# NSWC Carderock Division Teams Win 2015 SECNAV Innovation Awards

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WEST BETHESDA, Md. (NNS) -- Secretary of the Navy (SECNAV) Ray Mabus announced two Naval Surface Warfare Center, Carderock Division (NSWCCD) teams Feb. 9 as winners in the 2015 SECNAV Innovation Awards.

The awards program recognizes the top individual and team innovations that have made remarkable innovative accomplishments to solve the Navy's most challenging problems during this past year.

"We truly believe our team's commitment to excellence stems from a deep-seated dedication by all of you to our mission and to our Sailors," said Tim Arcano, NSWCCD technical director. "It is an honor for us today to draw out the work of several of our colleagues at NSWC Carderock Division who have been recognized by the SECNAV for their accomplishments."

NSWCCD's Underwater Wireless Energy Transfer (UnWET) system team was selected the winner of the Robotics/Autonomous Systems category. This award recognizes contributions in robotics and autonomous systems within the Navy's science and technology community or within the operational forces.

The UnWET system team, comprising members from Carderock and Naval Surface Warfare Center, Philadelphia Division, earned the award for demonstrating the feasibility of transferring power to unmanned systems underwater during tests at Carderock and Newport, Rhode Island, last year. They collaborated with personnel from the Naval Undersea Warfare Center, Division Newport, and Space and Naval Warfare Systems Center Pacific (SSC PAC).

The Navy currently uses its unmanned underwater vehicles (UUVs) to counter mine warfare threats, optimize remote sensing platforms and map the ocean floor. These UUVs launch from underway platforms and must return to recharge and offload data frequently.

"They have a very limited energy source, and that puts a lot of constraints and risks on our high-value assets, like our surface ships and submarines," said Alex Askari, NSWCCD UnWET technical lead. "Imagine if you could build an underwater 'gas station' for these unmanned systems. The UUVs can go there autonomously, recharge their batteries, offload their data and go to their mission again. Accomplishing this will significantly reduce burdens on the UUVs' host ships."

Askari said the team's work means someday these vehicles could potentially operate indefinitely away from their ships, greatly expanding their operational capabilities.

During the first phase of development, all involved organizations developed their own system modules: West Bethesda headed the wireless power transfer effort, Philadelphia designed the battery state of charge indicator, NUWC Newport developed an open-architecture docking system for the Mid-Size Autonomous Reconfigurable Vehicle (MARV) UUV, and SSC PAC provided acoustic and optical communication for data transfer.

In the second phase, the four organizations came together and integrated their modules into a complete system with the MARV UUV, and demonstrated the setup in a relevant environment (the Shallow Water Test Facility at Narragansett Bay in Newport) during ANTX 2015. The UnWET system recorded a nominal power transfer of 1.5kW to the MARV UUV, and an end-to-end efficiency of 89 percent in the seawater environment.

Throughout the development process, West Bethesda team members leveraged 3-D computer-aided design, parametric modeling and additive manufacturing technologies to accelerate the development of UnWET system components.

Kevin Lin, an electrical engineer and the lead designer behind the wireless power transfer coils, explained that "parametric modeling alongside 3-D printing allowed us to rapidly, inexpensively and iteratively test our coils, so that we could home in on the most optimal design for the MARV UUV."

"If we want to remain the world leader, we need to look at innovative technologies and new concepts so we can compete with our adversaries," Askari said. "Working on this has been a great experience. I personally believe if you want to accomplish something rapidly and effectively in the Navy, you have to collaborate across the different warfare centers. If you can bring your different capabilities and knowledge together, you can effectively develop and demonstrate your project-and that's what we were able to do."

The other members of the UnWET System Team recognized are Mayer Nelson, Joseph Curran, Michael Knauff, Willard Morris, Robert Stark, William Gottwald Jr., Crystal Lutkenhouse, Thomas Jiang, Steve Miller, and Tristan Wolfe.

NSWCCD'S Realtime Acoustic Imaging Team of Philip Gillett and Christian Sarofeen was selected as the winner of the Data Analytics category. This award seeks to identify members of the data-savvy workforce who implemented new approaches to using data analytics to improve performance, support decision making or provide meaningful insight to existing processes.

Gillett and Sarofeen's goal when they began working together at Carderock was to find a way to display acoustic data so that it could be visually understood.

"Right now, you are sampling the sound field with your ears," Gillett said. "When we do our tests in the water, we are sampling the sound field with thousands of sensors spaced throughout. You essentially have those two sensors. We can do different things to explore the physical

phenomena that are creating sound in the environment and make the sensors more sensitive in a specific direction so we can determine what a specific object or location sounds like."

Sarofeen said this data can be used to detect sources of noise to isolate and eliminate them.

The team determined they needed to enhance their available computing power to improve analysis of this data, moving from a one-dimensional analysis, which he compared to a single microphone that simply determines the presence of noise, or two-dimensional analysis, which he compared to a still photograph, to a 3-D model.

"Going further, we can establish our physical model, sample these three-dimensional locations and actually look at it in a virtual world," Sarofeen said. "We want to take these really large computers that we have access to, process things really quickly and process lots and lots of data and be able to get a real-time acoustic image in three dimensions of what's going on, so that when we watch something go by, it can actually show us what's happening in a very detailed manner."

Sarofeen said they worked toward this goal using the Department of Defense's High Performance Computing Modernization Program to secure a computer he described as "pretty much 50 computers wired together, each one of those having 10 cores," for a total of 500 cores, along with 50 NVIDIA advanced scientific GPUs. What the team did from here was to modify it so it was better suited for scientific computing and the specific algorithms they use. They improved their signal processing speed by using the graphic processing unit in addition to the central processing unit (CPU), as compared to conventional processing where only the CPU is utilized.

"We wrote the algorithm from the ground up specifically to take advantage of the architecture and hardware of this large computer to get every single little bit of performance we could out of it in order to get this algorithm so fast that it could be used it in real time to do lots and lots of processing," Sarofeen said.

Gillett said they worked on this process for over a year and a half, also writing a research paper that was cited in their nomination for this award.

"We'd like to keep moving forward with this because there's more work to be done," he said. "This was a demonstration of how much some optimization can garner. We look forward to implementing that, but that's not the end of where we're going with this."

Gillett said he and Sarofeen then entered Carderock's Technical Director's Innovation Challenge to pursue the next step in bringing this technology to the fleet.

"We asked ourselves, 'Now that I have some results and information, how do I present these results to the analyst, the commanding officer, or anyone else, in 2-D and 3-D, in a way they can sit down and look at it and immediately know what's going on?'" Gillett said. "The visualization and presentation of the result is as critical and important as how the processing works."

Gillett said while he and Sarofeen received the SECNAV Innovation Award for their work on the processing side, they are eager to take their progress further and collaborate with others to deliver this enhanced data analysis capability to the warfighter.

NSWCCD, a field activity of the Naval Sea Systems Command, leads the Navy in hull, mechanical and electrical engineering. Headquartered in West Bethesda, NSWCCD employs approximately 2,000 scientists, engineers, technicians and support personnel and includes detachments in Norfolk; Port Canaveral, Florida; Fort Lauderdale, Florida; Memphis, Tennessee; Bangor, Washington; Ketchikan, Alaska; and Bayview, Idaho.

For more news from Naval Surface Warfare Center Carderock, visit www.navy.mil/local/nswcc/.