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CRUSER · NEWS
Consortium for Robotics and Unmanned Systems Education and Research

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

Unmanned Systems Research and Information Dominance
by CAPT Tim Unrein, Information Dominance Center for Excellence, NPS, ltunrein@nps.edu

A constant, but worthy, challenge at NPS is to keep a solid connection between the cutting-edge research that faculty here perform and what is actually happening out in the Fleet, with new technologies and their operating methods in various stages of development.   On 24 April, NPS had its inaugural visitor as part of the SPAWAR Speaker Series, CAPT Miguel San Pedro from the Undersea Integration Program Office. His U.S. only presentation highlighted the Undersea Constellation, a concept that could radically change how communications are enabled throughout the Navy by leveraging a wide range of manned and unmanned systems and sensors.   CAPT San Pedro encouraged faculty and students to engage the Undersea Constellation as a thesis or capstone research project.

Also on the research front, OPNAV N2/N6 has put its top-priority research topics for the FY15 Naval Studies Program on the street.   Of 21 topics in the deck, three have focus on unmanned systems, with several others potentially relating to them.   Topics include Integration and Optimization of UUV/SUV Operations in Environmental Characterization, Sensor Capability Optimization, and Large Displacement Unmanned Underwater Vehicle (LDUUV) Acquisition Strategy.   The future of Information Dominance Warfare (IDW) is heavily invested in the effective employment of unmanned systems, which support all three core IDW capabilities of Assured Command and Control, Battlespace Awareness, and Integrated Fires. Focusing NPS talent in this area will be a key enabler for the Navy's combat effectiveness with unmanned and robotic technology, and the naval leaders (who are NPS students today) who will rely upon them.

White paper submissions for the upcoming Joint Interagency Field Experimentation (JIFX) 14-4 event are due on or before 1 July 2014. To learn more about JIFX, how you may participate, or to submit a white paper for consideration, please visit our website: www.nps.edu/fx

In addition to all areas of interest listed in the event's Request for Information (RFI), research and capabilities relating to the maritime domain are strongly encouraged to apply for participation.

JIFX 14-4 will occur 11-15 August 2014 at Camp Roberts, CA.
Experimentation relating to the maritime domain will occur during the week at Alameda, CA.

Please refer any questions to jifx@nps.edu

CRUSER Monthly Meetings are now recorded and available for viewing.
Link to May's recorded meeting: http://bit.ly/CRUSERMtg_14_5

Director's Corner
Steve Iatrou, Director Strategic Communication

The breadth of CRUSER's community of interest is on full display in this month's newsletter. We see the full spectrum of involvement from the fleet to the classroom. CAPT San Pedro brought us capabilities and future needs of our operational forces, eight Naval Academy Midshipmen conducted experiments off of Cape Cod, while across the pond in Portugal several eighth graders were learning about aerial, surface and underwater vehicles (and apparently a little bit about marine biology.) Add to this the NPS reserve component and the list of participants in the student systems engineering project and you get start to get the picture, CRUSER members are making a difference. What a great way to roll into summer and JIFX!

The Voyage of "ABoat Time"
By Prof Paul Miller, USNA Faculty, phmiller@usna.edu

A 1.2 meter, 20 kg, sail-powered ASV was launched off Truro Beach, Cape Cod, Massachusetts by midshipmen of the US Naval Academy at 1800 EDT on May 16th, 2014 with the goal of sailing to Ireland. Her launch was somewhat dramatic as she had to sail through three lines of two-meter surf and then was narrowly missed by a breaching humpback whale. She settled on a beam reach and over the next week saw winds from every quarter from 0-35 knots, seas to six meters and two days of calm winds and fog. She maintained a relatively consistent course to her first waypoint, averaging 1.75 knots until she hit the calm winds, and then she drifted in a circle for a day. Her fastest three-hour run had her clocked at her "hull speed" of 2.5 knots. On her sixth day she found some light and variable winds and resumed course. Unfortunately, later that day she was caught in a scallop dragger's net and was dragged a bit before being pulled on board. Her two solar panels were broken but the dragger crew reported she was still trying to steer and trim her sail and she was completely dry inside. The midshipmen would like to try again next year after the panels are replaced. The eight midshipmen were advised by Prof. Brad Bishop of the Weapons and Systems Engineering Department and Assoc. Prof. Paul Miller of the Naval Architecture and Ocean Engineering Department.

Tracking of "ABoat Time" from 16-23 May 2014

ONR Reserve Component
by LCDR Nick Wettels, nick.wettels@gmail.com

April 25 - 27th, NPS Monterey, CA: Office of Naval Research – Reserve Component (ONR-RC) completed a rapid concept design (RCD) exercise for three separate autonomy-related projects. The ONR-RC RCD process evaluates (normally over the span of a drill weekend) technologies' value to the Navy and Marine Corps and the most practical and effective ways to bring these systems into the Navy enterprise. RCDs typically produce documents providing direction to projects such as white papers and CONOPS. Past RCDs have supported various customers such as ONR and Navy Research Laboratory (NRL) program managers, ONR TechSolutions, SwampWorks, and the Chief of Naval Operations Strategic Studies Group.

The three projects of the April Monterey RCD included:

NASA-JPL's RoboSimian climbing over an obstacle simulating a rubble pile. This technology is being examined for autonomous maritime mobile manipulation tasks by ONR-RC.

- AquaSimian (NRL Code 5514): A CONOPS study of maritime human-scale robots designed for human-like access and manipulation.
- Autonomous Marine Geological Field Modeling (NRL Code 7430): Unmanned Underwater Vehicles (UUV) with remote sensing instrumentation measure underwater geophysical properties (e.g. bathymetry, roughness, and sub-seafloor morphology) in order to develop, assess, and improve models and databases for subsurface properties of interest.
- Enabling Technologies for Unmanned Ground Vehicles (ONR Code 30): Assessment of ongoing efforts both in the U.S. and overseas to develop and/or counter unmanned systems, particularly Autonomous Unmanned Ground Vehicles (AUGVs).

Participants included 20 personnel from ONR-RC, NPS and NASA-JPL with a wide range of academic and warfare expertise.

CRUSER Members in the News

PERSISTS: A coordinated multi-vehicle control experiment for ocean observation

by Javier Gilabert, UPCT, Spain, Tor Arne Johansen, NTNU, Norway, Kanna Rajan, FEUP, Portugal, Joao Sousa, FEUP, Portugal

In May 2014, off the southern coast of Portugal, an international multi-vehicle control experiment involving aerial, surface and underwater vehicles was attempted. PERSISTS' (Persistent Autonomous Aerial, Surface and Underwater Vehicles tracking Sun Fish) key objectives were threefold: to demonstrate the state of the art (and practice) in coordinated measurements using diverse assets looking at the same patch of the ocean at the same time. Two, to provide high resolution in-situ data for scientific observations to foster inter-disciplinary science and engineering. Three, to provide predictive (modeling) capability to understand the biological dynamics of Mola mola (bony Sunfish). And finally to generate interest in inter-disciplinary science in the next generation of researchers in STEM (Science, Technology, Engineering and Mathematics).

An X8 Flying Wing UAV being launched from land to look down at floating tags in the coastal ocean

The principal science objective was to work with biologists to tag and track Mola's and provide contextual environment data. While Mola's have been tracked by this science team over the last four years, obtaining high-resolution in-situ science data with the tags in use, has been challenging. A critical need was to understand why the Mola's follow a specific trajectory in the water-column (a 'Mola corridor') and what kinds of environmental conditions the Mola are, in turn, tracking. Our engineering objectives dove-tailed with the need to demonstrate the capability to bring together diverse autonomous assets with advanced methods in Artificial Intelligence (AI) based deliberative control for such observations, using a suite of sophisticated ground-based command and control tools being used at FEUP/UPorto.

The intent was to conduct a two week experiment off the coast of Olhao in the Algarve. This region was chosen because of the presence of a commercial Tuna pen, where the Mola's are often trapped providing biologists with the opportunity to tag and release these fish in open waters. New inexpensive tags, designed at FEUP, were built and derived from of two different technologies. Our experiment design called for a UAV (unmanned aerial vehicle) to be launched from a research vessel, once an indication of a Mola on the surface was received. The UAV would be sent to the vicinity of the tag location, visual identification was to follow over an IP-video feed, leading to the deployment of an AUV (autonomous underwater vehicle) with CTD (conductivity, temperature, density) sensors as well as the retargeting of a WaveGlider autonomous surface platform. Both the UAV and the AUV are controlled by the Teleo-Reactive EXecutive (T-REX) an AI-based controller onboard the AUV and on the ground for UAV control.

UPorto Xplorer AUV hand-launched from the support vessel for tracking Mola mola

Biologists releasing a tagged Mola for tracking

Weather conditions coupled with issues related to ship capabilities did not allow for launch and recovery operations as planned; however the key outcomes of the experiment were: 1) open water testing of the integrated tool chain distributed between onboard and off board robotic components 2) AUV and WaveGlider deployments from ship to survey the 'Mola corridor' to make coordinated measurements between an AUV and the WaveGlider; 3) detection of a thermal gradient in the water column near a shelf leading to frontal zone entrapping biota such as salp. Finally, the outreach effort with 8th graders in a school in the Porto region resulted in substantial interest in kids intrigued by the science and technology behind the experiment, which in turn lead to a Mola capture and dissection in class, a first for the school.

Detailed blogs, technology and outreach material can be found at http://sunfish.lsts.pt/

Send in your submissions for "CRUSER Members in the News" to cruser@nps.edu to feature your work in an upcoming issue

STUDENT CORNER

Student: Systems Engineering Capstone

Title: NPS/NAVAIR UAS IFC Process for ScanEagle

Link to Completed Project: contact Prof Dick Millar - rcmillar@nps.edu

Abstract:

In the past 12 years of sustained conflict, the Department of Defense (DoD) has procured thousands of unmanned aircraft systems for critical missions and flight safety is a major concern. The NPS capstone project is a three academic quarter long project that studies a real-world systems engineering problem confronting NAVAIR. Normally, the problem concerns an engineering system, such as an aircraft, a weapons system, or an information system. Our capstone project is unusual in that it was concerned with a process, the Interim Flight Clearance process as applied to small Unmanned Aerial Systems used in research by the Naval Postgraduate School (NPS). NPS uses very small UASs (less than 55 lbs.) in studying various applications of UAS technology. Because NPS is part of the Navy, the UASs are required to have Interim Flight Clearances (or IFCs) for test flights just like all other Navy-owned aircraft. The IFC process was designed to minimize risk when testing expensive, piloted aircraft and relies heavily on thorough, formally documented analysis. This sort of analysis is often not available or impractical for the small research UASs, which are often modified RC model aircraft. This has at times slowed the IFC process to months, when larger, more complex aircraft can get often IFCs within days. The delay in research is significant when other countries and civilian researchers in the USA are not restrained by the need to get certification for their small UAS projects. The project team studied the IFC process and the interaction between NPS and NAVAIR to determine methods that would result in faster IFCs while allowing NAVAIR to guarantee that risk in testing has been identified and minimized. These methods included improvements in documentation, better means for information exchange between NPS and NAVAIR, and tools for determining risk in operating small UASs. The study involved extensive background research of the IFC process and interviews with NPS researchers and NAVAIR personnel involved in the IFC process.

The team members were: LCDR Brent Olde, stationed at NAS Patuxent River; Sarah Reich, NAWCAD Orlando; Jason Wong, NAWCWD China Lake; and Stephen Williams, ISSC Jacksonville. The faculty advisor, Dr. Richard Millar, guided the project, which received funding from NPS's Consortium for Robotics and Unmanned Systems Education and Research (CRUSER). The project was initiated by Rich Adams in NAVAIR 4.0P and Gary Evans and James Zidzik (ret'd) in NAVAIR 4.1.

The project is continuing for another year with another student team from the NPS systems engineering program. This team will continue development of the risk management tool.

CRUSER Librarian Corner

Robotics on the Battlefield – Part I: Range, Persistence and Daring
http://www.cnas.org/range-persistence-daring

Franke, Ulrike Esther. "Drones, Drone Strikes, and US Policy: The Politics of Unmanned Aerial Vehicles." Parameters 44, no. 1 (Spring 2014): 121-130 [review essay]
http://strategicstudiesinstitute.army.mil/pubs/parameters/issues/Spring_2014/12A_Franke-ReviewEssays.pdf

Chasing Autonomy: How Much is Enough and How Much is Too Much?
http://dodccrp.org/events/19th_iccrts_2014/track_chair/papers/102.pdf

Structural Health Monitoring For Unmanned Aerial Systems
http://www.eecs.berkeley.edu/Pubs/TechRpts/2014/EECS-2014-70.pdf

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

- Unmanned Systems/Robotics research
- New Program/Systems/Projects
- Student Research/Competitions/Clubs
- Other aspect of Unmanned Systems/Robotics

CRUSER Monthly Meetings
Mon 7 Jul, 1200-1250 (PDT)
Mon 4 Aug, 1200-1250 (PDT)
ME Auditorium or Collaborate
contact us at cruser@nps.edu for the details

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