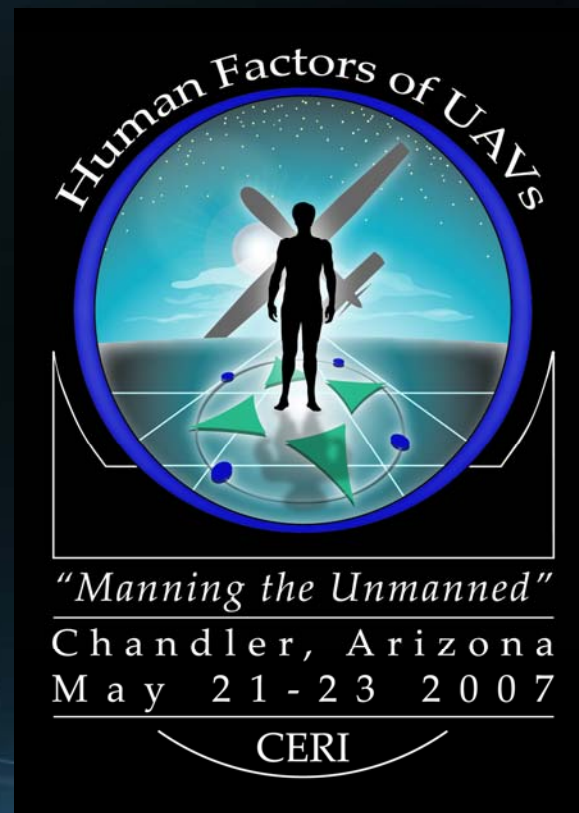


WELCOME TO CERI's Fourth Annual Human Factors of UAVs: "Manning the Unmanned"



Opening Session Overview

- Welcome & Logistics (0830-0845)
- A word from our sponsors:
Research Integrations,
AFRL/AFOSR;
- Jeff "Goldy" Goldfinger, L3-Com
- 9:30-9:45 BREAK
- Bruce Hunn, ARL
- Major Matt Martin, USAF

Scope of Workshop

Unmanned Aerial Vehicles

Unmanned Aerial Systems

Unmanned Combat Aerial
Vehicles

Uninhabited Aerial Vehicles

Unmanned Systems

Drones

Remotely Operated Systems

Remotely Operated Vehicles

Autonomous Vehicles/Systems

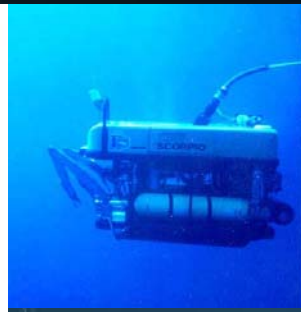
Military and Civilian Applications

*The Human is
not in the
vehicle...*

*but IS in the
Loop.*



Figure 7-1. Team Retarius UGV

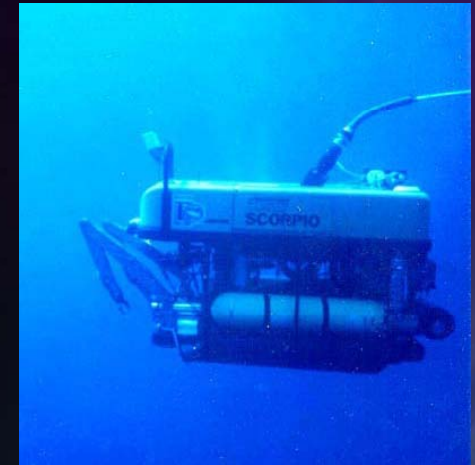


Broadening our Scope



Figure 7-1. Team Retriarius UGCV

Ground and Underwater Vehicles



Civilian Applications

Border Security



WHY?

Human Factors of UAVs: "Manning the Unmanned"



"Manning the Unmanned"

Chandler, Arizona

May 21 - 23 2007

CERI

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Figure 2 - Ground Control Station

Manning the Unmanned OR Inhabiting the Uninhabited



*"There are no
humans...therefore,
no Human Factors..."*



Unmanned Vehicles May be Unpiloted, But They are NOT “Unmanned.”

- 70 people involved by some counts
- The human is an integral and critical component of unmanned aerial vehicle systems in jobs ranging from air vehicle operator and sensor operator to weather experts and maintenance personnel
- But high mishap rate (100 x higher than manned aircraft)
- Many mishaps (33-43%) point to human factors issues
- Understanding of human capabilities and limitations needs to be integrated into system design and training – the earlier the better!

Some Human Causes of Mishaps

- Loss of situation awareness
- Operational tempo/fatigue/workload
- Poor teamwork/handoffs/lack of communication
- C2 chain inefficient
- Remote control with poor feedback
- Crew selection & training
- Aeromedical readiness
- Pilot proficiency/currency
- Personnel shortages



PROGRESS?

3 Year of...

Human Factors of UAVs: "Manning the Unmanned"



"Manning the Unmanned"

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Dispelling UAS Myths



“Unmanned” Means no Humans



- **Unmanned does not mean uncontrolled**
- **Operators are remote, not absent**
- **Ground personnel are numerous (1-5 Global Hawks require 28 maintenance personnel in theater; Army estimates staffing at 70 per vehicle)**
- **Cost savings on the vehicle currently exceeded by costs on the ground (ground equipment, net increase in people, training)**

The Human Has Been Automated “Out of the Loop”

- Thirty years of research demonstrates that automation changes the human’s task and not always for the better.
- Many mishaps are attributed to the human being “out of the loop.”
- The true beauty of the UAS is the ability for humans to override the automation to do dynamic re-tasking.



Just Like Air Traffic Control

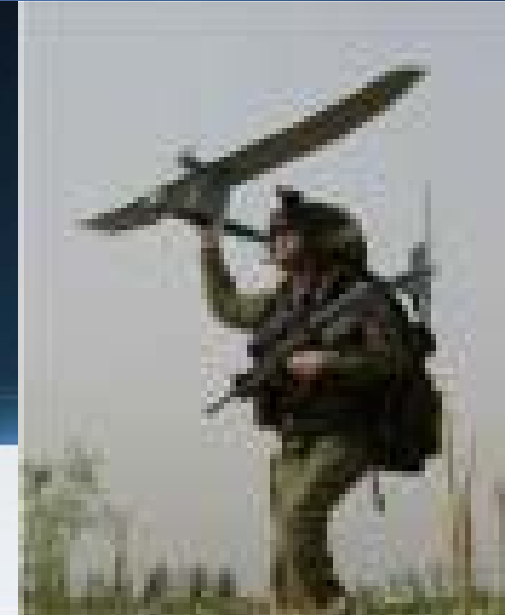
- The UAS control task involves much more than monitoring and control of aircraft position
- Dynamic re-tasking and re-planning maximally exploits the UAS
- State of practice is 2:1
- Research suggests that 1:4 is not currently feasible



NASA Dryden Flight Research Center Photo Collection
<http://www.dfrc.nasa.gov/Gallery/Photo/index.html>
NASA Photo: EC04-0347-06 Date: November 20, 2004 Photo By: Tom Tschida
Two identical RnR Products APV-3 aircraft validated cooperative flight control software in the Networked UAV Teaming Experiment at NASA Dryden in early 2005.

Just Like Manned Flight

- It is not a vehicle, but a system that includes vehicles, ground control, air operations, operators, intelligence, weather personnel, maintainers...
- Piloting analogy ignores years of studies on time lag, loss of visual cues, depth perception, etc.
- Piloting analogy ignores the system functions beyond flight (i.e., re-tasking, replanning, sensor operations)
- It may be more like robotics or video gaming



Identifying Human Factors of UAS Issues

PERCEPTUAL

- Soda straw views
- Spatial disorientation
- Target detection
- Vigilance

MULTIPLE UAS CONTROL

- Control of multiple UASs
- Optimal operators : vehicles
- Effective use of automation



INTERFACE

- Control design
- Effective feedback
- Geographical displays
- Multimodal displays
- Information overlays
- Decluttering

Command & Control

- Communications
- Reachback capabilities
- Coordination
- Teamwork

TRAINING & SELECTION

- Appropriate training/KSAs
- Crew selection
- Certification

NATIONAL AIRSPACE

- Standardization & multiple platforms
- Integration with national airspace

OTHER HF ISSUES

- Fatigue during lengthy missions
- Safety & error analysis
- Checklists & procedures
- Social/psychological implications of remote battlefield
- Situation awareness

Communicating Concepts and Issues

HUMAN FACTORS OF REMOTELY OPERATED
VEHICLES (2006)

EDITORS: NANCY J. COOKE, HEATHER
PRINGLE, HARRY PEDERSEN, & OLENA CONNOR

Topics Covered

(much from 2004 & 2005 workshops)

- Errors, mishaps, & accidents
- The ROV interface
- Control of multiple ROVs
- Team control of ROVs
- ROVs on the ground



ADVANCES IN HUMAN PERFORMANCE AND
COGNITIVE ENGINEERING RESEARCH
VOLUME 7
Series Editor: EDUARDO SALAS

HUMAN FACTORS OF
REMOTELY OPERATED VEHICLES

NANCY J. COOKE
HEATHER L. PRINGLE
HARRY K. PEDERSEN
OLENA CONNOR
Editors

Impact?

Piloted remotely from a Nevada air base half a

*U It's a high tech way of **watching**
S **the border** and took flight at Fort
t **Huachuca Monday.***

*sol **in the war on terror that**
by next year the U.S. could
be spending nearly seven
times more on the vehicles
than it did before the 9/11
attacks.*

Impact?

*Preliminary accident report by the National Transportation Safety Board cited **pilot error** as the probable cause of the crash of the Predator, which was a newer and more expensive model than those in the Air Force's fleet.*

Investigators also found that the flight-control system unique to remotely piloted planes was a contributing factor: The pilot cut off the fuel supply by mistake while transferring control of the plane from one console to another.

Impact?

Meeting the growing demands

*All More Predators sought, r
P but Air Force **short on** f
20 crew*

***communications problems**
were ironed out.*

Workshop Organizing Team



Dr. Nancy Cooke
CERI & ASU



Pat Fitzgerald
AFRL-Mesa



Harry Pedersen
CERI & NMSU



Jennifer Winner
CERI & ASU



Ben Schaub
CERI & ASU



Dr. Steven Shope
Executive Director
CERI

Operator Panels

*Give questions to
Nancy Cooke...*

Logistics

- Posters & demos
- Meals & special needs
- Dinner tickets
- Surveys
- Other?



**ASTM International F38 Meeting on Unmanned Aircraft Systems
May 24-25**

*Development of standards for safety and performance ...
Facilitating worldwide access to commercial airspace ...*

Hosted by the Cognitive Engineering Research Institute



5810 S. Sossaman, Suite 106
Mesa, AZ



See one of us for a tour

- Independent Organization
- Not-for-profit
- A partnership of
 - Academic
 - Government
 - Industry

- Board of Directors
 - Representing CERI partner organizations
 - Provides joint leadership of CERI
- Research Projects
 - **Unmanned Aerial Vehicles**
 - Emergency Management
 - Communication Analysis
 - Design for Quality Healthcare
 - Underground Operations

CERI would like to thank the sponsors of the 4th annual Human Factors of UAVs workshop

