Issue 43 Sept 2014

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

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2014 RoboSub Competition at SPAWAR Systems Center Pacific

By Jennifer M. Pels, Strategic Analyst, 8.4.1, jennifer.pels.ctr@navy.mil

The 17th Annual International RoboSub Competition was held July 28 through August 3, 2014 at the Space and Naval Warfare Systems Center Pacific in San Diego, CA. Hosted by the Association of Unmanned Vehicle Systems International (AUVSI) and the Office of Naval Research (ONR), this event provided an opportunity for the next generation of engineers to develop autonomous underwater vehicles (AUVs) that can demonstrate their autonomy by completing a series of mission tasks.

A U.S. Navy Diver swims with the RoboSub entry from Cornell University in the TRANSDEC pool at the Space and Naval Warfare Systems Center Pacific.

Teams from 39 high schools and universities worldwide participated in the event. Each team was allotted a 15 minute performance period to complete a series of underwater obstacles and mission tasks. Mission tasks involved interacting with a control panel, maneuvering tasks, rerouting power, establishing a landing site, firing torpedoes through a cutout, and locating and picking up an object. Aside from demonstrating the performance of their RoboSub, teams were also required to provide an oral presentation, a journal paper and abstract, team resumes, and a team video. Judges scored each team using a combination of subjective and performance measures. Cornell University won the competition and took home a $10,000 prize.

RoboSub is designed to generate excitement within engineering students while providing a platform for networking, outreach, and innovation. Participants were exposed to challenges in system design and systems engineering which will enhance their ability to continue to develop the AUVs of the future.

2014 RoboSub winners:
1st Place – Cornell University, Ithaca, NY
2nd Place – University of Florida, Gainesville, FL
3rd Place – École Technologie Supérieure (ETS), Montréal, Canada
4th Place – Far Eastern Federal University, Vladivostok, Russian Federation
5th Place – National University of Singapore, Singapore

Judges' Awards:
Best New Entry – California Institute of Technology, Pasadena, CA
Best Branding – McGill University, Montréal, Canada
International Collaboration – Team Bangalore Robotics, Bangalore, India
Mayor's Cup for Outreach - École Technologie Supérieure (ETS), Montréal, Canada

Director's Corner

Lyla Englehorn, CRUSER Director of Concept Generation

September is Warfare Innovation Workshop month! Co-sponsored by NWDC and CRUSER, we have over 60 participants from NPS, other DoD commands, industry and academia placed on 7 concept generation teams to address "Warfighting in the Contested Littorals." Teams will spend their first day on Monday 22 September in knowledge-leveling briefs including injects of potential technologies, and an innovation seminar. They will then have the next two days to address the larger research question: "Will emergent technologies (unmanned systems, advanced computing power, automation, advanced sensor capabilities, laser weapons etc.) allow us to fight effectively in the complex and electromagnetically contested littoral environment against sea denial forces?" On Thursday morning, 25 September, each team will give a final brief. A final report detailing their final concept presentations will be available in late October. Next up on the Concept Generation horizon is Robo-Ethics 2015 – stand by!!

Overview of Cyber Operational Architecture Training System (COATS)

By GySgt Joffre Castillo, USMC, NPS Student

In August 2014, CRUSER sponsored me to observe a Cyber Operational Architecture Training System (COATS) at Lackland Air Force Base conducted by the 90th Information Operations Squadron (IOS). The mission was to analyze how the implementation of the COATS architecture could impact the testing of the Legged Squad Support System (LS3) aka "Big Dog" which is a rough-terrain robot that goes anywhere a Marine can go to help carry their load.

The Department of Defense (DoD) conducts numerous cyber exercises with limited capability with cyber events, attacks, and responses. The mission of COATS is to significantly improve the quality of integrated cyber operations during major exercises by reducing or eliminating gaps and seams between existing traditional and cyber test and training architectures thus increasing the capability of cyber events, attacks and responses. COATS is designed using existing DoD technologies that have been approved for operation on DoD networks and integrating them for a more realistic and accurate cyber training experience. These technologies include: EXata and Air and Space Collaboration Environment Information Operations Suite (ACE-IOS) used for Modeling and Simulation, SolarWinds/Orion and Nagios used for Cyber Sensors, Joint Information Operations Range (JIOR) used as the Cyber Range, Radian Mercury used as a cross domain communications Interface and the Network Effects Emulation System (NE2S) used as the cyber emulators. When integrated, these existing technologies can prove to be very effective on depicting a realistic cyber event and response action.

The COATS demonstration included 4 vignette each tailored to identify a specific improvement to our current cyber effect architecture. The first vignette shows a red cyber network attack (CNA) on a Blue system to portray degradation on a specific workstation operator. Specifically the red cyber effect was a fatal system error page aka "Blue Screen of Death" sent to a workstation essentially being emulated by the NE2S software on the machine showing the simulation but not affecting the machine itself. Nagios will depict this workstation as being affected in seconds depending on refresh rate settings and SolarWinds/Orion will update the link to the workstation to a down state. The second vignette demonstrated a red kinetic attack on a blue communications facility to simulate how a kinetic effect could lead to a cyber-effect. The other two vignettes included a Distributed Denial of Service (DDoS) attack to disrupt full motion video and an attack on critical infrastructure. All vignettes utilized the same concept of sending a cyber-effect, simulation of that effect being done at the target host/device/service using NE2S and sensor data representation using Nagios, SolarWinds and Orion. The demonstration provided a realistic common operational picture of all vignettes which is a capability highly demanded in today's cyber environments.

The LS3 is originally designed to automatically follow its leader but it also had other capabilities like traveling to dedicated locations using terrain sensing and Global Positioning System (GPS). As the LS3 software improves there is a potential that NE2S software could be included to conduct simulated cyber effects to the LS3 robot and accurately responding to those effects. As a Marine you always train as you fight, so having a more realistic environment for simulation is key to our success.

NAWCAD's 2030 Strategic MMOWGLI thru 19 Sept

Naval Air Warfare Center Aircraft Division (NAWCAD) in Patuxent River Maryland is embarking on a new era of change and transformation in how they develop, test, and deliver products to our warfighters in response to global threats. Please participate in the NAWCAD 2030 Strategic MMOWGLI Game. Together, we have the ideas and ability to help our organization formulate innovative breakthrough strategies to address three areas that will become strategically significant over the next 15 years:

1. Highly Autonomous and Information-Centric Integrated Coalition Warfighting: Future State Regional Deterrence
2. Next-Generation Terrorism: Deterring Asymmetric Threats
3. Arctic Region: Ensuring Security in an Emerging Global Commons

Your thoughts and ideas in helping us address these areas are critical to shaping NAWCAD's strategy for future success.

https://mmowgli.nps.edu/nsc

FrankenEye: Creating a Scalable, Modular Unmanned Aerial System (UAS) Using 3D Printing

by Kevin Reynolds, NASA Ames, kevin.w.reynolds@nasa.gov

Many unmanned aircraft missions involve taking measurements in dangerous regions or phenomenon where conditions have prevented manned aircraft operation. For NASA Ames Research Center in Moffett Field, CA, Earth Science missions often require modification to a stock aircraft to accommodate certain critical payloads and sensors. The FrankenEye concept explores a unique opportunity to exploit smaller, expendable unmanned aircraft systems (UAS) to build modular, scalable UAS with improved performance using 3D printing and rapid manufacturing. Design for manufacturing (DFM) techniques were applied for significantly reducing development time and project costs.

In January 2014, a team of aerospace engineers and research scientists at NASA Ames Research Center were awarded a Center of Innovation (CIF) project to demonstrate a proof-of-concept of the use of 3D printing to optimize science mission aircraft by combining newly fabricated parts with stock RQ-14 Dragon Eye (DE) UAS donated to the Center. A library of parts was created to provide the building blocks for a scalable, modular UAS concept referred to as the FrankenEye UAV that could be designed, built, and flown in less than a week.

With a total budget of $150K over 12 months, the project "sanitized" the Dragon Eye UAS for sensitive components including the autopilot and considered options for replacing hardware using commercial off-the-shelf (COTS) components. Summer students were hired to the project and organized into teams to design and build their own aircraft concepts from the virtual library of parts. NASA Ames provided access to rapid prototyping equipment that included 3D printers, laser cutters, and CNC mills through an onsite facility known as the SpaceShop.

New parts for the aircraft were modeled, analyzed, and fabricated to enable aircraft to fly for longer durations at higher altitudes while carrying more payload. One of the key features of these new designs involved span loading the wing through rigid connectors used to join wing sections. Lift-dependent drag, also known as induced drag, reduces for a fixed weight allowing aerodynamic efficiency of new aircraft to improve as a function of wing size/span.

Several potential benefits of 3D printing were identified.

The 8 foot Chimera UAV was constructed with 3D printed cambered flaps, wing ribs, and a three-axis gimbaled camera system. Image Credit: NASA Ames)

An adjustable bungee-powered launch system was designed and constructed to enable launch of a three-fuselage wide configuration. Shown above are the twin-fuselage Chimera and the Alicanto UAVs. Image Credit: NASA Ames)

Printing in ABS plastic allowed for a rapid turnaround time of the outer mold line of wing sections which could then be coated/wrapped in stronger materials. Carry-through channels in 3D printed parts allowed for a carbon fiber tube to be used as the primary loading carrying member along the wingspan. Complex multi-element flaps were printed as fully assembled parts. With the removal of support material, the flaps were articulated using servo drive. Wing ribs, winglets, nose cones, camera gimbals, servo brackets, connectors, and even propellers were printed.

Many parts entered into flight-testing after less than two months after receiving approval from the NASA Airworthiness and Flight Safety Review Board (AFSRB). The main risks that were addressed involved the structural integrity of the 3D printed parts. Analysis from static and coupon testing results showed great potential for much larger wing spans and significantly improved performance capabilities.

New NPS Lithium Polymer Battery Policy

by Debora Waxer, Supervisory Safety Engineer, dewaxer@nps.edu

Lithium Polymer (LiPo) batteries have inherent fire hazards and usage of LiPo batteries by NPS researchers requires a formal NAVSEA approval. We have recently obtained a "green box" or blanket approval for LiPo battery systems. The NAVSEA approval requires adherence to the Standard Operating procedures (SOP) for purchase, storage, charging, usage, and disposal as outlined in the reference below. Many thanks to Dr Kevin Jones for his work in developing the LiPo Battery SOP.

Full policy available at: http://hdl.handle.net/10945/43305

STUDENT CORNER

Student: Donald R Lowe, Holly B Story, Matthew B Parsons

Title: U.S. Army Unmanned Aircraft Systems (UAS)—a historical perspective to identifying and understanding stakeholder relationships

Curriculum: MASTER OF Science in Program Management

Link to Completed Thesis: http://hdl.handle.net/10945/42678

Abstract:

This research is intended to advance understanding of relationships between unmanned aircraft systems (UAS) stakeholders and programs to allow the Army to increase efficiencies and reduce costs. It was found that the Army had never completed a formal UAS stakeholder identification and analysis. Internal and external stakeholders are identified here and fall within categories of Army executive program leadership (e.g., Program Executive Office for Aviation), Army and service components (active, Guard, reserve forces), senior Army leadership (e.g., Headquarters, Department of Army), other federal and non-federal government entities (e.g., Congress), commercial interests (e.g., industry and academia), and other interested parties, such as the American people. An analysis of relationships affecting these stakeholders was conducted, including organizational beliefs and cultures, management of resources, policies and law and future UAS enhancements planned by the Army and industry partners. The most important problems found were inter-service and inter-branch disputes that shape UAS policies and procedures, forecasting for future UAS growth while managing costs and finding more efficient, less redundant ways to use current UAS capabilities, and safe integration into the national airspace system. This stakeholder analysis allows the Army to leverage the support of others for funding, resources, intellectual property, lessons learned and cooperation.

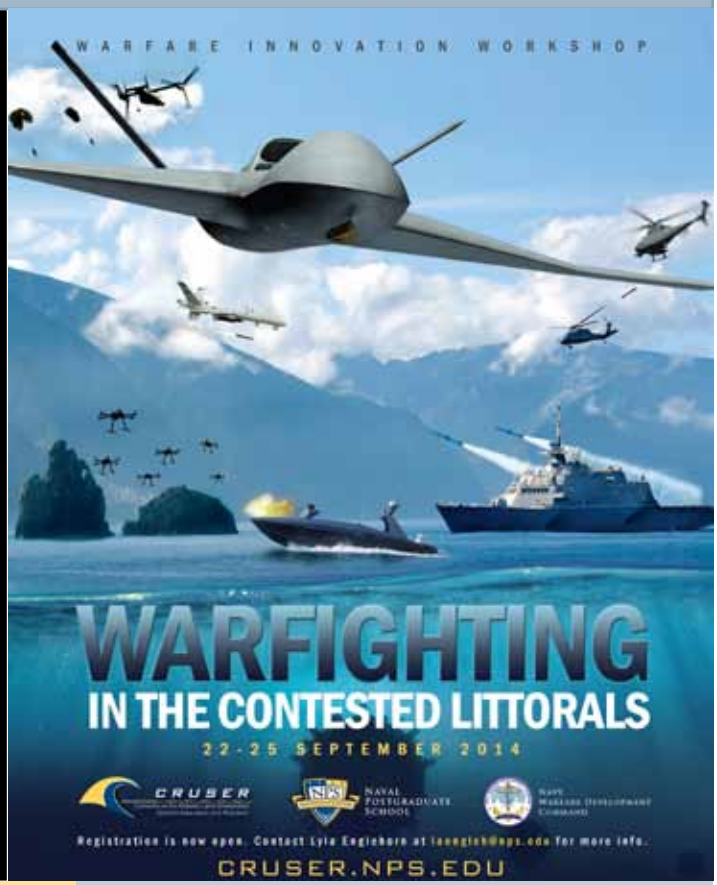
CRUSER Librarian Corner

Losing Sight of the Human Cost: Casualty Recording and Remote Control Warfare
http://www.oxfordresearchgroup.org.uk/sites/default/files/EC-RC-Losing-Sight.pdf

Domestic Drones: Implications for Privacy and Due Process in the United State
http://www.mpac.org/assets/docs/publications/MPAC-Domestic-Drones-full-paper.pdf

Unmanned Aerial Vehicles in Humanitarian Response
http://reliefweb.int/sites/reliefweb.int/files/resources/Unmanned%20Aerial%20Vehicles%20in%20Humanitarian%20Response%20OCHA%20July%202014.pdf

Operationalizing Use of Drones Against Non-State Terrorist Under the International Law of Self-defense
http://ssrn.com/abstract=2459649



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 6 Oct, 1200-1250 (PDT)
Mon 3 Nov, 1200-1250 (PST)
ME Auditorium or Collaborate Webinar
contact us at cruser@nps.edu for the details