December 2020

ON&T

oceannews.com

OCEAN NEWS & TECHNOLOGY

THE FUTURE OF OCEAN TECHNOLOGY

2020 EDITION

| FEATURE |

THE FUTURE OF DEEP OCEAN RESEARCH

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The future of deep ocean research charts a parallel course to how satellite systems have revolutionized global science and communication over the last fifty years. Today, satellites are instrumental to global environmental planning, positioning, and connectivity. We need a similar infrastructure for our oceans. The prospect of a network of high-reliability subsea systems designed to support deep ocean research poses a monumental challenge—in more ways than one—but, in the same spirit that compelled Jules Verne to imagine the inconceivable over 150 years ago, the time to prioritize such efforts is now.

The satellite concept was imagined in the mid-1950s by the Rand Corporation for military purposes. Today, there are satellite constellations orbiting the globe that provide continuous and comprehensive coverage. The ability to connect, communicate and operate global sensors through multiple satellite networks allows us to live, work and innovate within this seamless infrastructure. Given how ubiquitous this network has become to our daily lives, couldn't we imagine similar for our oceans?

Yes, but there are unique challenges. While electromagnetic waves travel through the vacuum of space—providing a wireless connection between buildings, planes, and satellites in outer space, all the way to the edge of our solar system—the same rules do not apply for hydrospace. Radio waves cannot travel through water in the same fashion. Sound waves do, but the bandwidth of signals is limited to a speed one million times slower than that above the surface.

» *Certified Acrylic Pressure Vessel for Subsea Habitat (Photo credit: Hydrospace Group)*

Traditionally, ocean research has relied on ships to traverse new frontiers, chart various locations, and collect relevant data. It is relatively slow and tedious task but has rewarded us with some significant discoveries, including the movement of tectonic plates, seafloor mountain ranges, hydro-thermal vents, and much more. Similarly, breakthroughs in acoustic sensing continue to accelerate our exploration of offshore resources. But we need more.

UNDERWATER CONSTELLATION

So, what's next? Short of global quantum computing capable of penetrating our deepest waters, we need another "constellation" of oceanic instruments designed to measure, study, and communicate in hydrospace.

Rather than being dependent on topside vessels, deep ocean research requires a new generation of failproof, interconnected systems with long-term submergence capabilities, stationed on the ocean floor or in the water column. Technically speaking, this is a multi-decade endeavor which will rely on generational collaboration. Certain nations and government agencies have responded by setting up research and funding groups and are pushing ahead to champion innovation in subsea vehicle technology and instrumentations, as sub-systems for communication, navigation, and survey.

Notably, the United Nations has proclaimed a Decade of Ocean Science for Sustainable Development (2021-2030) to support research in ocean health. This effort calls on ocean stakeholders worldwide to support a common framework of ocean science for the sustainable development of the ocean around the globe. SEABED 2030 was also launched in 2020 as an international, collaborative project between the IHO/IOC General Bathymetric Chart of the Oceans (GEBCO) and the Nippon Foundation that aims to facilitate the complete mapping of the world's ocean floor by 2030.

MULTI-LAYER MAPPING

Every long journey starts with a first step. Today, it is generally accepted that only 19% of the global seabed has been accurately mapped, and that fully understanding how marine environments influence life on Earth starts with revealing its topographical qualities. However, beyond bathymetry, this is a multi-layer mapping exercise: The second layer must map life form composition, followed by a third layer to map the distribution of fauna and flora and the ecosystems they maintain. The fourth layer would consist of analyzing the health of these marine ecosystems (shallow and deep), while the fifth should examine ecosystems in the water column.

Exploring hostile ocean environments in the name of mapping these five layers will hinge on the collaboration of all major fields of advanced science and engineering. Systems, components, and sub-systems must be reliable, self-maintaining, and intelligent. Some of this will come from AI and Machine Learning, while others rely on human heuristics. This will surely require a full spectrum of large-scale subsea drones, strings of instruments and robot deployments, and innovations in manned submersibles, especially for layers 3, 4 and 5. What they all have in common is the need for high reliability systems. I often think of the system designs we made 30 years ago for Mars exploration, intended to carry out a 5-year mission. Today, when considering system designs for 5-year mission life at the bottom of the ocean, Mars appears a lot more benign; with a light atmosphere, some dust, but surely not encumbered by millions of biological life forms and the sorts of corrosive surroundings intent on exposing any weakness of human construct.

DEEP-SEA SYSTEMS

The only way we can foreseeably achieve global subsea coverage would be via a highly engineered "constellation" of deep-sea systems. This demands devices be suitable for long-term residency and for all components to be exceptionally reliable. Critical components and sub-systems include:

1. Power plant systems and components: Batteries, super capacitors, power generators, energy management systems for AUVs, ROVs, and seafloor stations

2. Electric motion control and components: Electric motors, propulsion systems, drive mechanisms, winch drives, valve actuators, pump drives, and pointing mechanisms

3. Robotic systems: Electric robotic manipulators for high performance capability and long submergence reliability

4. Pressure vessels and components: Pressure vessels for human occupancy, acrylic pressure vessels, hi-rel deep ocean pressure hulls, and housings and tanks for special applications.

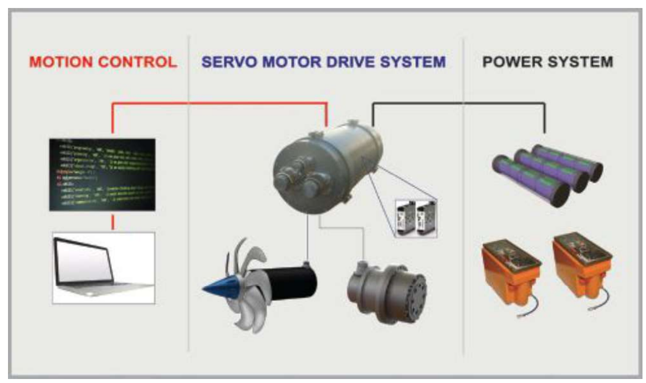
5. Manned submersible vehicles for certified, safe and reliable exploration

Hydrospace Group specializes in high reliability system design and our experience bridges from space exploration to, since 1995, subsea innovation. Hydrospace provides proven solutions for all types of systems (manned and unmanned), and expert engineering for power storage, propulsion, actuation, navigation, robotics, pressure vessels and crewed vehicles.

So, in many ways, the future is what we determine it to be. Take Jules Verne, for example: Nautilus—his fictional submarine in Twenty Thousand Leagues Under the Sea may have been his most fabled creation, but the true magic came from its power source. It was propelled by "electricity"—a concept that was little explained and must have sounded futuristic. Turns out, he was close; you need pressure vessels and electricity. As experts in electricity, pressure vessels, and underwater vehicles, the team at Hydrospace Group sees an exciting future bound only by our imagination, and we remain committed to providing a continuous flow of innovative solutions for all types of subsea critical mission systems and components.

For more information, visit: *www.hydrospacegroup.com*

» *Deep Ocean Electric Brushless DC Rotary Actuator (Photo credit: Hydrospace Group)*



» *Electromechanical & Battery Systems for Deep Ocean Vehicles and Instrumentation (Image credit: Hydrospace Group)*

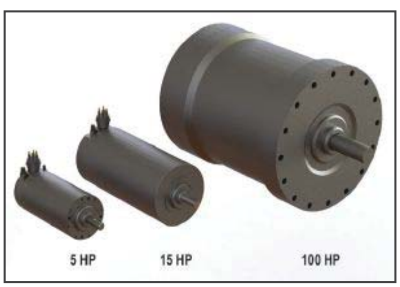
» *Aurora Deep Ocean Exploration Submersible for 3 Persons (Photo credit: Seamagine Hydrospace Corp)*

25 Years Heritage in Design and Fabrication - from Space to Deep Ocean Exploration

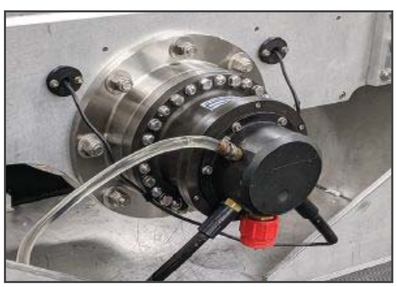
SPACE TOURISM INDUSTRY

HYPERLOOP INDUSTRY

UW VEHICLES INDUSTRY



BDC ELECTRIC MOTORS



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