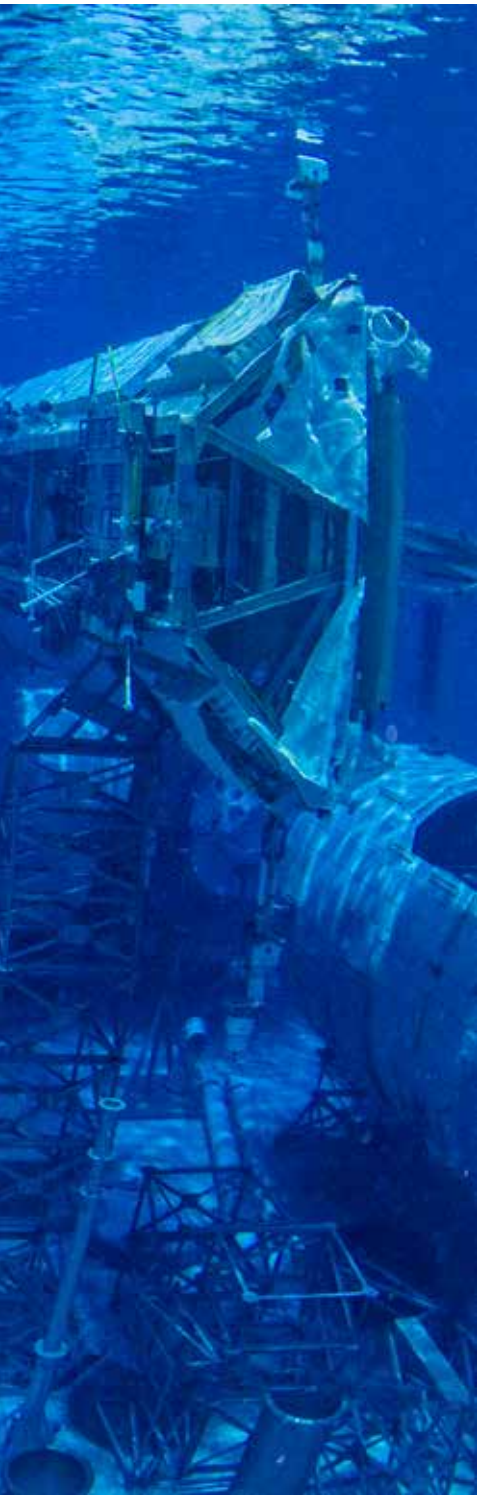
COMMERCIAL UNMANNED MARITIME SYSTEMS: PRESENT & FUTURE

By Brian Sprowl

Aquanaut posing with a safety diver at the NASA Neutral Buoyancy Laboratory during recent testing.
Photo: Houston Mechatronics



Autonomous and unmanned maritime systems are being used for a plethora of operations commercially.

This month, *Unmanned Systems* takes a look at some of the companies creating these platforms and the technologies that power them and gets perspectives from industry leaders on how to inspire the next generation of robotic maritime innovators.

Conveying action

Formed in 2018 by a group of engineers working in the AUV industry, Dive Technologies was launched with the intent of developing a low-cost, large-displacement AUV that could support the emerging needs of commercial and defense customers by being rapidly configured with different payloads and sensors.

"We had an idea that the AUV market would be in need of a platform like this over the next five years and beyond, so we decided to start Dive Technologies to bring our vision to fruition," Dive Technologies founder and CEO Jerry Sgobbo tells *Unmanned Systems*.

Dive Technologies' base AUV platform is named DIVE-LD. Expected to be used primarily for offshore geophysical surveys, the vehicle will be equipped with a standard commercial survey package, as well as other payloads that are unique to the company's defense and research customers.

Sgobbo says the first DIVE-LD is being fabricated now and is expected to complete in-water testing by mid-2020. The AUV is being designed to support deep-water survey missions for oil and gas customers, as well as shallow-water survey missions for various commercial customers. The AUV will also be capable of supporting various defense applications as well.

"We chose the name Dive for our company because it conveys action. Our vehicles should be underwater accomplishing missions for our customers, not sitting on shore working through costly and time-consuming payload integrations," Sgobbo says

.

The 'secret sauce'

While companies such as Dive Technologies have in-house staff who are perfectly capable of developing the technologies that power its AUV, not all entities have that luxury, which is where entities such as HydroComp Inc. come into play.

Founded in 1984, HydroComp is a small research consultancy and software provider that provides analysis services to naval architects and shipbuilders.

According to Donald MacPherson, technical director and cofounder of HydroComp, the consultancy's goal is to make good vehicles with good drives into great systems. For HydroComp, this process starts with an interview.

"People have an idea of what they think they want, but sometimes we have to change their thinking about things," MacPherson tells *Unmanned Systems*. With this in mind, HydroComp establishes what an entity's core requirements are during the interview process, and begins to deconstruct what they're planning on and hoping to achieve, as well as what represents an optimal system to meet those requirements.

MacPherson says HydroComp throws out constraints early on, "to see the best of all possible worlds," but there are times when HydroComp has hard constraints that an entity has already set in place; for instance, the entity may have already selected a motor type or defined limits on how large a propeller can be.

Within those constraints, HydroComp seeks to optimize the components of a system while keeping the system as the core objective.

"Any one thing isn't the secret sauce, but it's the whole system," MacPherson says.

HydroComp's flagship product is NavCad, designed to predict and analyze vessel speed and power performance.

The software also "provides for the selection of suitable propulsion system components — engines, gears and propellers," HydroComp says, and it can be used for the design and analysis of just about any type of monohull or catamaran, from large displacement vessels to fast planing craft.

Other software products HydroComp has developed include PropExpert, PropCad and PropElements; programs for propeller sizing and analysis, propeller CAD, resistance and powering, and sea-trial and analysis.

One vehicle that has benefited from HydroComp's work is Tend Ocean's Drone Tug, an unmanned vessel designed to tow large objects of varying and unknown dimensions. For this vehicle, HydroComp is designing an optimized propeller that will develop maximum thrust at the highest efficiency, which

An artistic rendering of Dive Technologies' large-displacement AUV, DIVE-LD. **Photo: Dive Technologies**

is important to preserve the energy budget — i.e., the fuel supply — and allow the vehicle to have the greatest range possible.

"When we talk about autonomy, autonomy requires you bring everything with you, including energy," MacPherson says. "While we're not involved in energy storage, we are involved in helping people use energy as efficiently as possible to expand the scope of autonomous missions."

Inspiring the next generation

Developing technology that is fit for purpose and "not too bad on the eyes either," Houston Mechatronics has developed technology that is not only useful, but aesthetically pleasing. The company's flagship product, the Aquanaut, is an "all-electric underwater transformer" that can convert seamlessly between autonomous underwater vehicle (AUV) and remotely operated vehicle (ROV).

In AUV mode, Aquanaut can cover up to 200 kilometers while performing typical AUV missions such as seabed mapping and wide area structure inspection. Equipped with several features that the company says differentiate it from other AUVs such as vertical thrust control and an articulating bow, the Aquanaut transforms by actuating four in-house designed and built high-reliability linear actuators. In one fluid motion, the hull separates, exposing two more control thrusters, the vehicle arms, and adding another degree of freedom to the vehicle head mechanism.

In ROV mode, the Aquanaut can accomplish several missions including turning a valve and scanning structures. These missions can be performed with a few mouse clicks, as the vehicle is controlled this way instead of using joysticks.

The company says its multi-mode machine vision system is made up of acoustic, optical, and laser-based tools that are processed into a dynamic point cloud using the computing power available onboard the vehicle. The point cloud is then compressed using the company's new compression technology, which offers compression ratios between 5,000:1 and 75,000:1 (depending on the scene quality). Whether onboard a support ship or at the company's home office, the operator can always maintain supervisory control over the vehicle.

Nicolaus A. Radford, Houston Mechatronics' cofounder and CTO, says it's the company's desire to create cool technology that could hopefully inspire the next generation of innovators and get them interested in unmanned maritime vehicles. That process starts early on, as Radford notes that during his youth, he never thought about the ocean as a place of opportunity.

"It felt rusty, smelly, old and very low tech and that people that worked around the ocean were bearded with few teeth and a floppy hat," Radford recalls.

Radford, who spent 14 years at NASA's Johnson Space Center in the Dexterous Robotics Laboratory, remembers the first book he read about the space shuttle and the feeling of excitement he got from it.

> Autonomous and unmanned maritime systems are being used for a variety of commercial operations, but it's important to inspire the next generation of engineers and scientists to use them.

"It felt high-tech, high energy, smart, clean, and, more importantly, to be associated with it meant you were in another league because you must be a genius," he says. Radford says the imagery from each industry "divides our early perception.

"Yes, there are pretty pictures of beaches and the ocean is awe inspiring and beautiful from a vacation standpoint, but as for working in it — do a Google image search — 'working in the ocean' and then do one for 'working in space.' Which one inspires you?" Radford asks.

With this in mind, Radford says making the ocean feel like a cool place to work starts in the schools, noting that his daughter is in a subsea robotics club at her middle school called Sea Tech. Radford volunteers there and helps the kids build ROVs using the SeaPerch kit from RoboNation.

"These kids are sold. And here's the opportunity," Radford says. "Combining robotics and the ocean is making the ocean high tech. I gave the middle school students a tour of HMI and they saw Aquanaut. And now, there has been a palatable change in the conversation about the ocean and the possibilities."

Working in the ocean is expensive, Radford notes, so to push the industry forward also takes a community being willing to invest in the work.

"That's already baked in for the space industry. We know it's long and expensive and most importantly they are willing to change and adapt to new ideas because by nature it's more cutting edge," Radford says.

While some industries might be slow, and even push back against change, Radford says "that's what start-ups do. They change things," which creates the "tension and barrier to innovation and to new companies in the traditional ocean space of oil and gas.

"So, you have to have alligator blood to keep at it. Few folks do. But currently, we've got economics on our side. They can't afford to keep doing it the same way. So, I like our chances." US