Hydroid's 'Sea Launcher' seeks to link underwater and surface autonomous worlds

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- Hydroid's 'Sea Launcher' launch-and-recovery system is designed to enable navies' use of UUVs at sea
- Designed for smaller surface vessels, the system presents opportunities to increase integration between USVs and UUVs

Navies around the world are steadily increasing their use of unmanned technologies, as manned platform numbers remain relatively static while threats become increasingly dynamic.

The underwater battlespace is an area of growing competition, with Western navies striving to maintain technological and operational leadership over improving Russian and Chinese capabilities. In this domain impactful tasks could include anti-submarine warfare (ASW), mine-countermeasures (MCM) operations, surveillance, and maritime situational awareness.

However, there may be several reasons why opportunities to embrace underwater unmanned technologies are not being seized upon as quickly as perhaps expected. These could include budget priorities elsewhere, levels of confidence in the technologies' robustness, and the challenges of deploying such technologies effectively at sea.

Unmanned vehicles operating at sea are mostly deployed from a host platform. The concepts of operation for unmanned technologies at sea – such as to provide sustained presence and capability, to increase stand-off capacity, or to reduce the requirement to place personnel in harm's way – present opportunities to integrate unmanned surface vessels (USVs) and unmanned underwater vehicles (UUVs), with USVs as host platforms.

This reflects the US Navy's focus, for example, on developing maritime unmanned systems as a cross-domain 'family' of capabilities, within which aerial, surface, and underwater vehicles are integrated with high levels of interoperability.

Launching integration

Hydroid, a US marine robotics company, has designed its 'Sea Launcher' launch-and-recovery system (LARS) to enable such cross-domain integration.

'Sea Launcher' is a LARS compact and mobile enough to be fitted to smaller surface ships (those with a 2 m freeboard or less). The company posits that the system's ability to deploy UUVs from small platforms raises the possibility of developing a transformational capability by joining up USV and UUV operations.

"We really look at 'Sea Launcher' as the lynchpin between a UUV and a USV," Tom Reynolds, Hydroid's vice-president for US government business, told *Jane's*. "If any navy is going to operate UUVs and have them work with USVs, there has to be an autonomous [LARS]," he continued. "That's where ['Sea Launcher'] comes in."

'Sea Launcher' has two main roots. First, Hydroid's Norwegian parent company Kongsberg Maritime produces a LARS called 'Stinger', designed to support the operation of the company's large HUGIN UUV. Second, Hydroid's own 'Sea Launcher' is designed to support its commercially developed REMUS autonomous underwater vehicle (AUV) family, and principally REMUS 600.

In the 1990s, the earlier REMUS 100 was operated from a fixed docking station to collect environmental data. "Those are the two technologies that converge to give us the 'Sea Launcher' system," said
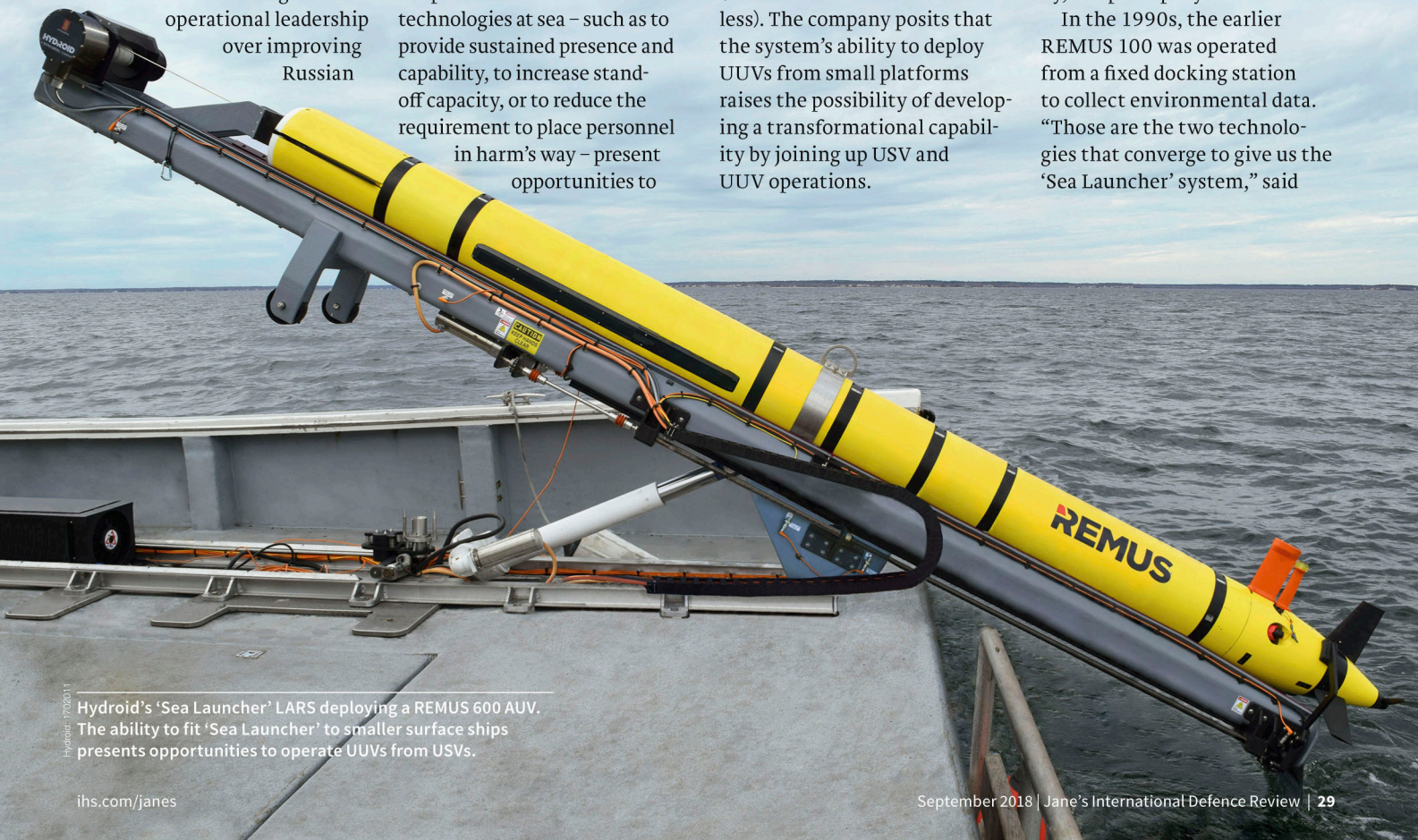
Hydroid's 'Sea Launcher' LARS deploying a REMUS 600 AUV. The ability to fit 'Sea Launcher' to smaller surface ships presents opportunities to operate UUVs from USVs.
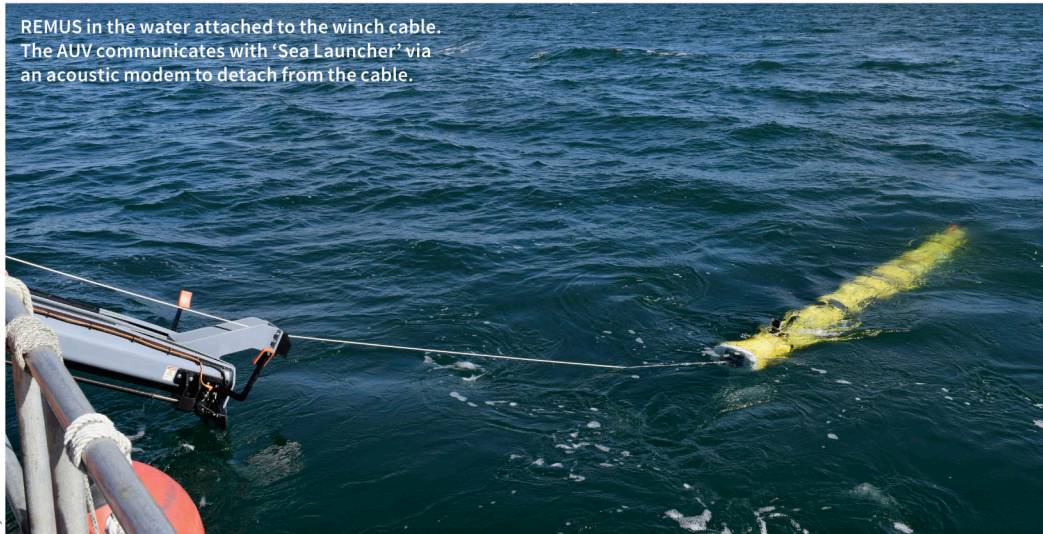
REMUS in the water attached to the winch cable. The AUV communicates with 'Sea Launcher' via an acoustic modem to detach from the cable.

Hydroid: 1702013

Reynolds. "We just put that stationary docking station onto a mobile platform."

In combining these two concepts, Hydroid has developed 'Sea Launcher' as a smaller, lighter system than 'Stinger' – particularly through using a carbon-fibre framework – to enable deployment on small vessels.

'Sea Launcher' fits to a ship's stern. For launching, the system extends aft and tilts upwards before deploying REMUS via a 50 m winch cable.

REMUS then "disconnects itself from the winch cable through an acoustic command", said Ian Monteith, Hydroid's principal engineer for the LARS capability. "The vehicle goes away on its mission and then, when it's ready for recovery, it homes in to the winch line, latches onto the line, and 'Sea Launcher' winches the vehicle back up on the deck." Recovery is conducted at 1–2 kt speeds, to allow the UUV to catch up with the host platform. The homing and latching process is enabled by a 'towfish' device on the end of the winch cable that the UUV locates and homes in on acoustically, and a specially designed nose fitted to the UUV that enables it to grab the line.

"Think of this system as [if] we're trawling for fish," said Reynolds. Habitually, a ship must stop to recover a UUV or a USV: this can mean the ship loses forward momentum, is often moving around, and has difficulty maintaining heading. "With this system, we can have the line out with that acoustic device, a lot like it's a lure on the end of a fishing line," added Reynolds. The UUV can sense and locate the line at depth, and "swims to and captures that line while the ship is still making way", he continued. "Then it's again like reeling in fish, [and] you have positive control of the UUV well before it gets close to the ship," reducing the risk of the UUV and host platform colliding.

Sea states

The company is evaluating sea states in which 'Sea Launcher' can operate. "It's designed to operate up to somewhere around Sea States 3 or 4," said Jeromy Rezac, Hydroid's programme manager for global commercial and military systems. Sea state limits are examined continually; Rezac noted that the system has been tested in Sea State 3 or higher. "The sea state it can operate in depends significantly on the vessel that it's deployed on," Monteith added. "Smaller vessels are likely to be bouncing around, and so it's more difficult to launch and recover the AUV in the higher sea states."

'Sea Launcher' is designed specifically to provide a modular capability, with an emphasis on ease of installation and operation.

"We have developed the system to be bolt-on/bolt-off," said Reynolds. "It's about an 18 ft [5.5 m] long by 2 ft wide system that can be bolted onto a deck … [using] standard interfaces for power and control."

As regards bolt-on/bolt-off fitting, the system uses a standard 0.6x0.6 m interface for fixing directly to the deck, said Rezac. However, he added, "We have used adaptor pallets to attach ['Sea Launcher'] to platforms that have different interfaces."

While the power requirement is typically 220V AC, other voltages can be used depending on what is available on the vessel. Communication with 'Sea Launcher' is conducted via an Ethernet line and a control computer. The computer also communicates with a standalone acoustic modem; in turn, the modem communicates with the UUV. The control computer also has an operator interface, so that an operator can drive the system from the host platform or remotely.

"You could command it from another location if you are not on board that vessel, or there is capability to add a mission plan … that would control it as well," said Rezac.

'Sea Launcher' thus can be operated both autonomously or in manual mode. "A simple man-in-the-loop [capability] really does help make things a lot easier," said Monteith, "but we know that robotics is the way of the future, and we have to make sure that we can run it all autonomously, which we can."

Unmanned transformation

As unmanned technologies become more reliable, opportunities to use them – and to combine their use – to increase operational output become more apparent. One such opportunity, according to Hydroid, is the ability to use 'Sea Launcher' to deploy UUVs from USVs.

Reynolds highlighted three elements of this concept. First, he said, "Pairing a USV with a UUV allows the customer to get a capability on target fast and far away," and in a more clandestine manner. Second, he continued, "You have the advantage of having a vessel … that can operate as an underwater-to-air communications interface." Third, a USV/UUV combination reduces the requirement for putting personnel in harm's way, especially if the host vessel "will just be loitering at sea for a long period of time". The idea "had a lot to do with really reducing risk to personnel", said Reynolds.

In the latter instance, "This kind of system will allow fewer people to do more," Reynolds continued. "We're really thinking about small USVs … married up with small UUVs, out doing missions [for which] you don't need to send a minesweeper with 80 people on board."

Hydroid regularly tests 'Sea Launcher' in autonomous mode, using its own trials boat (with personnel embarked to

ensure safe host platform operation in congested waters). Such trials are usually focused on LARS capability, as opposed to conducting autonomous missions, with multiple missions run each time. "We just send [the UUV] out to what we call the loiter point," said Rezac, "where it waits for the command to begin the docking, and then it [comes] in and does the line capture and recovery.

"Our testing has really revolved around two aspects," Rezac continued. "A dual effort, to develop both the 'Sea Launcher' and also the REMUS AUV to operate with [it]." For 'Sea Launcher', Hydroid has addressed operational parameters, system reliability, and interfaces with the control computer and modem. LARS reliability is being developed by 'marinising' components and evolving the design to improve robustness in high sea states.

For REMUS, Rezac said, the focus has been on developing the "software and knowledge that has to go into the AUV in order to perform the docking process".

To date, 'Sea Launcher' has been used with REMUS 600. This, Reynolds noted, is because "that's really the vehicle that the customers are already operating". Monteith pointed to some practical challenges in accommodating other UUVs, including different diameters, weights, and nose designs, alongside software compatibility. Reynolds added, however, that "we see this product as … UUV-agnostic. We want it to be able to scale to accommodate whatever vehicles the customers operate."

Hydroid has delivered its first 'Sea Launcher' into the commercial market. The company is incorporating lessons from delivering this system prior to the first productionised commercial systems being available in 2019.

"Our next steps are to continue with testing," said Rezac. "We want to get out in the higher sea states; we want to really test the robustness of the system that we have right now.

"We are trying to make this [system] such that it can be easily operated autonomously or with 'man-in-the-loop'," he continued. "So, we are currently developing a 'man-in-the-loop' tool." This can be done using simple interfaces, push-button commands, or some other form of control. "It's really the user interface that we are concentrating on, and the driving software behind it," Rezac added. "It's doing trials with users as well, to understand what works well and what doesn't work well for them." ∎

Comment

One challenge facing the unmanned technology community is that, in the naval domain, many current platforms have been designed with 30-year service lives – lifespans that could potentially extend to 50 years – yet largely have not been designed to accommodate unmanned system deployment.

"Most of the ships of the world were made without thinking of UUVs," Reynolds noted. "The ships already exist … It's on us to integrate with them, not the other way around."

However, the system's size and mobility potentially offers other deployment options. Fitting 'Sea Launcher' to an 11 m rigid-hull inflatable boat (RHIB) – itself able to operate as a manned or unmanned host platform – would allow the system to be embarked in a transport aircraft. While a RHIB would not be as robust as a surface ship, "you can at least have some capability rapidly deployed by aircraft", said Reynolds.