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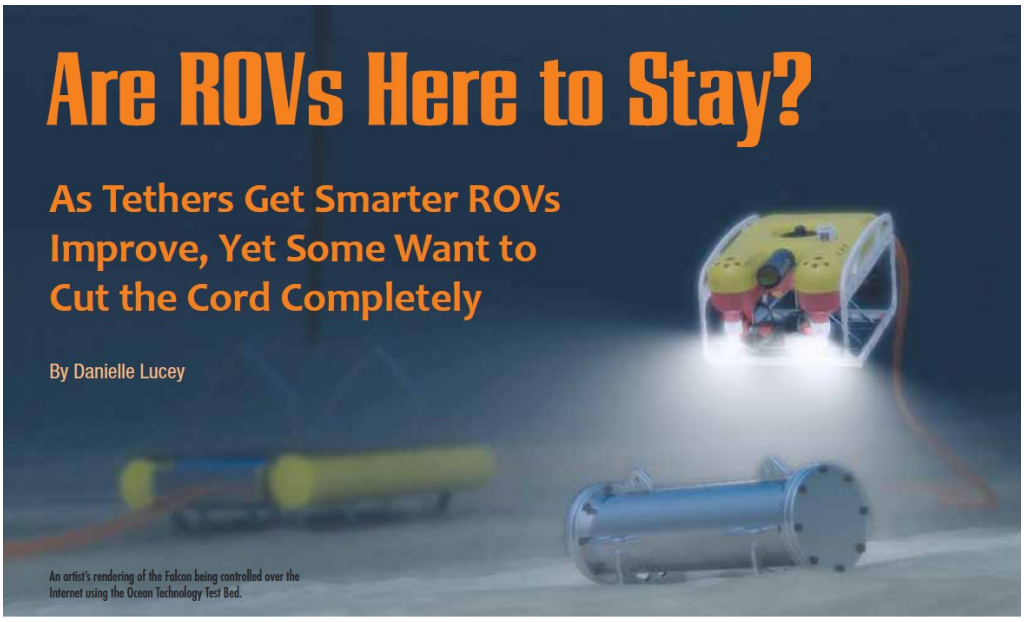
Are ROVs Here to Stay?

As Tethers Get Smarter ROVs Improve, Yet Some Want to Cut the Cord Completely

By Danielle Lucey



An artist's rendering of the Falcon being controlled over the Internet using the Ocean Technology Test Bed.

Remotely operated vehicles, still the preferred unmanned technology for much of the maritime community, have edged out their sister technology, autonomous underwater vehicles, since the 1980s. But while ROVs improve their tethers and get smaller and easier to operate, are also they becoming at risk of being largely wiped out by AUVs?

Tethers Get Smart

This summer, ROV manufacturer VideoRay and its partner company BlueView Technologies went on the road to promote their respective technologies on the 2009 Underwater Port Security Tour. The second U.S. promotional tour for both of these companies, the focus of the events was on VideoRay's new vessel, the Pro 4 ROV system, and BlueView's accompanying HD Imaging Sonar Attachment.

The Pro 4, which was released in March of this year at the Underwater Intervention 2009 conference in New Orleans, has a grabber arm, video camera and depth rating of 1,000 feet.

The products work together, along with a Smart Tether non-acoustic positioning system from KCF Technologies and a Hawk Integrated Real-Time Video Enhancement system from Sweden-based LYYN to create a sort of one-stop port security solution.

The tour, which coincides with Phoenixville, Pa.-based VideoRay's 10th anniversary, set up waterside demonstrations in 29 U.S. cities over the course of two and a half months, with the Washington, D.C., stop featuring the Pro 4 inspecting ship hulls in the Southwest waterfront marina. The intention of the package is to provide diver tracking and interdiction, berth and hull improvised explosive device detection, harbor bottom inspection, search and recovery, and infrastructure inspection missions.

"There is no a silver bullet that's going to solve all your problems. … This is never going to replace the diver," says Craig Thorngren, owner and operator of Submerged Recovery and Inspection Services LLC and a VideoRay consultant and instructor. "An ROV is a diver's best friend, and a diver is an ROV's best friend." Both the vessel and the diver need each other to best handle every situation, he continues.

Thorngren told a somber story of firefighters dive training off of Puerto Vallarta, Mexico, near El Diablo (an underwater cliff that quickly drops from 300 to 1,500 feet) when suddenly an earthquake shook the seafloor, opening up a gaping hole and quickly sucking down a group of divers to 200 feet. Since there were no hyperbaric chambers available on land so divers could find bodies, the Pro 4 was deployed and found three of the men who had died.

How the ROV navigates is different from some unmanned underwater vessels. Instead of relying on an internal navigation system, the Pro 4 knows where it is because of its tether. Labeled a "drop and go" system by KCF Technologies, its Smart Tether provides all the positioning information to the ground station for the vessel. The real-time data transmission tether, which was created under an Office of Naval Research project, requires two people to operate and is made up of a series of nodes that use pressure and orientation sensors to track the heading and positioning of the Pro 4. The vehicle is also capable of going to a spot when Global Positioning System coordinates are provided. The 1,000-pound breaking strength tether has a two-meter accuracy rating.

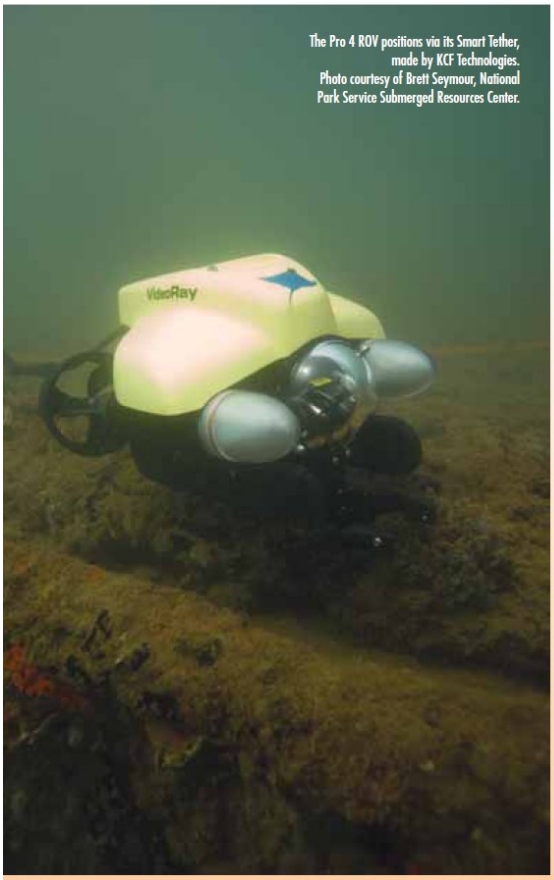
There is also a military version of the Smart Tether (the U.S. Coast Guard is VideoRay's biggest client) that is capable of working around

steel hulls without affecting the compass, says Thorngren.

To obtain more data related to its mission, the ROV transmits its sonar and camera information back to BlueView's computers for user review. In limited or zero-visibility environments, the sonar enables the user to perform tasks such as IED detection, body recovery and object location. And when water is murky or when a user needs to clarify what the sonar is showing, LYYN's video enhancement feature improves what users can see, according to Thorngren. The camera can also take an overexposed and underexposed image and combine the two to get a clearer image.

The companies said they decided to put their products on the road because in increases awareness of what users can do with these new technologies.

"Some people didn't know they could do hull inspections without divers," says Erick Estrada, sales manager for VideoRay. Hulls, which are covered with poisonous antifouling products, can actually harm divers, he continues.



The Pro 4 ROV positions via its Smart Tether, made by KCF Technologies. Photo courtesy of Brett Seymour, National Park Service Submerged Resources Center.

Extreme Remote Control

The University of Victoria in British Columbia, Canada, has brought a whole new meaning to remotely operated vehicle. Through its Ocean Technology Test Bed (funded by the Canadian Foundation for Innovation and the British Columbia Knowledge Development Fund), the university acquired a Saab Seaeye Falcon ROV and will be operating it via the Internet, the first time that has been done for a commercial vehicle.

According to Alison Proctor, a research engineer for the test bed and University of Victoria Ph.D. student, the Falcon is perfect for the project because the way the communications and control allow the Falcon to be operated over the Internet without any major changes

New to the Market

Two new ROVs are coming to the commercial market by the end of this year. Learn more about them here:

Name: Predator

Manufacturer: Made through a development partnership with Global Marine Systems and Cetrax Systems

Status: Slated for sales in the next few months.

What Makes it Different: The Predator is designed to be completely modular, with a PC interface and a plug-and-play equipment configuration. Also, the vehicle functions are monitored by diagnostic electronics.

Depth rating: 300 meters (984 feet)

Size: 900 millimeters by 620 millimeters by 450 millimeters (35.4 inches by 24.4 inches by 17.7 inches)

Dry weight: 60 kilograms (132 pounds)

Name: Vector T4

Manufacturer: Deep Ocean Engineering

Status: First deliveries are occurring in the fourth quarter.

What Makes it Different: The Vector observation class of ROVs can dive deep with a heavy payload. This model shrinks in size from others in its class by nine inches (200 millimeters), is lighter than other Vectors and has the greatest thrust-to-weight ratio.

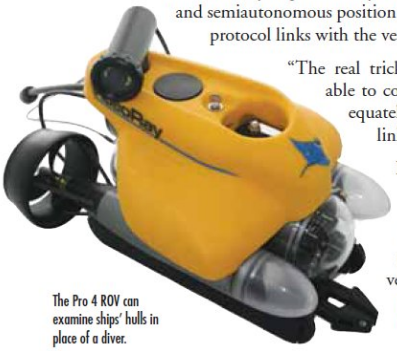
Depth rating: 1,000 meters (3,281 feet)

Size: 902 millimeters by 450 millimeters by 350 millimeters (35.5 inches by 17.7 inches by 13.8 inches)

Dry weight: 28 kilograms (62 pounds)

to the vehicle itself. The Falcon, which has a 1-to-1 power-to-weight ratio, is a "very powerful little vehicle," says Proctor.

It will be possible to operate this vehicle in two modes: the conventional method, where the pilot controls the vehicle from a boat using a normal tether, and in bottom-tethered mode, where the vehicle is on the test bed and the pilot can control the vehicle from anywhere there is an Internet connection—even his or her own living room. When in the bottom-tethered configuration, the vehicle is limited geographically by the 50-meter tether the Falcon has to use to operate, meaning it has to stay relatively close to the Ocean Technology Test Bed offshore Vancouver Island.



The Pro 4 ROV can examine ships' hulls in place of a diver.

The university hopes to study vision-based navigation and semiautonomous position control over Internet protocol links with the vessel, says Proctor.

"The real trick of course is being able to control the vehicle adequately over this type of link," she says.

Future research may also include long-term studies into anticorrosion and antifouling. The university hopes to have its initial results in the next year or so, Proctor says.

The Ocean Technology Test Bed, or OTTB, is operated through the university's Laboratory for Automation Communications and Information Systems Research. It is a seafloor laboratory in about 80 meters of water. The OTTB is integrated with VENUS, or the Victoria Experimental Network Under the Sea, which is an undersea cabled observatory.

Wave of the Future: ROVs Replaced by AUVs?

While ROVs remain the standard for most missions, like the ones described above, some see the day where autonomous underwater vehicles, or AUVs, will take over military and security applications.

Both AUVs and ROVs fall under the broader classification of unmanned underwater vehicles, or UUVs. AUVs, which do not have a tether and instead can swim freely, have been slow and costly to introduce to military and offshore markets according to a Space and Naval Warfare Systems Center report. ROVs came to maturity more than 20 years ago, while AUVs were still in their infancy.

Greg Moeller of Woburn, Mass.-based Scientific Systems Company Inc., which creates software that directs AUVs when they're in a swarm, says he thinks AUVs could be more desirable than ROVs in military applications because they don't need a ship with a surface presence.

"I believe, or at least SSCI believes, the direction of unmanned ve-

hicles is moving toward teams of unmanned vehicles," he says, referring to AUV swarms.

While swarms—or AUVs that are programmed to cooperate to accomplish a common mission—are still in developmental stages, Moeller says SSCI has grouped as many as 40 AUVs successfully. Some AUVs are now capable of extremely long deployment times, he says—government test beds, such as the one owned by the Naval Undersea Warfare Center in Rhode Island, have put them in the ocean and observed them for up to a week.

Additionally, Boston's iRobot has delivered more than 80 of its Seaglider AUVs worldwide, which can dive to 1,000 meters and are designed for months-long missions. And in July, the Space and Naval Warfare Systems Command awarded Teledyne Brown Engineering a $6.2 million contract to design a littoral battlespace sensing glider (an AUV that uses wings and changes in buoyancy to propel itself without much power consumption) with a $52.6 million potential value if the Navy buys 150 gliders by 2014.

So what is stopping AUVs from largely retiring ROVs? Moeller says that there has been a lag in getting AUVs deployed to customers. Until that time, he says that ROVs are still really useful and perform their work well. But SSCI's view is that where high power is not an application requirement, tethered ROVs will evolve into untethered vehicles.

"I agree that AUVs can provide more flexibility than ROVs," says UVIC's Proctor. "They require less surface support and don't need a tether, which makes it possible for them to get into areas that ROVs can't fly. However, there are a number of technical issues that will need to be addressed before AUVs will be a serious threat to ROVs."

Among those challenges is the manipulation of objects, for which ROVs are better suited because a pilot can control their movements. Performing this same object manipulation autonomously would be much more difficult.

"Without a pilot, AUVs will have to be able to untangle lines or manipulate valves autonomously," Proctor says. "I personally believe that we are still a ways off from having AUVs that can do everything that an ROV can do."

According to Moeller, SSCI believes that ROVs will likely stick around and "have their place," but the technology will benefit from combining their use with teams of AUVs. That way, AUVs could provide quick scans of an area that needs attention and an ROV would handle the scrutiny of objects of interest, he says.

Danielle Lucey is associate editor of Unmanned Systems *magazine.*

For More Information:

www.videoray.com/Pro4/Pro4_Main.html

www.blueview.com/

web.uvic.ca/~lacir/ocean/ottb.php