



CRUSER • NEWS

Consortium for Robotics and Unmanned Systems Education and Research

FROM TECHNICAL TO ETHICAL FROM CONCEPT GENERATION TO EXPERIMENTATION



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POSTGRADUATE
SCHOOL

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CETMONS Workshop Continues the Discussion of Ethics and Technology

By Amanda D. Stein

Attendees at the Consortium for Emerging Technologies, Military Operations and National Security (CETMONS) gather for a three-day workshop titled "Ethics and War-fighting Technologies." The consortium provides engineers, scientists and ethics professionals an environment to discuss current challenges and opportunities in defense technologies.

Participants from around the country gathered to share ideas and explore research topics of interest. With ethics a key area of focus for the event, keynote speaker NPS Professor and recently appointed Chair of of Defense Analysis, Dr. John Arquilla, acknowledged that cyber warfare, his area of expertise, brings up many ethical challenges, for which there are no simple answers.

"I applaud the work you do here," Arquilla said in his opening remarks. "This is very important. And I am pleased that there are ethicists here with technologists. It is truly the only way ahead."

Also representing NPS at the event was retired Navy Capt. and Operations Research Senior Lecturer Jeff Kline, Director of the Consortium of Robotics and Unmanned Systems Education and Research (CRUSER), who offered an overview of the efforts CRUSER is making in bringing together the various departments of NPS in unmanned systems research. Director of the Undersea Warfare Research Center, retired Rear Adm. Jerry Ellis, and Associate Professor of Applied Science, Dr. Don Brutzman, also spoke about unmanned systems and the collaborative research environment made possible at NPS.

Robotic Systems Joint Project Office

In 1989, the Department of Defense was directed by



congressional language in the FY89 Defense Appropriations Bill to advance joint robotics programs or development

efforts. Accordingly, in

direct response to this direction from Congress, the Office of the Secretary of Defense (OSD) migrated two separate advanced robotics development projects underway within U.S. Army and Marine Corps to mature technology. In order to eliminate duplication of effort within DoD, this initiative provided for the establishment of the Unmanned Ground Vehicles/Systems Joint Projects Office which was later renamed the Robotic Systems Joint Project Office (RSJPO) to manage the joint UGV/ systems programs.

Under this Joint Project Charter, the RSJPO has three pillars of responsibility:

- (1) Act as focal point for joint robotics initiatives and provide the interface amongst the Planning, Programming and Budgeting System (PPBS); the Joint Capabilities Integration Development System (JCIDS) Requirements Generation System; and, the Acquisition Management System;
- (2) Translate approved operational needs into stable, affordable acquisition programs; and
- (3) Utilize or energize technology base research activities to break technological barriers by transferring demonstrated technical solution and/or capability into UGV systems.

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DIRECTOR'S CORNER

WANTED: Innovative thinkers to help shape the future of the navy's unmanned systems – new ideas for current systems. CRUSER is sponsoring a three and a half day Warfare Innovation Workshop 19 – 22 September 2011 on the NPS campus. Our focus will be on Concept Generation involving revolutionary ways to leverage current and evolving unmanned systems. Participants will include NPS students, faculty and engineers from Navy and civilian labs and industry. Please contact me at cjoneal@nps.edu if you want to be part of the Innovation Team!

CAPT Carol O'Neal, USN Ret
CRUSER Director of Concept Generation and Innovation



Robo-Sub 2011: You'll love this challenge

By Captain Edward Lundquist, USN (Ret.), a principal science writer with MCR Federal LLC.

If you like robotics, then you would love this year's theme and challenge for the 14th Robo-Sub competition, sponsored by the AUUSI Foundation and the Office of Naval Research (ONR), held July 13-17. The endearing theme for the 2011 challenge was "RoboLove."

The competition attracted 27 teams from universities around the world, as well as two high schools. Teams had to submit presentation papers, websites, videos, and of course, an autonomous robot that could successfully navigate the course that was constructed underwater in the Transducer Evaluation Center—TRANSDEC—pool at the Navy's Space and Naval Warfare Systems Center in San Diego.

The teams faced a Valentine's Day date with destiny. "You are on your way to your sweetie's house. Your path is laid out in orange. Collect flowers (touch a buoy). Follow the path to "lover's lane" (pass over a bar). Choose between dropping off love letters (drop items in a bin) or firing Cupid's arrow through a heart (send a projectile through a heart shaped object). Pass over another part of lover's lane, pick up a vase and deliver the flowers (retrieve a PVC structure and place it inside an octagon).

For the robotic romance, competitors came from as far away as Reykjavik University in Iceland; Kyushu Institute of Technology in Japan; Harbin Engineering University in China; and two teams from India representing Delhi and Khargpur. A pair of Canadian teams participated, including the 2011 Robo-Sub champions, Team SONIA from École de Technologie Supérieure in Montreal. Team Sonia took home "le gros chèque" of \$7,000.

The university teams included undergraduate, graduate students and PhD candidates. Two high schools entered the competition. Amador Valley High School in San Diego returns again this year, while Carl Hayden High School's Falcon Robotics team from Phoenix is a Robo-Sub rookie.

The smallest squad is the two-man team from Utah State University, appearing in their first AUV challenge. Daniel Morwood and Brandon Holdaway found out about the event while surfing the web. "It looked pretty cool," Morewood says.

Morewood found the experience rewarding and the atmosphere collegial. "This isn't a competition. It's a club. Everybody here is willing to help you. We'll be back. We love it."



Embry-Riddle solution is essentially a self-propelled autonomous underwater briefcase.

Additional Robosub Pictures and results available at:
<https://wiki.nps.edu/display/CRUSER/Aug+2011>

CRUSER Interns at NPS

During their summer break four students completed an internship at NPS working for Dr Timothy H Chung. Here are reports from the interns:

Matt Epperson

During my internship with CRUSER at the Naval Postgraduate School I was afforded the opportunity to work with almost a dozen different retired USSOCOM robots. Many of the robots did not work due to missing parts, dead batteries, and fried microcontrollers; however, with some mixing and matching we were able to restore a few to life. The next objective was to modernize the control units for the robots, which were bulky and largely outdated. With limited time we chose to focus our efforts upon the QASAR, which like all members of the Ratler family of robots has a unique split body design and is made out of high strength carbon fiber. In order to renovate the robot, we used a Toothpick microcontroller that communicates over Bluetooth. We directly connected our Toothpick to the robot's motor control to set the power and direction of the motors. From there another intern, Derek Burch, was able to write a program that allowed us to control the robot using an Xbox controller as a joystick. Since then we have reconfigured the robot to use an Xbee Pro wireless module as the communication device and an Android phone to serve as the brains. I am extremely grateful to have had this experience because it has given me valuable insight into different types of engineering and reinforced my desire to pursue a career in the engineering field.

Stefan Jorgensen

I am a third-year undergraduate Electrical Engineering student at UCLA, hoping to go into the field of robotics. This summer I have been working with the Pioneer 3DX robot platform and the Robot Operating System (ROS). ROS is an open source operating system which makes it easy to communicate between various sensors and platforms even if they are not made to work together. Ordinarily, one would have to figure out how to get all of the drivers to communicate to each other and thus it takes much longer to get a system ready to run code developed for it. In my case, ROS made it very simple to connect a laser sensor to the Pioneer and develop an obstacle avoidance algorithm. My hope is to have the robot autonomously navigate Bullard Hall and piece together a map from the laser scan data. This internship has given me a preview of what it means to be a roboticist and an idea of what classes will help me as I continue to study at UCLA.



Derek Burch

I am currently a Computer Science PhD student at the University of California, Merced. My PhD work involves using robots to search for lost targets. The NPS internship this summer has allowed me to branch away from just working on theory and focus on the hardware and system aspects of robotics. Before the internship I had very little experience with electrical engineering, but by the end of the internship I was able to learn some of the basics by working with my fellow interns to rebuild the circuitry of a QASAR robot. We managed to have the robot controllable via an Xbox controller, use text to speech, and record GPS data all over a wireless connection. The combination of electrical and software engineering work needed for this project will greatly benefit my future work in robotics.

Katia Gonzalez



Sue Higgins, Katia Gonzalez, Adm Carr

Attended the Naval STEM Forum in June, "It was such a wonderful experience. I never thought I would find myself talking to all of these important people. And this guy, the one that wore the white suit, I would never think he would tell me that I would be a wonderful rocket scientist!"

RSJPO Cont

This final action provides assistance to the Project Manager (PM) in finding scientific solutions to pacing problems and presents an opportunity to expose users to state-of-the-art system improvements.

The RSJPO public website is: <http://www.rsjpo.army.mil/index.html>.

Additionally the RSJPO Unmanned Ground Systems Roadmap ADDENDUM is available on the CRUSER Wiki at <https://wiki.nps.edu/display/CRUSER/CRUSER+News+Articles>

Dr Isaac I. Kaminer

Mechanical and Aerospace Engineering, NPS has been selected as the section editor of:
Handbook of Unmanned Aerial Vehicles (UAVs)
Part III (UAV Fundamentals)

STUDENT RESEARCH: IN-PROGRESS

MAJOR LES PAYTON, USMC - DEFENSE SYSTEMS ANALYSIS

TITLE: "THE FUTURE OF UNMANNED AIRCRAFT SYSTEMS IN SUPPORT OF A MARINE EXPEDITIONARY UNIT"

The USMC Marine Expeditionary Unit is commonly referred to as "the nations 911 force." It must be capable of executing a full spectrum of missions from low intensity humanitarian assistance and noncombat evacuations to high intensity major combat operations. The structure and equipment are designed around this multi-mission requirement. However, the Marine Corps has a small fixed wing UAS, the small tactical UAS (STUAS) deployed aboard a MEU and is researching a cargo resupply UAS based on helicopter technology. The Marine's focus on single mission UAS does not fit with its mission requirements and will prevent full employment of future systems due to limited space on the ARG.

This thesis will examine MEU mission requirements and recommend a UAS capability set that will best support these operations. The thesis will determine the requisite UAS capabilities by examining a MEU executing the Marine Corps "distributed operations" mission. Once a full set of capabilities has been derived from the examination of the distributed operations mission, the UAS will be compared to current manned systems assigned to the MEU's Aviation Combat Element (ACE) to determine if this new unmanned system can alleviate requirements on manned systems. The answer to this question will enable planners to adjust the ACE table of equipment (T/E) to take full advantage of the capabilities of each aviation asset, to include the UAS.

Finally once the UAS has been vetted for its relevance and the capability set verified against the manned aviation platforms, a cost analysis will determine the full life cycle costs of the proposed UAS.

Recruiting NPS Students to join CRUSER

New Student Fairs at NPS are held quarterly and provide information for incoming students about various programs and clubs at NPS as well as information from vendors in the local area. CRUSER has a table to sign-up new students and let them know about the opportunities that CRUSER has for them while they are here as students. To showcase the CRUSER table at the July fair intern Matt Epperson created the "Unmanned Recruiting Robot" and drove it around, while he didn't get any sign-ups on the robot - we were able to recruit several new students to join CRUSER. By having thesis topics available from not only professors at NPS but from DoD organizations, students are able to complete research about one of the many facets of unmanned systems. Many of the new students this quarter that joined are in the acquisitions curriculum, so our student population covers a wide variety of interests, not just technical aspects. In addition to the new student fair, CRUSER sponsors periodic lectures or other events on campus which also provide an



opportunity for students to learn about CRUSER. Many students have a background in unmanned systems and are interested in joining when they find out what CRUSER is. But for other students having thesis topics available as well as opportunities to participate in real-world research and experiments, helps us reach those who may not have thought about researching unmanned systems.

Thesis Topics from DoD Organizations

Does your DoD Organization have a potential graduate thesis topics related to unmanned systems they would like NPS students to research?

CRUSER has funds for student travel to support thesis research and attend experiments in CRUSER related topics. Please contact Lisa at cruser@nps.edu

CALENDAR OF EVENTS

The CRUSER Calendar of Events is located on our Wiki:

<https://wiki.nps.edu/display/CRUSER/>

Submit your events:

http://www.nps.edu/Research/cruser/cruser_EventSub_Form.html

CRUSER

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