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CRUSER · NEWS

Consortium for Robotics and Unmanned Systems Education and Research

FROM TECHNICAL TO ETHICAL

FROM CONCEPT GENERATION TO EXPERIMENTATION

NAVAL POSTGRADUATE SCHOOL

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CRUSER STEM Initiatives

by Lisa Trawick

An objective of both SECNAV and the Office of Naval Research (ONR) is to attract young people to become the next generation of scientists and engineers. Science, Technology, Engineering, and Math (STEM) initiatives are one method of inspiring students to pursue careers in technical fields, providing opportunities to experience short programs and internships that focus on STEM related fields.

ONR's Stem2Stern (http://www.stem2stern.org/) portal consolidates opportunities for students and highlights current STEM participant's successes.

Members of the NPS CRUSER Community of Interest (CoI) have participated in a number of recent STEM initiatives:

"Girl's Day In" allowed over 50 middle & high school girls from local schools to spend a day at NPS to learn more about science and technical careers. They had the opportunity to build Lego Mindstorm Robots, program, and operate them. CRUSER's Director of Education and Research, Dr Timothy H Chung, led this activity.

Dr Timothy Chung demonstrating how to build a robot during Girl's Day In.

"Robots in the Roses", a research fair to facilitate interaction between Navy researchers and NPS students provided another opportunity for young students to learn more about various unmanned systems on display.

Students from the Monterey Academy of Oceanographic Science (MAOS), a college prep program at Monterey High School visited NPS where they had an opportunity to tours labs, watch demonstrations and supplement class work with practical experience.

NPS is hosting and co-sponsoring the upcoming 43rd Annual Monterey County Mathletics, providing another opportunity for young students through STEM.

To read more about ONR and STEM please refer to ONR's website. http://www.onr.navy.mil/en/Media-Center/Press-Releases/2009/ONR-STEM2Stern-Diverse-Researchers.aspx

CRUSER News Contributions

Short articles of about 200-300 words are needed for future CRUSER News'.

Please contact Lisa Trawick at cruser@nps.edu for additional information.

DIRECTOR'S CORNER

A core element of CRUSER, in addition to promoting synergistic research, is its emphasis and commitment to supporting education in robotics. Not only do we seek to educate our rising military leaders and thinkers, but we also wish to foster future generations via STEM outreach activities. From commands to classrooms, CRUSER carries education to the fore.

Dr Timothy H Chung
CRUSER Director Education & Research

(photograph by Javier Chagoya)

A Launch Recovery Design for DDG-based, high-capability UAVs

Jeremy Wiley, Founder, Tethered Air

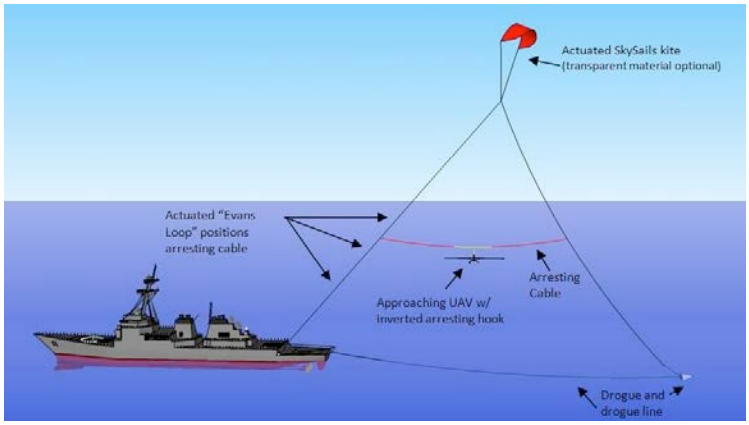
Large UAV systems offer important capabilities to military commanders as high-speed, long-range platforms whose high-power sensors can respond quickly to today's time-sensitive contingencies. But integrating these high-capability UAVs for operation aboard existing naval vessels has presented a number of challenges. With carrier landing already described as the most difficult task in the military and UAV piloting systems described as "looking through a soda straw", can large UAVs safely land on carriers?

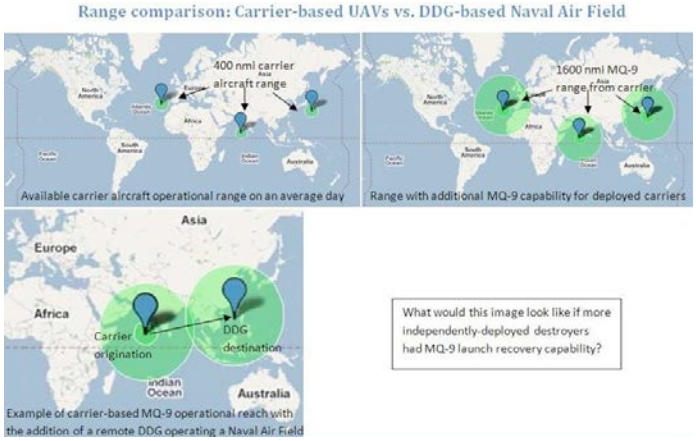
Smaller ScanEagle systems currently operate aboard several DDGs and LSDs using a launch catapult and an innovative wire capture system enabled by differential GPS feedback. This system has noticeably decentralized the Navy's ISR capability, allowing a destroyer to respond, for instance, to information on piracy activity without distracting a carrier strike group. But ScanEagle operations are mostly limited to the 62.5 nmi range of the ship's HF control link because SATCOM antennas weigh nearly 100 lbs. As the design's airframe loading reaches 12Gs during recovery, scaling the design is impractical as it calls for a very robust, inefficient airframe.

In ScanEagle's early development, an anchored kite was used as a flexible recovery system, offering lower impact force, scalability, and quick deployment and recovery. Tethered Air envisions a modern kite-based launch and recovery device with control that was not possible at the time of ScanEagle's development. This design allows large UAVs to operate from small-deck surface combatants, decentralizing naval ISR capabilities as the ScanEagle has, but adding strike, higher speed, longer range, and many high-power sensor competencies to its list of capabilities.

In recent years, twelve different groups have demonstrated well-controlled, autonomous kite systems with long-endurance flight. The commercially available SkySails system is especially notable for its implementation aboard about a dozen cargo vessels as a fuel-saving ship towing system. The Tethered Air design is essentially an alternative deployment of that design, with additional actuated cables and a towed drogue that spreads the device over a large area. During capture, an approaching UAV flies with an inverted (topside) arresting hook deployed, approaching perpendicular to the vessel at a constant altitude, velocity and heading. Shipboard line winches position the arresting cable (red with a yellow target area) in line with the aircraft's inverted arresting hook.

Tethered Air is searching for NPS students interested in operational research on this system's impact, and has an informational white paper available to students upon request through CRUSER.





Ethical and Legal Aspects of Unmanned Systems

Gerhard Dabringer (ed.)

Since 1994, when the U.S. Department of Defence commissioned the production of the Predator model the number of Unmanned Aerial Systems (UAS) has risen steadily. And the spread of robotic systems is not merely a military phenomenon but constitutes a trend of the society as a whole.

The history of the use of UAS by the military dates back as far as the 19th century, to the use of unmanned balloon bombs during the siege of Venice (1849). Similar concepts had also been developed for the American Civil War, though they were not deployed. The development has been driven on by Nikola Tesla, Archibald Low and many others to the point that since World War II, UAS have been deployed by many nations in military conflicts.

Why is it, that a technology that has been used by the armed forces for decades, should as of now revolutionize warfare itself? One of the main aspects of change will be constituted by the impact of autonomous potential of UXS on warfare. something which, in its implementation, is yet difficult to predict. Although, with the political agenda as it is, it can be considered as a certainty, that these systems will have a profound impact on the future of warfare and the role of the warfighter himself.

The Institute for Religion and Peace of the Austrian Catholic Military Chaplaincy has put together a collection of interviews to further the discussion on ethical and legal aspects of the military use of Unmanned Systems. The publication is a free download (http://www.irf.ac.at/index.php?option=com_docman&task=doc_download&gid=141&Itemid=18).

Contributors

John Canning, Gerhard Dabringer: Ethical Challenges of Unmanned Systems

Colin Allen: Morality and Artificial Intelligence

George Bekey: Robots and Ethics

Noel Sharkey: Moral and Legal Aspects of Military Robots

Armin Krishnan: Ethical and Legal Challenges

Peter W. Singer: The Future of War

Robert Sparrow: The Ethical Challenges of Military Robots

Peter Asaro: Military Robots and Just War Theory

Jürgen Altmann: Uninhabited Systems and Arms Control

Gianmarco Veruggio, Fiorella Operto: Ethical and societal guidelines for Robotics

Ronald C. Arkin: Governing Lethal Behaviour

John P. Sullins: Aspects of Telerobotic Systems

Roger F. Gay: A Developer's Perspective

CRUSER's Robots in the Roses

by CAPT (ret) Carol O'Neal, USN

Faculty and students from across campus came to the university's rose garden for a special event to mark the initial stand-up of the SECNAV-sponsored Consortium for Robotics and Unmanned Systems Education and Research, or CRUSER. The garden provided the perfect venue for "Robots in the Roses" a forum where students, faculty and their families can observe and inspect actual robots representing cross-campus research, and engage the faculty in active discussions. Many attendees joined in a lively competition, creating paper airplanes to fly off the balcony, attempting to land them onto a model aircraft carrier weatherdeck. More importantly, the event also provided an opportunity to learn more about potential thesis topics, research opportunities and more.

President Oliver remarked "The Under Secretary of the Navy, the Honorable Mr. Robert Work, signed a memorandum authorizing NPS to establish CRUSER to shape generations of naval officers through education, research, concept generation and experimentation in maritime application of robotics, automation and unmanned systems." He continued, "Mr. Work recognized the great potential of NPS faculty and students to provide a foundation for innovative thought and application of new technologies in the robotics age. Today's Robots in the Roses event, although important to display our diverse and exciting research in areas of unmanned systems, is just one of many ways we intend to advance our nation¹s knowledge in the opportunities afforded by these capabilities."

In addition to capturing the workshops, wargames, projects, research and experimentation NPS has done since the beginning of this fiscal year, CRUSER will continue to sponsor, inspire and participate in concept generation events, at-sea testing, technical symposia, classroom projects, education, research and seminars

CRUSER Calendar of Events

The Calendar of events is located on the CRUSER Wiki. All unmanned system events can be submitted for inclusion on the calendar.
Please submit events through our website: http://www.nps.edu/Research/cruser/cruser_EventSub_Form.html
Include the following information: Event Name, Date/Time, Location, Point of Contact, and a URL link for additional information.

STUDENT RESEARCH: IN-PROGRESS

LT MATTHEW PAWLENKO

DERIVATION OF RIVER BATHYMETRY USING IMAGERY FROM UNMANNED AERIAL VEHICLES

Depth derivation from imagery is nothing new. Utilizing satellite imagers, radiance values, and radiative transfer concepts, depths can be derived for near-shore, coastal environments, given the right conditions. Although not impossible, issues arise when trying to transfer these methods to a fluvial environment, such as imager resolution versus river width, and satellite orbit versus area of interest. A method for overcoming these issues is the use of Unmanned Aerial Vehicles (UAV) to collect this imagery. Most units requiring river depths for safe navigation either have these tools in their arsenal, or have ready access to them through tasking. Imagery can be collected specifically for determining depths, or as secondary tasking while transiting from one point to another. RGB values from these images can then be used to derive depths using very minimal in-situ information on the area of interest. This research involves using these RGB values and very few in-situ measurements to test two different methods for deriving river depths. The first involves a radiative transfer method adapted for digital numbers taken from images. The second method looks at the feasibility of using a simple look-up table that relates pixel intensity to an actual depth. Time allowing, other areas related to this topic will be investigated. One such area would determining what the maximum error tolerances are in depths that could still produce a useful tactical product. Along with this, finding what the effects of turbidity and suspended sediment are on the accuracy of the depth derivation. Another item would be to determine which imagery provides more accurate results: those created from full motion video or from high resolution stills. It is possible that with video, imperfections due to sun glint and noise could be removed by averaging. The final topic would look at what the feasibility of defining river edge and large obstructions utilizing the thermal imager available on most UAVs is.

Future Unmanned Naval Systems Wargame Competition

by CAPT (ret) Carol O'Neal, USN

Twenty one NPS students, representing various services and multiple cross-campus curriculums recently faced off in a three and a half day Wargame Competition. Divided into three teams their mission was to determine who could come up with the most innovative, tactically effective and cost efficient solution to the challenge of developing concepts of operation for our future unmanned naval systems. Sponsored by the NPS Chair for Undersea Warfare, RADM Jerry Ellis, UNS (ret), Battelle and CRUSER, this wargame was a new initiative designed to challenge and showcase the abilities of NPS students and faculty by exploring the current and expected capabilities of unmanned systems to conduct coordinated operations in a naval conflict set five years in the future. When the dust settled and the judges voted, TEAM SIGS, representing the School for International Graduate Studies, led by Army Major Devin Eselius, accepted the first place trophy from RADM Ellis. He is surrounded by his fellow wargame participants and NPS faculty.

(photograph by MC1 Rob Rubio)

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

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