littoral testing waters, making them particularly well-suited for research in uncrewed underwater vehicles (UUVs).

Through their Phase I and Phase II Navy-funded SBIR efforts, Charles River has developed novel technology that overcomes these challenges, delivering precise underwater detection using an array of sonar and electro-optics sensors coupled with algorithms that integrate motion data from dead-reckoning sensors to provide accurate localization in real time.

Part of this technology underpins a new commercial product, AutoTRap Onboard™, which was developed in partnership with Teledyne Gavia. AutoTRap Onboard applies advances in deep learning object detection and representation to locate and classify objects in side-scan sonar data and can be trained to detect a wide range of other objects, including shipping containers, pipelines, hull defects, and more.

Dr. Arjuna Balasuriya, a senior autonomous marine sensing scientist at Charles River, heard that Teledyne was interested in finding solutions to the problem of underwater image processing, and recognized that his team could apply their deep expertise from work on numerous Navy contracts.



A Teledyne Gavia prepared for testing with AutoTRap Onboard™ at Ashumet Pond in North Falmouth, Mass.

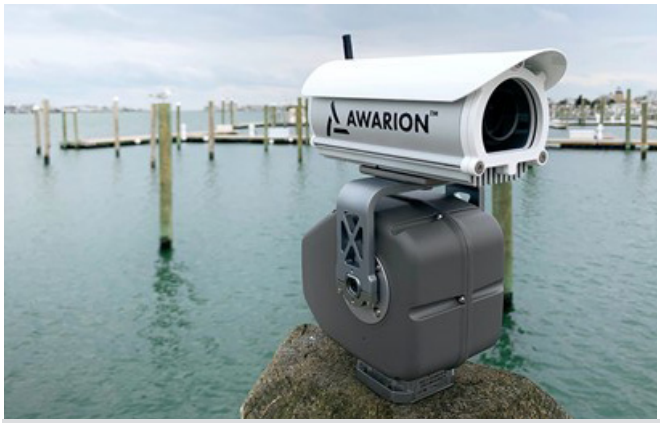
"When AutoTRap Onboard recognizes objects on the seafloor, it alerts the UUV, so it can investigate further on its own—eliminating the need for any human intervention," Balasuriya described. He went on to explain how, without an automated system, human analysts must painstakingly inspect survey data to find objects of interest. This process can be difficult, error prone, and dangerous.

"The sea state can be really choppy," Balasuriya said, recalling his cruises on the North Sea. "You have to tie your laptop down onto a pole or some structure, and you have to tie yourself down or you will be rolled and thrown out."

AutoTRap Onboard has demonstrated excellent detection and false positive rates on test targets in the North Sea and in other marine environments, such as the North Atlantic off Iceland, where it has identified truncated conical objects on a rocky volcanic seafloor at depths of 10-30 meters with 90% accuracy.

Another at-sea product emerging from Charles River is Awarion™, an autonomous lookout system that uses a smart camera coupled with image processing and control software to deliver situational awareness at the sea surface. It detects and classifies ships and obstacles, and performs threat assessment. Charles River's work with the Navy SBIR/STTR Transition Program (Navy STP) has been a large contributor to the company's success developing and marketing this new system. As part of the Navy STP, they demonstrated their progress on the system at the Naval League's Sea-Air-Space 2020 Exposition.

Charles River's Navy project work has also yielded many interesting and useful technologies away from the sea; for example, the DATEM Cable Calibration Tool (CCT), which uses machine learning, probabilistic programming, and visualization to pinpoint component failures. The DATEM CCT is currently deployed at NIWC LANT; however, this technology can be adapted to any system where fault identification and repair can be accelerated by understanding system health and status data.



Prototype Awarion smart camera, part of the autonomous lookout system that delivers situational awareness at the sea surface.

Charles River is already looking for the next big transition effort beyond AutoTRap Onboard and the CCT. "Our work with the Navy through their STP has been instrumental for us as we discover possibilities for projects similar to AutoTrap Onboard—getting innovative technology established in Phase II into the hands of operational users," said Hyland. "We've got an endless pipeline of innovation here. We want to get more of these great ideas and prototypes pressed into service."

For more information on Charles Rivers' innovative work, visit its website at https://www.cra.com/.

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