



CRUSER • NEWS

Consortium for Robotics and Unmanned Systems Education and Research

FROM TECHNICAL TO ETHICAL...FROM CONCEPT GENERATION TO EXPERIMENTATION

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Surveillance, Tracking, and Monitoring by Autonomous Underwater Gliders

by Dr Kevin Smith, NPS Faculty, kbsmith@nps.edu

Autonomous vehicles are proving to play an important role in the development of future systems and Naval operations. At the Naval Postgraduate School, both fundamental and applied research is ongoing across campus in a variety of areas related to unmanned systems. In addition to other types of autonomous vehicles, NPS is expanding its expertise in the use of underwater autonomous vehicles (AUVs), platforms which present unique challenges due to the harsh nature of the undersea environment and the difficulties associated with communications for command and control.

The Office of Naval Research, Code 321MS, has provided NPS with several underwater gliders developed by Exocetus Development LLC (formerly part of Alaska Native Technologies). When equipped with environmental sensors to measure properties of the ocean, and acoustic sensors to detect sources of noise, such AUVs provide a platform for various applications, including marine mammal mitigation and acoustic tracking, real-time distributed environmental monitoring, and persistent surveillance.

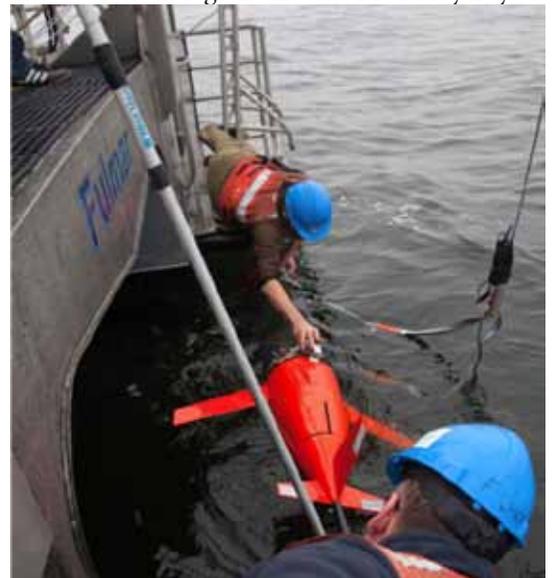
Under the management of Dr. Kevin B. Smith, professor of physics and principle researcher, and in collaboration with NPS's Center for Autonomous Vehicle Research (CAVR), these gliders are being equipped with various underwater sensors and are being deployed in shallow water coastal zones, such as Monterey Bay, CA. "These autonomous platforms provide NPS with a great opportunity to study the use of persistent sensing technologies in the undersea environment, allowing us to pursue both basic and applied research of interest to the Navy," said Dr. Smith.

In August, 2012, Dr. Smith and Tad Masek (CAVR) led a small team of researchers from NPS and GA Tech in the successful deployment of two such AUVs equipped with advanced acoustic sensors in Monterey Bay. Acoustic data collected by the gliders is being analyzed by NPS and GA Tech in order to determine the utility of such systems for target tracking, and

provide a system level context for consideration and evaluation of technology components under development for future DNS nodes or ad hoc ranges.

In March, 2013, Dr. Smith's team from NPS, along with numerous students from across campus, fielded additional systems undergoing engineering tests. In all, NPS expects to have 6 such AUVs on-site by this summer. Future efforts at NPS will focus on the integration of new hardware into the gliders, including underwater acoustic modems, new data acquisition systems and timing clocks, and updated versions of the acoustic sensors.

A goal of Dr. Smith and his team over the next year is to develop consistency and improve reliability in glider operations and communications, thereby allowing for extended tasking of the gliders for weeks at a time. In addition, data processing strings are being completed and inter-platform communication protocols are being examined to allow studies of collaborative behavior and area-wide reporting. Such persistence over extended ranges will produce a wealth of data on environmental and acoustic fluctuations in regions like the Monterey Bay.



Recovering glider after testing in Mar 2013

DIRECTOR'S CORNER

Innovation without execution is just another good idea. Within the next few months we will have three distinct CRUSER Innovation Threads in various phases of execution. Two concepts from **Innovation Thread One** selected for experimentation (digital semaphore and aerial swarm vs swarm) were successfully fielded in various live experiments at Camp Roberts in February. Our March Warfare Innovation Workshop was very successful and resulted in adding over forty new concepts to our **Innovation Thread Two**. Planning is currently underway to design our September Warfare Innovation Workshop that will kick-off our **Innovation Thread Three**.

CAPT Carol O'Neal, USN (ret)

CRUSER Director of Innovation and Concept Generation



C2 Agility and Combat Boots: One Size Does Not Fit All

by Dr. Mark E. Nissen, NPS Faculty, MNissen[at]nps.edu or faculty.nps.edu/menissen/Welcome.htm

The average shoe size of US men is 10.5¹. If one were to standardize military combat boots, then just issue size 10.5 for everyone. All boots would be the same, and anyone could step literally into another's shoes. This logic is simple and administratively easy: the kind of logic that large bureaucratic organizations thrive upon.

Roughly 15% of military personnel² are women, however, the average shoe size of whom is 9. The standard size should be 10.275 then, or one could round down to size 10 and pin a gold star on the wall for taking women into account. Again, this reflects the kind of administratively easy logic that large bureaucratic organizations thrive upon.

Still, even within men or women, there is considerable variation: one size does not fit all. Why not issue boots to each military member based upon the size that fits? Well, it's administratively more difficult; one must measure and record shoe sizes for personnel. It's less economical too; procuring, storing and issuing boots of multiple sizes cost more than a single, standard size. Nonetheless, the US Military makes this exception to standardization; having boots that fit is worth the effort.

Yet with command and control (C2), one finds the ubiquitous, hierarchical, functional, bureaucratic approach to organizing military forces. From the Stone Age to the Information Age, from Plato to NATO³, one size has been force fit onto C2. Someone's in charge at every level; work is divided via J-codes; people follow standardized procedures; it's administratively easy and logical.

But what about C2 in novel circumstances, like when no one's in charge? Roughly 3500 NGOs helped after the Indian Ocean Tsunami of 2004⁴; the US Military participated actively but was not in charge. How about anti-piracy operations with US, Russian and Chinese ships working toward partially shared goals? How about when autonomous unmanned systems proliferate to the point where they perform more missions than people do?

The social science of Organization Design concentrates on arranging the various parts of organizations (e.g., hierarchical levels, spans of control, divisions of labor, distributions of information, patterns of interaction, methods of planning and control) to establish good fit with a particular organization's mission-environmental circumstances, and our research on dynamic fit⁵ emphasizes C2 agility: altering, re-establishing and maintaining good fit across diverse circumstances that change through time. One size does not fit all in C2: not now, and certainly not throughout time.

¹ American Academy of Orthopaedic Surgeons, *Statistic Brain*; URL: <http://www.statisticbrain.com/shoe-size-averages/>; retrieved 02/27/2013.

² *Women In Military Service For America Memorial Foundation*, Dept. 560, Washington, DC 20042-0560 (statistics as of 30 September 2011); URL: <http://www.womensmemorial.org/PDFs/StatsonWIM.pdf>; retrieved 02/27/2013.

³ Van Creveld, M., *Command in War* Cambridge, MA: Harvard University Press (1985).

⁴ *the Command & Control Research Program*; URL: <http://www.dodccrp.org>; retrieved 02/27/2013. Also the Edge Center; URL: <http://www.nps.edu/Academics/Centers/CEP/>; retrieved 02/27/2013

⁵ Nissen, M.E. and Burton, R.M., "Designing Organizations for Dynamic Fit: System Stability, Maneuverability and Opportunity Loss," *IEEE Transactions on Systems, Man and Cybernetics - Part A* 41:3 (May 2011), pp. 418-433.

CRUSER Monthly Meetings

CRUSER monthly meetings are an opportunity to hear short presentations on current research and to participate in the open discussion session with other CRUSER members. The meetings are available via VTC or Elluminate to watch the presentation and audio is available via dial-in.

Contact Lisa to schedule a presentation at cruser@nps.edu

Upcoming CRUSER Monthly Meetings

Wed 15 May 2013, 1200-1250 (PDT)
Root 242, VTC, or dial-in 831-656-6681

Wed 19 June 2013, 1200-1250 (PDT)
Root 272, VTC, or dial-in 831-656-6685

Office of Naval Research Reserve Component (ONR-RC) Unit 113 and CRUSER at NPS

by CAPT David Harach, ONR/NRL S&T 113 CO, david.harach1@navy.mil

The mission of ONR-RC is to leverage unique Navy Reserve capabilities to help the Office of Naval Research (ONR) and the Naval Research Laboratory (NRL) provide science and technology solutions to the warfighter. Many members of ONR-RC combine an exceptional degree of operational and technical expertise in a single individual. All members of ONR-RC are assigned to one of 15 reserve units. The primary mission of these units is to supply a cadre of uniquely qualified individuals for project work that leverages the unique capabilities of the Program. Individual units also have additional missions. The location of these units is based on a balance between two considerations, mission requirements and demographics of personnel with required skills.

ONR/NRL S&T 113 Unit leads ONR-RC's Unmanned Vehicles (UV) Focus Area, responsible for all ONR-RC direct support to ONR on UV research and development, project support, and fleet introduction of critical UV emerging technologies. ONR/NRL S&T 113 is operationally assigned to support ONR-funded projects at NPS and is administratively assigned to Naval Operational Support Center (NOSC) San Jose. Personnel in ONR Reserve units have the flexibility to support any ONR-RC project that has a good match to the Reservists experience and qualifications, and qualified robotics and autonomy experts in other ONR-RC units are available to support CRUSER work at NPS.

ONR/NRL 113 has supported many NPS projects in recent years, and CRUSER is a growing project support area. Recently three unit members worked with NPS Systems Engineering Prof. Timothy Chung and his colleagues during Advanced Robotic Systems Engineering Laboratory (ARSENL) Swarm UAV field experimentation and flight test at NPS and Camp Roberts, assisting in flight preparation and operations resulting in new NPS records for UAVs airborne at one time and significantly reducing the interval between aircraft launches. The Navy Reserve personnel also contributed to refining flight preparation, launch, and safety checklists and began the design of pilot and aircraft logs. This collaborative effort is scheduled to continue as Prof. Chung expands his flight test program.

For further information on ONR-RC support to CRUSER or other ONR research programs at NPS, please contact CAPT David Harach, ONR/NRL S&T 113 CO, at 619-545-9744 or david.harach1@navy.mil. Dr. Harach is a Senior Materials Engineer at the NAVAIR Materials Engineering Laboratory at Fleet Readiness Center Southwest, NAS North Island, San Diego and will be at NPS various times in April and May and is available for meetings or discussion on potential ONR-RC support.

Short articles of 300-500 words for CRUSER News are always welcome - cruser@nps.edu

- Unmanned Systems/Robotics research
- Organizational Descriptions
- New Program/Systems/Projects
- Other aspect of Unmanned Systems/Robotics

Research & Experimentation for Local & International Emergency First Responders

by Tristan Allan, NPS Research Associate, relief@nps.edu

This is a call for whitepapers for the upcoming Research & Experimentation for Local & International Emergency First Responders (RELIEF) event. RELIEF 13-3 will be held 6-9 May 2013 at the Naval Postgraduate School's McMillan Airfield facility on the Camp Roberts, CA National Guard base.

Occurring quarterly, RELIEF is a multi-institutional, semi-structured event focused on the testing and development of humanitarian assistance & disaster response technologies and processes. RELIEF continues to seek technologies that empower and enable the affected population to rapidly assess and self-organize in the pre-response environment. Additionally, RELIEF explores emerging technology solutions for humanitarian workers, first responders, government, military, and others involved in the humanitarian assistance and disaster relief operations both domestic and worldwide.

To review the Request for Information (RFI) and apply to participate in the 13-3 event, please visit our website: www.npsrelief.org

To be considered for the 13-3 event, whitepapers must be submitted to the Naval Postgraduate School no later than April 15, 2013.

STUDENT CORNER

STUDENT: CDR GARY LAZZARO, USN

TITLE: Manpower Requirements Estimation For Unmanned Carrier Launched Airborne Surveillance And Strike (UCLASS) Squadrons

CURRICULUM: Manpower Systems Analysis

ABSTRACT: Unmanned Carrier Launched Airborne Surveillance and Strike (UCLASS) is an unmanned aerial system scheduled to operate from aircraft carriers in 2020. Scant research has been conducted on manpower requirements in support of UCLASS aboard aircraft carriers. The manpower requirements of a UCLASS unit are defined in terms of aircraft operators, maintainers and squadron support. A review of existing squadron manpower documents and unmanned systems doctrine yields quantitative and qualitative UCLASS manpower requirements estimates.

This research derives manpower requirements estimates for two potential configurations of an independent UCLASS squadron. The squadron can be organized as either a completely deployable unit or as a unit with a shore component and deployable detachments. Both UCLASS squadron configurations result in a smaller footprint and lower manpower requirements than existing F/A-18F squadrons. The greatest manpower savings occur in a UCLASS squadron configured as a shore component with five deploying detachments. The results of the research recommend a UCLASS squadron configured with a shore component and five detachments, which has an estimated total manpower requirement for 103 officers and 540 enlisted. The annual manpower cost of a UCLASS squadron configured with five detachments is \$61.8 million less than the cost of five F/A-18F squadrons.

Does your DoD Organization have a potential thesis topic for NPS Students? Contact us at CRUSER@nps.edu

Homeland Security Digital Library (HSDL)

by Jeff Rothal, NPS Librarian, jrothal@nps.edu



This month, Librarian's Corner would like to bring to your attention the Homeland Security Digital Library (HSDL) (<http://www.hsdl.org/>), the nation's premier collection of documents related to homeland security policy, strategy and organizational management. Sponsored by the Department of Homeland Security and NPS's Center for Homeland Defense and Security (<http://www.chds.us/>), the HSDL contains over 155,000 documents and receives over 20,000 unique website visitors each month.

The HSDL collects content from federal, state, local, tribal and international government agencies, as well as think tanks, academic researchers and other organizations. HSDL content includes draft and official publications, research reports, scholarly theses, congressional testimony, transcripts of lectures and speeches and a variety of other resources. The HSDL is staffed by a team of librarians and subject-area specialists.

Last fall, the HSDL content team created a Featured Topic list on Unmanned Systems (<https://www.hsdl.org/?collection/cluster&id=2556>). Featured Topic lists are hand-selected compilations of HSDL content, intended for users to explore key topics in homeland security and organized to help researchers get smart fast. The lists are updated as frequently as new content becomes available.

Recent additions to the UxS list include the Department of Defense Report to Congress on Addressing Challenges for Unmanned Aircraft Systems (<https://www.hsdl.org/?abstract&did=733202>); Extremely Stealthy and Incredibly Close: Drones, Control, and Legal Responsibility (<https://www.hsdl.org/?abstract&did=732897>), a working paper from the Danish Institute for International Studies; Legal Issues Relating to Unmanned Maritime Systems, a monograph from the U.S. Naval War College (<https://www.hsdl.org/?abstract&did=731705>); and Integration of Drones into Domestic Airspace: Selected Legal Issues (<https://www.hsdl.org/?abstract&did=730503>) by the Congressional Research Service, a non-partisan research agency within the Library of Congress.

The HSDL weekly email alerts will be of special interest to the CRUSER community. First, register for an individual account (<http://www.hsdl.org/?access>). Second, try some simple searches in the HSDL (see results for the keyword unmanned or the phrase "remotely operated"), Last, if you like what you see, click at the top of the search results page on the link to "Set email alert for these terms." You will receive an email every Friday with any new HSDL content that meets your search criteria.

In addition to holding the complete archives of CRUSER News, the HSDL welcomes relevant content from researchers in the UxS community. Put the broad scope and reach of the HSDL to work for you, and submit your papers for consideration: <http://www.hsdl.org/?contribute>