

The National Academies of
SCIENCES • ENGINEERING • MEDICINE

AGENDA

**Human-Automation Interaction Considerations for Unmanned Aerial System Integration:
A Workshop**

January 10-11, 2018
THE NAS BUILDING OF THE NATIONAL ACADEMIES
LECTURE ROOM
WASHINGTON, DC 20001
PHONE: (202) 334-3776

MEETING OBJECTIVES

The ad hoc committee on Human-Automation Interaction Considerations for Unmanned Aerial System Integration will conduct a 2-day workshop aimed at advancing the understanding of the human factors/human systems integration issues associated with the full integration of Unmanned Aerial Systems (UAS) into the National Airspace System (NAS). The focus will be on human interaction considerations relevant to the design and operations of Unmanned Aerial Systems (UAS) technology, particularly within the context of implementing automation capabilities within ground control stations (GCS). The workshop will highlight existing human factors and human-systems integration research while identifying opportunities to address gaps and opportunities in research, application, and implementation.

WEDNESDAY, January 10, 2018 – Lecture Room

OPEN SESSION

7:45 Breakfast and Welcomes

8:30 a.m. **Sponsor Briefing**

- ❖ Jay Shively, *Subproject Manager for Detect and Avoid for the UAS Integration in the NAS project*, Ames Research Center, NASA

9:00 a.m. **Human System Integration Issues for UASs and automation technologies**

- ❖ Kim Cardosi, Principal Technical Advisor for Aviation Human Factors, Volpe Center, U.S. Department of Transportation
- ❖ Mica Endsley, *President*, SA Technologies. Inc.
- ❖ Moderated by Mica Endsley, *Committee Member*

What human systems integration considerations are paramount as this evolution of new UAS and automation technologies into the NAS takes place? This session will review the state of research on Human-Automation Interaction, and considerations for operating UASs in the National Air Space. In addition, this session will also offer suggestions for supporting pilot situation awareness and UAS integration in the NAS, and research needs to support these operations.

10:00 a.m. **Break**

10:15 a.m. **The reality of full GCS Automation... How far away are we really?**

- ❖ Marcie Langelier, *HSE&I UAS Airspace Integration Lead, Human Systems Engineering & Integration, US Navy*
- ❖ Bill Kaliardos, *Human Factors Specialist, FAA*
- ❖ Moderated by Julie Ryan and Doug Davis (via Zoom), *Committee Member*

How can automation technologies be leveraged to support UAS integration into the NAS? An interesting way of approaching this question is by looking at how manned aircraft interact with the NAS. A great deal of human activity is performed by pilots, including verbal interactions as well as human-triggered actions (such as activating or deactivating systems). Analyzing these pilot-driven activities for the potential for automation and the repercussions thereof (both intended and unintended) provides an important set of attributes for consideration. Taking advantage of the strengths of automated systems (like the ability to ‘remember’ long complicated process-driven events) and identifying the strengths of humans in or over the loop (such as recognizing subtle problems and conceiving novel reactions to unforeseeable events) is an obvious way to proceed with developing a systematic understanding of the challenges and potentials.

11:15 a.m. **Transition planning from old GCS to new Briefing/Discussion**

- ❖ Nadine Sarter, *Professor, Industrial and Operational Engineering; Director, Center for Ergonomics, University of Michigan*
- ❖ John-Paul Clarke, *College of Engineering Dean’s Professor, Daniel Guggenheim School of Aerospace Engineering and (by courtesy) H. Milton Stewart School of Industrial and Systems Engineering, Director, Air Transportation Laboratory, Georgia Institute of Technology*
- ❖ Moderated by John-Paul Clarke, *Committee Member*

Transition—the path “from here to there”—is often far more difficult to define than the desired end state. This is partly due to the great challenge we often face with respect to finding the right balance between off the shelf technology and technology under development—the latter with greater potential but also greater uncertainty. Transition planning is also challenging because of uncertainty with respect market evolution, and therefore the requirements for the supporting systems, and the uncertainty with respect to the operating environment. In this session, we will explore the requirements for UAS ground control systems with an eye to articulating the essential requirements, i.e., the requirements that are robust to both requirements and operational uncertainty.

12:15 p.m. **Lunch with Discussion by Attendees**

Lecture Room

1:00 p.m. **Near-term HSI Challenges with UAS Automation**

- ❖ Ellen Bass, *Professor and Head*, Department of Information Science, College of Computing & Informatics; Professor, Department of Health Systems and Sciences Research, College of Nursing & Health Professions Drexel University
- ❖ Erik Theunissen, *Professor in Avionics*, Netherlands Defense Academy
- ❖ Moderated by Ellen Bass, *Committee Member*

What are the minimum automation requirements in the joint GCS-vehicle system to integrate UAS into the NAS and what challenges do they create for automation-based human performance issues that exist in legacy systems?

2:00 p.m. **Knowledge Gaps**

- ❖ Mica Endsley, *President*, SA Technologies. Inc.
- ❖ Mary “Missy” Cummings, *Professor*, Department of Mechanical Engineering and Materials Science, Duke University
- ❖ Kathy Abbott, Chief Scientific and Technical Advisor, Flight Deck Human Factors, Federal Aviation Administration
- ❖ Moderated by John Hansman, *Committee Member*

What are the key knowledge gaps within these communities for understanding the interaction of the pilot/operator with GCS automation technologies?

3:00 p.m. **Break**

3:15 p.m. **Lessons Learned, Issues Identified in DoD GCS R&D Efforts**

- ❖ Mark Draper, *Program Manager*, SIRUS lab, AFRL
- ❖ Grant Taylor, Engineering Research Psychologist, Human-Systems Interface Technical Area (HSI TA) Aviation Development Directorate (ADD), U.S. Army AMRDEC / RDECOM
- ❖ Moderated by Chris Miller, *Committee Member*

Most of the R&D efforts in HSI for UASs to date have focused on DoD UAS platforms (as well as GCSs for other Unmanned and/or Autonomous Vehicles). This session will review lessons learned and issues identified from that community with reference to their bearing on Human-Automation Interaction considerations for operating UASs in the National Air Space. In addition, this session will also offer suggestions for ongoing collaboration and information sharing across these fields.

4:15 p.m. **Man vs. Machine or Man + Machine?**

- ❖ Mary “Missy” Cummings, *Professor*, Department of Mechanical Engineering and Materials Science, Duke University
- ❖ Moderated by Mary “Missy” Cummings, Committee Member

This presentation will focus on how to allocate roles and functions between humans and computers in order to design systems that leverage the symbiotic strengths of humans and computer. Such collaborative systems should allow humans the ability to harness the raw computational and search power of computers, but also allow them the latitude to apply inductive reasoning for potentially creative, out-of-the-box thinking. Successful systems of the future will be those that combine the human and computer as a team instead of simply replacing humans with automation.

5:15 p.m. End of session

THURSDAY, January 11, 2018 – Lecture Room

OPEN SESSION

- 8:00 a.m. **RPIC Control Station Considerations: A Pilot's Perspective**
- ❖ Kurt J. Carraway, *UAS Executive Director*, Applied Aviation Research Center, Kansas State University Polytechnic
 - ❖ Moderated by David Arterburn, *Committee Member*

This presentation will discuss manned aviation pilot instrumentation and the relevance to UAS CS considerations. Retired USAF Colonel Kurt Carraway will relate his experience as a Global Hawk instructor as well as his experience in the operations of small UAS to address some automation design considerations. This discussion will include a discussion about the relationship between various levels of automation and training as well as the following considerations: pilot flight display requirements; unique UA attributes; and command and control links.

- 9:00 a.m. **Human System Integration Issues for UASs and automation technologies (cont.)**
- ❖ Amy Pritchett, *Department Head*, Department of Aerospace Engineering, Penn State
 - ❖ Moderated by Julie Ryan, *Committee Member*

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- 10:00 a.m. **Break**

- 10:15 a.m. **What do we not know! Pulling committee competencies into the proceedings!**
- ❖ All committee members
 - ❖ Moderated by Nancy Tippins, *Committee Chair*

- 11:15 a.m. **Wrap up Discussion with Sponsor and Attendees**
- ❖ Nancy Tippins, *Committee Chair*

- ❖ Jay Shively, *Lead Project Engineer for the Human System Integration Subproject for the NASA UAS Integration into the NAS project*, Ames Research Center, NASA

12:15 p.m. Adjourn open session

END OF OPEN SESSION