Inside NRL's Laboratory for Autonomous Systems Research

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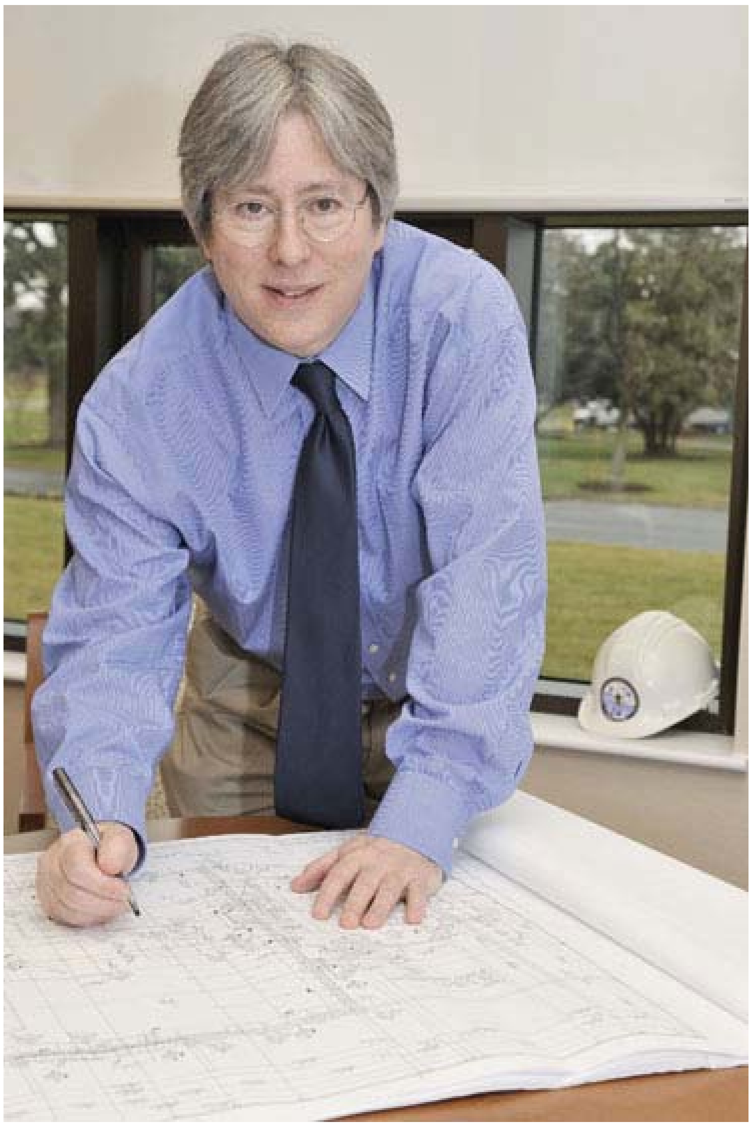
On Friday, March 16, 2012, the Naval Research Laboratory will open a new facility — the Laboratory for Autonomous Systems Research (LASR), at its main site located in Washington, D.C. In advance of the opening, SPECTRA magazine got the inside scoop from Alan Schultz, Director, Autonomous Systems Research at NRL.



Alan Schultz is the first Director of NRL's new Laboratory for Autonomous Systems Research.
(Photo: U.S. Naval Research Laboratory)

The Littoral High Bay, part of the Laboratory for Autonomous Systems Research, features a 45' x 25' x 5.5' deep pool. This pool will have a 16-channel wave generator, allowing researchers to create directional waves
(Photo: U.S. Naval Research Laboratory)

The Tropical High Bay, part of the Laboratory for Autonomous Systems Research, is a 60' by 40' greenhouse that contains a re-creation of a southeast Asian rain forest. In the Tropical High Bay, temperatures average 80 degrees with 80 percent humidity year round.
(Photo: U.S. Naval Research Laboratory)

Exterior view of the Laboratory for Autonomous Systems Research, located at the Naval Research Laboratory, Washington, D.C.
(Photo: U.S. Naval Research Laboratory)

1. Tell us about the capabilities of the Laboratory for Autonomous Systems Research?

The new facility has a number of high bay environments and laboratories with many unique features to support research in autonomous systems.

The Prototyping High Bay is 150' x 75' x 30' high. This space can be used for small autonomous air vehicles, autonomous ground vehicles, and of course the people who will interact with them. The most unique feature of this space is a motion capture system, which will allow us to track up to 50 objects, and gather high accuracy ground truth data of all positions of these tracked objects at 120Hz. Our tracking system currently has the largest capture volume in existence. In addition, we have high-speed cameras on motorized pan/tilt heads which can be automatically cued by the motion capture system, allowing us to record video of specific targets.

We have an audio system that allows us to inject directional sound into the environment, allowing us, to for example, inject the sound of troops marching from the southeast to the northwest, or environmental background noises. We can flood a 40' x 40' area to a 4-inch depth, so we can simulate a shallow body of water, or allow sensors from an air vehicle to see specular reflections. Lighting is adjustable, and nighttime conditions can be simulated. Four labs overlook the high bay and can be used for testing human interaction with remote systems, and as control rooms.

The Littoral High Bay features a 45' x 25' x 5.5' deep pool. This pool will have a 16-channel wave generator, allowing us to create directional waves. In addition, the far side of the pool will contain a structure allowing us to put a slope on that end of the pool. We will have materials such as sand, dirt and gravel that can then be put into the pool, allowing us to create surf-like conditions. The wave generator and slope mechanism can be removed with our overhead crane for those who need a constant depth and the full length of the pool. The Littoral High Bay will also have a variety of sediment tanks for testing sensors and energy harvesting devices.

The Desert High Bay contains a 40' by 14' area of sand 2-foot deep, and contains 18-foot high rock walls that allow testing of robots and sensors in a desert-like environment. We can introduce blowing sand, and can control the lighting in that environment.

The Tropical High Bay is a 60' by 40' greenhouse that contains a re-creation of a southeast Asian rain forest, with temperatures that average 80 degrees and 80 percent humidity year round. Rain events of up to 6 inches per hour can be generated, allowing us to test autonomous systems, sensors and communications in these harsh environments.

We have specialized laboratories for human-systems interaction, sensors, and power and energy. The four human-systems interaction labs overlook the Prototyping High Bay and can be used, as described earlier, as control rooms for human-subject experiments, or for development of autonomy software. These labs contain eye trackers (useful for studying how people work with advanced interfaces for autonomous systems) and multi-user/multi-touch displays. The sensor lab contains environmental chambers (including a smaller chamber where temperature, humidity and barometric pressure can be controlled and a large walk-in chamber with control of temperature and humidity), an anechoic chamber, and an aerosol test facility.

2. Who will work in LASR?

LASR is an NRL-wide resource. NRL researchers who have relevant projects can register to use the facility using our on-line registration process that will be available soon. In that process, the principal investigator will describe the work to be done and which of our labs and environments they intend to use. The lab director and facility manager will then determine appropriateness of the project and whether space is available. Priority will be for multidisciplinary research in autonomous systems. Once the project is approved, researchers may then create experimental setups in our scheduling system and reserve time for specific experiments.

3. Will LASR be opened to outside researchers or is it just for NRL scientists and engineers?

While the facility was created to support NRL research, outside collaborators on funded projects will be able to work with NRL scientists in the facility. The facility is not generally available for rent.

4. What types of research will be done in LASR?

LASR will support a broad range of research related to autonomous systems, from basic, to applied, and for integration across different disciplines. For example, while we do expect to have a lot of research involving autonomous vehicles, autonomy goes beyond vehicle platforms to autonomous systems for self-configuring and self-healing networks, autonomous sensor networks, and software to aid the warfighter in decision-making. The lab will support research in power and energy systems and sensors that are both part of the autonomous systems and as the payloads.

To show the breadth of the science, a few of the research projects that are already slated to start work in the building include damage control for the 21st century, which is working in advanced shipboard firefighting technology, including autonomous firefighting robots, and the large-displacement UUV, where research is being performed on sensors, power and energy, and on the technology for testing and evaluating autonomous control algorithms.

5. How are NRL researchers uniquely positioned to take full advantage of a laboratory like LASR?

NRL is uniquely positioned because of the breadth and depth of our science, and because we have the underlying science needed for all aspects of autonomous systems. As I went around to NRL's various divisions to brief our scientists about the new facility, I realized that virtually all of our research divisions have a role, whether its bio-molecular researchers developing CBRNe sensors, material scientists developing novel ways to embed antennas or electronics into vehicle structures, or psychologists studying how our warfighters will work with these systems. The potential for cross-disciplinary work is huge, and I am already seeing folks working together to solve the bigger problems in autonomous systems that cannot be solved when these groups work in isolation.

6. What do you see being accomplished using LASR that is not currently being accomplished in NRL's individual research divisions?

While many of our divisions already work together in interesting ways to solve these bigger problems, LASR will allow us to do larger scale integration of the science, and to test out our ideas before we go to the field. Our facility gives us a cost saving method for testing out concepts and ideas before we go to the expense of field trials. In essence, it bridges the gap between laboratory work and field experiments.

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Alan C. Schultz is Director of the Navy Center for Applied Research in Artificial Intelligence at the Naval Research Laboratory in Washington D.C., in addition to being selected as the first Director of NRL's new Laboratory for Autonomous Systems Research. He has 26 years experience and over 100 publications in autonomous systems, robotics, human-robot interaction, and machine learning, and is responsible for establishing and running the robotics laboratory at NRL. Mr. Schultz was selected to teach at the first IEEE/RAS Summer School on Human-Robot Interaction, has been editor of several collections in multi-robot systems, and has chaired many conferences and workshops in robotics and human-robot interaction. Mr. Schultz received his M.S. in Computer Science from George Mason University in 1988. Mr. Schultz has been P.I. on numerous ONR, DARPA, NASA and DOE grants. He is the recipient of 20 Navy Special Achievement awards for significant contributions, and the Alan Berman Research Publication Award. His research is in the areas of human-robot interaction, autonomous systems, and adaptive systems.

About the U.S. Naval Research Laboratory

The U.S. Naval Research Laboratory is the Navy's full-spectrum corporate laboratory, conducting a broadly based multidisciplinary program of scientific research and advanced technological development. The Laboratory, with a total complement of nearly 2,500 personnel, is located in southwest Washington, D.C., with other major sites at the Stennis Space Center, Miss., and Monterey, Calif. NRL has served the Navy and the nation for over 85 years and continues to meet the complex technological challenges of today's world. For more information, visit the NRL homepage or join the conversation on Twitter, Facebook, and YouTube.