Unmanned Systems Special Interest Group Session Summary

DoD HFE TAG 64
25 October – 28 October, 2010, San Jose

Doubletree Hotel San Jose
2050 Gateway Place
San Jose, CA
United States, 95110
(408) 453-4000

Chair: Ajoy Muralidhar
NSWC Dahlgren
NSWCDD, Code W62, Bldg 1470
18444 Frontage Rd Suite 327
Dahlgren, VA 22448-5161
(540) 284-0701

The Unmanned Systems Special Interest Group had two sessions and was well attended (25 and 40 attendees). At the first session, hard copies of the draft charter were distributed to the attendees. The draft charter had been submitted to the board but has not been voted upon. Attendees were asked to provide feedback before the charter is voted upon at the next HFE TAG or at an intermeeting session of the TAG board. Electronic copies will be sent to the session attendees in the weeks following the meeting. There was one speaker scheduled at the first session and five speakers at the second session. The presenters represented the Army, Navy, Industry and Academia. Each presentation generated discussion between the attendees and the presenter.

SCHEDULE

Tuesday October 26 Session 0730-0830

0730-0745 Setup/Welcome
Ajoy Muralidhar and Cindy Ching

Hard copies of the draft Unmanned Systems SubTAG Charter were distributed. Attendees are asked to provide comments on the charter.
Evaluation of a Prototype: Man Machine Interface for the PackBot EOD Robot

Michael R. McWilliams, MS, CHFP
U.S. Navy, Space and Naval Warfare Systems Center Pacific

Abstract
A prototype robot control system utilizing a single mode, game pad controller and the legacy PackBot Operator Control Unit (OCU) were evaluated using a realistic mission scenario in which a series of embedded tasks were performed by US Navy Explosive Ordnance Disposal (EOD) technicians. The experiment used a within-subject design, with treatments counterbalanced to control for learning effects and the resulting data were analyzed using repeated measures ANOVA tests. The participants were able to successfully perform all driving and reconnaissance tasks described in the mission scenario in both controller conditions. NASA TLX workload scores for the prototype condition were lower than those for the legacy PackBot condition. Task performance times for top performers were lower for the prototype condition however no significant differences were noted in overall performance times between conditions. Results of an exit survey indicated a strong participant preference for the prototype single-mode controller.

Bio
Mr. McWilliams holds a Master of Science degree in Industrial and Organizational Psychology from San Diego State University and is a Certified Human Factors Professional with over 30 years experience in the areas of human factors and safety. He is currently employed as a Human Factors Research Psychologist at the Space and Naval Warfare Systems Center Pacific in San Diego, California. Mr. McWilliams is the principal investigator for a multi-year research project sponsored by the Office of Naval Research (ONR) investigating human / robot interaction (HRI) issues in the use of unmanned ground vehicles for counter EOD measures.

Discussion
Q: How representative is the test of the mission in theatre?
A: UAV have taken pictures of PacBots in action. There are classification issues with release of images from UAV. Mission scenarios are vetted by returning EOD techs (n=20).

Q: What were the SA measures?
A: The first part of the study focused on usability (Spiral 1: controller complexity). The next part will focus on SA (Spiral 2: Video display enhancement). Simplified controls free up cognitive loading to do more SA but it wasn’t the focus.

Q: What were the human performance measures and what the threshold for acceptable performance?
A: Time to Complete Task with several embedded tasks, Operator Errors including driving out of bounds, bumping into obstacles, and gross inadvertent movements. Operator error was used as a threshold, but there was no acceptable/unacceptable time.

Spiral 1 Results Summary
Q: Were the operators gamers?
A: Most were, but the difference was not shown between gamers and non-gamers. Some operators were just good operators. Experience and type of games played were collected, but there was no correlation shown.

Q: Do the operators perform the test with gloved hands?
A: Occasionally light mechanics gloves, but usually no gloves. Probably not in hot environment, perhaps in MOPP IV or arctic environments.

Spiral 2 Interface Design
Q: Are there physical limitations for the screen?
A: It was assumed the hardware cannot be changed.

Q: What makes a person a top performer? Experience?
A: Some people were just good performers. Gaming skills, specifically first-person shooter games are helpful.
Wednesday October 27 Session 0730-1100

0730-0740  Setup/Welcome
Ajoy Muralidhar and Cindy Ching

0740-0810  Bridging the Understanding Gap between Human(s) and Machine(s) in Unmanned Vehicle Operations: a Review of Research Approaches
Sylvain Bruni
Aptima, Inc.

Abstract
While the number of unmanned systems being deployed in the field has drastically increased, multiple bottlenecks have surfaced: from the shortage of qualified personnel adequately trained to operate these systems to the deliberate objective to "invert the ratio" with operators handling teams of vehicles, high cognitive stress and pressure are placed upon the human component of these systems. One solution to mitigate these demands has consisted in increasing the levels of autonomy and automation of the vehicles, as a means to reduce the operator's cognitive load by moving some decision-making authority, tasks, functions, and competencies to the machine. Although an acceptable path to an immediate increase in capacity, this approach has repeatedly shown its limits, in multiple domains. In particular with the human operator adopting a supervisory role, a critical need has emerged: both the human and the machine need to acquire, maintain and operate with an adequate understanding of each other. In particular, three essential elements contribute to the building of such reciprocal understanding: operator capabilities and performance, technology operation and intent, and mission requirements. To address these components, Aptima has been working with multiple agencies including ONR, AFRL, ARL, NASA and the FAA, to explore innovative approaches which will enable smoother and more efficient and effective human(s)-machine(s) interaction in unmanned vehicle operations. This presentation will review a few of these approaches.

Bio
Sylvain Bruni is a Human Systems Engineer at Aptima, Inc., where he provides expertise in human-automation interaction, interface design, and the statistical design of experiment. His research targets the design of computer-supported interactive training systems and the conceptualization of human-automation collaboration interfaces for multi-vehicle command and control. Prior to joining Aptima, Mr. Bruni conducted research at the Massachusetts Institute of Technology (MIT), focusing on designing and testing collaborative decision-support systems, specifically in military environments. Mr. Bruni holds a S.M. in Aeronautics and Astronautics from MIT and a Diplôme d'Ingénieur from the Ecole Supérieure d'Electricité (Supélec, France). He is currently a doctoral candidate in Aeronautics and Astronautics at MIT's Humans and Automation Laboratory.

Abstract
Our goal is to improve the design of human-Unmanned Aircraft System (UAS) interaction so operators can have better situation awareness (SA) of conditions pertaining to the UASs. We developed a UAS interaction design approach that uses pre-loaded terrain data to augment real-time video data sensed by the UASs. We hypothesized that augmentation of the video in this manner would provide better SA than a video stream alone. To test the hypothesis, we performed a counterbalanced within-subjects experiment in which the independent variable was video presentation approach. Our results show an increase in comprehension of 3D spatial relationships between the UAS and points on the earth when experiment participants were given an augmented video presentation, as evidenced by a statistically significant difference in participants' mapping accuracy. We believe our results will generalize to situations beyond UASs to those situations in which people must monitor and comprehend real-time, map-based information.

Bio
Dr. Jill Drury received a BA in Physics from Macalester College in 1980. She received MS degrees in Business Administration in 1986 and Computer Science in 1994, both from Boston University. A Doctor of Science (Sc.D) degree in Computer Science followed from the University of Massachusetts Lowell in 2002. Her research interests are in optimizing interactive technologies for team-based decision-making in safety-critical applications; particularly for unmanned systems, operations centers, and command and control systems. She is Associate Department Head of the Collaboration and Multi-Media Department of The MITRE Corporation and an Adjunct Assistant Professor at the University of Massachusetts Lowell.

Q: Wide-view is needed for SA. Were there any pilots in the study?
A: This was a sensory task, not a piloting task
0840-0900  What Need to be Done Regarding Unmanned Systems Human-Robot Interaction Standards and UI Guidance (Open Discussion)

Mike McWilliams (SPAWAR) and Ajoy Muralidhar (NSWCDD)

Discussion

MIL-STD-1472 doesn’t focus on GUI. Navy has a display standard ommon Presentation layer Standard which is a NAVSEA user interface specification. General design principles would be good.

There are issues with Techipedia. Use will require a CAC, including for first time user. Logging on will automatically subscribe you to DTIC.

OSD is facing standardization of Ground Control Systems. The pilot is limited to certain maneuvers due to distance away. Cannot foresee staffing less than one pilot per UAV.

0930-1000  Key Issues in Adaptively Automated Unmanned Ground Vehicles: Invocation Method, Situation Awareness, Workload, and Performance

Dr. Lauren Reinerman-Jones  
University of Central Florida (UCF), Institute for Simulation and Training (IST), Applied Cognition and Training in Immersive Virtual Environments (ACTIVE) Laboratory

Abstract

Automation is employed in systems to offload a given task in order for the operator to perform at a higher level on other tasks. The detriment of static automation, however, is a loss in situation awareness leading to problems when the operator needs to act in a fail-safe capacity. In contrast, fully manual systems often lead to a performance decrement, particularly in instances of task overload. The simple solution appears to be that of adaptive automation. Adaptive automation refers to a system capability that enables flexible task allocations between the human operator and the machine agent in the context of the work environment (Parasuraman & Hancock, 2001). When properly implemented, adaptive automation provides optimized operator performance while enabling situation awareness to be maintained. Thus the purpose for the present line of research, which is a collaborative effort between the Institute for Simulation and Training (IST) and the Army Research Laboratory (ARL), was to assess the effects of adaptive automation on unmanned ground vehicle (UGV) operators' multi-tasking performance, situation awareness, and workload using a complex visual display. The context was that of a reconnaissance mission. Invocation method was explored, including time-base, performance-based, and state-based (indexed by physiological response), to create a baseline for future research and a deeper understanding of adaptive automation for improved human-robot interactions was gained.

Bio

Dr. Lauren Reinerman-Jones started college at the age of 14 and graduated with her doctorate by the time she was 23 years old. She is the Human Factors and Ergonomics Society’s Augmented Cognition Technical Group Program Chair and thus her research focuses on physiological measures as indicators, selection tools, and predictors of cognitive state and human performance. She is a research faculty member within the Applied Cognition and Training in Immersive Virtual Environments Lab at the University
of Central Florida's Institute for Simulation and Training. Working with government agency collaborators including ARL, ONR, and NRC, her current interests have centered on investigating invocation tools for automated systems, particularly Unmanned Ground Vehicles, with attention to eye tracking, EEG, ECG, and GSR.

Discussion

Q: How did you control for daydreaming?
A: Physiological measures included blink counts. Scenarios were only nine minutes long. But future studies would need to consider vigilance.

Q: Was student expertise or gender differences apparent?
A: A novice population was used. Military experience was screened out. Gamers did not have better performance than non-gamers.

1000-1030 Beyond 'New Atlantis': Tightly Integrated Human-Unmanned Systems Teams
Dr. Elan Moritz
Naval Surface Warfare Center Panama City Division

Abstract
This 'micro-orientation' on some of the activities at Naval Surface Warfare, Panama City Division, will particularly emphasize unmanned systems-related missions and technology interests. Dr. Moritz will share [personal] perspectives about Navy & DOD challenges in the coming years and share some perspectives on where 'we' are with 'intelligent machines'. A principal focus of discussion will be the potential, need, and considerations associated with Tightly Integrated Human-Unmanned Systems Teams.

Bio
Dr. Elan Moritz is Strategic Planner at the Naval Surface Warfare Center, Panama City Division where he provides future oriented inputs into the Command's planning efforts. Dr. Moritz pays particular attention to emerging technologies and urgent operational requirements. Basic and applied research in the areas of automation, unmanned systems, intelligent autonomous systems, computational algorithms, modularization, standardization, systems engineering and design, information security, biological and biologically inspired systems are some of his main current interests. Dr. Moritz directed NSWC PCD signal and image processing projects and modeling and simulation projects. He's currently exploring the application of brain based metaphors and experimental neuroscience findings to what's coming to be known as 'neurorobotics' and future automated/computer based systems. He earned his Ph.D. in physics during the last century.
1030-1055  Designing for Unmanned Aerial Operators in the Future Battlefield
Susan Flaherty
US Army Aeroflightdynamics Directorate

Abstract

Bio
Susan Flaherty completed her undergraduate degree in Psychology at UC Berkeley, followed by an M.A. in Experimental Psychology from San Jose State University. Since 2002, she has worked for the US Army Aeroflightdynamics Directorate as a research psychologist in the Human Systems Integration Group at Moffett Field, CA. Susan attended Shadow UAV operator training at Ft. Huachuca, AZ. Her research interests include delegation control of multiple unmanned systems and manned-unmanned systems teaming.