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CRUSER • NEWS

Consortium for Robotics and Unmanned Systems Education and Research

From Technical to Ethical...From Concept Generation to Experimentation

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September NWDC/CRUSER Sponsored Warfare Innovation Workshop

EXCERPTED from Workshop Spurs Maritime Warfare Innovation by Kenneth A. Stewart, NPS

The Sept 2014 NWDC/CRUSER Warfare Innovation Workshop report is now available. Please contact Lyla Englehorn at laengleh@nps.edu

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The Naval Postgraduate School (NPS) recently hosted its annual Warfare Innovation Workshop (WIW) in NPS' Ingersoll Hall, Sept. 22-25. The workshop brought together students as well as members of industry, Navy laboratories, system commands and academia to explore innovative concepts in future warfare scenarios.

"The Warfare Innovation Workshop provides a variety of ways for NPS and CRUSER to support one of the Navy's top objectives for FY15, namely the proliferation of unmanned systems," said Buettner. "CRUSER uses the WIW as the kick-off event for a two-year thread of activities focused on concept generation, exploration and experimentation.

"Doing this as part of an educational program is a very efficient use of the taxpayers' resources and a really great way for us to help the Naval Postgraduate School execute its rather unique mission," stressed Buettner.

Another key aspect of the workshop, notes Buettner, is its support of the Secretary of the Navy's (SECNAV) call to fully integrate unmanned systems into naval operations.

"The WIW is also an important vehicle for addressing the SECNAV's goal of integrating unmanned systems into the Department of the Navy's culture. By bringing together early and late career professionals, in uniform and out, from government, industry and academia to address an important naval challenge – with robotic and unmanned systems thinking integrated into it from the beginning – we infuse such thinking into the naval culture," said Buettner

NPS Professor of Practice and Warfare Innovation Director Jeff Kline is a long-time supporter of the workshops.

"This is our fourth iteration of the Warfare Innovation Workshop," said Kline. "We take [the good ideas generated here] and spread them across campus; they become thesis work, capstone projects and research threads for both CRUSER and our Littoral Operations Center.

"Our purpose is to coordinate and execute a series of cross-campus educational and research activities synchronized by the Chair of Systems Engineering Analysis and the Chair of Warfare Innovation with a central theme of exploring future methods for warfighting in the contested littorals," said Kline.

Team ZUMWALT generating concepts of operations during the September 2014 Warfare Innovation Workshop, "Warfighting in the Contested Littorals.

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Director's Corner

Steve Iatrou, CRUSER Director of Strategic Communication

'tis the season for giving thanks, being a member of CRUSER certainly gives us much for which we can be grateful. This issue of CRUSER news captures but a few of these things: in the Warfare Innovation Workshop we had the opportunity to explore new areas of operations unconstrained by existing technologies or doctrine (or dogma); JIFX provides a venue to test new ideas in the field; and our three articles demonstrate the breadth of our community of interest from midshipmen entering the arena through active duty officers blending operational experience with technical knowledge to experienced engineers pushing the boundaries of the possible. Such a span of exploration among a group or thinkers and doers that enjoy competition as much as camaraderie is a rare find – Thank you CRUSER community for a great year.

Cont from page 1 As suggested by Kline, NPS' Littoral Operations Center has been a major beneficiary of WIW work. Workshop participants have helped to define and solve strategic and technological issues common to Sailors operating in the littorals – the shallow coastal areas where most of the earth's population resides.

"We are challenging our students and our guests from industry to address these challenges head on to see if they can come up with some unique concepts," said Buettner.

NPS Faculty Director for Innovation Initiatives Dr. Neal Thornberry, with the university's Center for Executive Education, has been working with Buettner and Kline to help workshop participants tap into their innovative and creative potential.

"I ask people to think of innovation as using the creative thought process to help the Navy outsmart, outmaneuver, and outperform our adversaries," noted Thornberry.

"Innovation should result in a tangible outcome that can be measured in terms of value creation," continued Thornberry. "For example, getting a wounded soldier to a hospital 10 minutes sooner than the norm due to a creative change in the transport process can create measurable value.

"Innovation is a tool, not a destination," he added. "We are asking people to be mission ready and to do more with less. Innovation can be a powerful enabler in helping the Navy do things smarter, better, cheaper and faster without sacrificing mission readiness."

Buettner offered several examples of WIW innovation that have had an impact on naval operations in both blue water and littoral zone operations. He spoke of student contributions to ideas such as the deployment of small Marine groups to islands in the South China Sea, and swarming tactics for unmanned aerial vehicles. He also notes student attempts to address the need of naval forces to operate in the absence of a functioning network.

"What happens when we take the network away? Network optional warfare is one of the concepts that we are exploring," said Buettner.

"It was fun to come up with creative out-of-this-world ideas and actually figure out a way to make them useful that is not completely insane," said SSG member and NPS student Lt. Leslie Ward.

Emily Gyde with Battelle, a non-profit organization focused on research and development, traveled to NPS to participate in the workshop. She was part of team Zumwalt.

"We are looking at cutting-edge technologies and exploring the best manner in which to deploy them," said Gyde.

"The purpose of the workshop is to push the innovation envelope," added NPS student and fellow Zumwalt team member, Lt. Cmdr. Reginald Johnson.

"The scenarios are based on current events, extrapolating upon what could happen in 20 years," said Lt. Mathew Hipple, a member of the Commander's Action Group for Commander, Naval Surface Forces Atlantic. "We are looking at something that we are familiar with, and expanding it to a worse-case scenario to pit our innovation processes against it."

Full article available at: http://nps.edu/About/News/Workshop-Spurs-Maritime-Warfare-Innovation.html

CRUSER Librarian Corner

Autonomous Weapon Systems at the United Nations
http://www.cnas.org/sites/default/files/publications-pdf/CNAS_AutonomousWeaponsUN_HorowitzScharreSayler.pdf

Lethal Autonomous Weapons Systems: Future Challenges
http://www.css.ethz.ch/publications/pdfs/CSSAnalyse164-EN.pdf

Short articles (up to 500 words) for CRUSER News are always welcome submit to: cruser@nps.edu

CRUSER Monthly Meetings

Mon 1 Dec, 1200-1250 (PST)
Mon 12 Jan, 1200-1250 (PST)
details at: http://CRUSER.nps.edu

JIFX
9-13 Feb 2015 at Alameda, CA

Adaptive Electronic Camouflage at SPAWAR Systems Center Pacific

by Narek Pezeshkian, Design Engineer, narek@spawar.navy.mil, Jennifer M. Pels, Strategic Analyst, jennifer.pels.ctr@navy.mil

Camouflaged robots and leave-behind surveillance sensors are desirable in intelligence, surveillance, and reconnaissance operations to minimize the chances of detection by the enemy. Today's camouflaging techniques involve nets and painted patterns that are fixed in color and geometry, limiting their use to specific environments; a fact illustrated by numerous changes in military uniforms designed to fit the latest operating environment.

A more effective technique is to automatically adapt surface patterns and colors to match the environment, as is done by several species in nature. This can lead to the development of new and more effective robotic behaviors in surveillance missions and stealth operations. This biologically-inspired adaptive camouflage can be achieved by a) sampling the environment with a camera, b) synthesizing a camouflage image, and c) and reproducing it on color displays. These color displays are part of the outer enclosure surface of the robot or device with shrouded or embedded color electronic paper, which is thin, reflective, conformal, and requires minimal power for operation. Future development of exotic textiles will allow the robot or device to simply be draped with fabric-like electrophoretic displays. Knowing what camouflage pattern to display is equally as important as the display technology itself. This has been the focus of the research conducted at SPAWAR Systems Center Pacific, which has been working to develop the Adaptive Electronics Camouflage (AEC) system.

Initial development efforts concentrated on using a single image to synthesize a color camouflage pattern, which was achieved via modifications made to a gray-level texture-synthesis method that makes use of gray-level co-occurrence matrices (GLCMs). GLCMs were used because they have been shown to have high correlation with the human perception of texture similarity. Since the goal of the AEC system is to make observers unaware of the presence of the camouflaged object, the camouflage image must be visually similar to its surrounding environment as perceived by human observers.

The renderings to the right show a virtual robot outfitted with the AEC system, both without camouflage (top images) and with it (bottom images). The camouflage pattern used in the simulation is produced using the color-camouflage-synthesis method developed at SPAWAR. Develepors at SSC Pacific are currently seeking collaboration with academic researchers. To learn more about the AEC system, please contact Narek Pezeshkian at narek@spawar.navy.mil.

Joint Interagency Field Experimentation (JIFX) 15-2 Now Accepting Experiment Proposals

The Naval Postgraduate School's Joint Interagency Field Experimentation (JIFX) program is now accepting Experiment Proposals for its 15-2 event. The 15-2 event will be held 9-13 February 2015 at the Department of Transportation's Maritime Administration Facility on Alameda Island, CA. This event will be hosted in a maritime port facility setting and aboard a large military cargo ship. Please refer all questions to jifx@nps.edu

Interested parties are encouraged to visit the JIFX website to review the event's Request for Information (RFI) document and submit an Experiment Proposal. The RFI document outlines the parameters for participation and lists the areas of interest for the event. http://my.nps.edu/web/fx/propose

Applications will be accepted that relate to any of the RFI areas of interest, however the following areas are of greatest interest:

- Software solutions that leverage social media for situational awareness and operational decision making
- Maritime domain awareness including sensing and command and control solutions
- Technologies Relating to Pandemic Response/Post-Disaster Public Health (See Special Interest RFI)

STUDENT CORNER

Observing Swarm SUAS Technology Development at JIFX 14-4, Camp Roberts

by Captain Caroline Scudder, USMC, NPS Student

This August, I had the opportunity to attend Joint Interagency Field Experimentation (JIFX) 14-4 to observe ongoing experiments involving small unmanned aircraft system (SUAS) swarming technology. While I was not a primary stakeholder, Dr. Timothy Chung and his research team were gracious enough to allow me to observe, ask questions, and assist (annoy) the technicians and researchers involved in the experiments. My interest lies primarily in the use of swarms of SUAS as electronic warfare countermeasures against adversary integrated air defense systems (IADS); understanding the basics of airborne swarm mechanisms is essential.
Swarms offer very unique capabilities with make them suited to combating radar-controlled and -guided air defense systems. Air defense radars can be broadly subcategorized as either acquisition or track radars. Acquisition radars sweep the sky for targets, and are generally susceptible to chaff and decoys. Upon identifying an appropriate target, the acquisition radar will typically pass the information to the track radar (methods of doing this vary and include human-driven target selection). The target track radar (which can be co-located with the acquisition radar or remote) will then track and prosecute the target, often providing guidance for surface-launched anti-air missiles. In some systems, particularly modern-day models, self-guided homing or heat-seeking missiles are included and can be launched once the radar system detects the aircraft to be in the appropriate engagement envelope. Defeating such an integrated system is challenging, but usually defeating just one of the components will prevent or sufficiently delay missile launch. Unfortunately, integrated systems are very well developed to minimize weaknesses and make defeating them difficult, and threat systems vary sufficiently to make preparing for every known type and model impracticable – at least on a single aircraft. Outfitting one aircraft with every type of countermeasure available is impracticable due to weight and power available. Configuring a swarm, however, where each of several aircraft can be uniquely configured, offers flexibility not available in current aviation EW countermeasures. Individual aircraft as part of a swarm can be configured for a single exploit each, while the whole system is prepared to attack every node of even the most sophisticated IADS.

I am somewhat familiar with the challenges of airspace maneuver to, from, and in the battlefield, and ground-controlled UAS are not new, but the automation required to effectively operate a swarm presents a new angle. Operators will need to determine if full automation reasonable in a dynamic battle environment. A swarm must be capable of taking commands, navigating, and communicating its position and intentions to its controller and other aircraft in the area; it may make sense to have a dedicated communications individual within a swarm carrying out these tasks (while the others communicate just with the that one and not externally).

Observing the iterative approach to designing and operating a swarm was illuminating, and presented these aspects I had not before considered in detail. This was a great chance for me to look into the design and development process as I begin investigating the design requirements for implementing a swarm as aviation EW countermeasures. The time I spent was invaluable and I owe thanks to Dr. Chung's team and their professionalism for the opportunity.

USNA Wins World Robotic Sailing Championship!

by Paul Miller, USNA Faculty, phmiller@usna.edu

This September a team from the Naval Academy became the first non-European team to win the World Robotic Sailing Championship. Using their two-meter SailBot named "SeaQuester", the team competed in Galway, Ireland against eleven teams from the UK, France, Ireland, Russia and Portugal. The events included precision navigation, station keeping, collision avoidance, fleet racing and endurance. SeaQuester was designed and built by the eleven midshipmen (naval architects and systems engineers) to be a low-cost yet high-performance boat. She was built mainly of 1.5 mm plywood and tipped the scales at just 54 pounds (of which 27 were in the lead ballast bulb). She had only one breakdown during the week, which occurred when a trimming line became entangled in the winch. Her control system was built around an Aruduino MegaPro with a wind direction sensor, compass and GPS. The wind conditions varied from calm to 25 knots and her top recorded speed was 6.4 knots. To cap off the week the team's paper at the associated International Robotic Sailing Conference was awarded "Best Paper"! Next year the championship will be held in Finland and the mids are busy designing an experimental wing sail.