Human Factors in Unmanned Aircraft Systems

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Introduction

- As part of the FAA Reauthorization Act, the Federal Aviation Administration is tasked to develop regulations testing and licensing unmanned aircraft systems (UAS) to be integrated in the National Airspace System (NAS)
- Led by NASA's Dryden Flight Research Center, a project is underway to address safety and operational challenges for UAS integration
- The Research Ground Control Station is being developed as a test bed and database to provide data and proof of concept for a Ground Control Station
- The RGCS will support piloting operations for control of the D.R.O.I.D. and TG-14 surrogate aircraft
- This work supports the development of requirements and practices with consideration to human factors issues for the RGCS

Unmanned Aircraft Systems

- Currently, piloting an unmanned aircraft is a drastically different experience from that of a manned aircraft
  - Delays between the GCS and aircraft
  - Non-standard information displays
  - Restricted out-the-window view (30° field of view)
  - Deprived of other sensory feedback from the aircraft
    - Auditory, Vibrotactile, Olfactory, Taste

Human Factors Considerations

Federal Aviation Regulations

- The FAA is developing regulations and classifications for UAS, and the operation of UAS in the NAS
- **Tasks:**
  - Determine current, relevant FAR regulations for manned aircraft with similar characteristics and capabilities as unmanned aircraft
  - The RGCS human-machine interface shall be capable of controlling a wide range of UAVs

Situation Awareness

A significant predictor of performance SA is the

1. **Perception** of elements in the environment within a volume of time and space
2. **Comprehension** of their meaning
3. **Projection** of their status in the near future

- Information should be displayed to support pilot's SA without over-whelming cognitive processing

Information Requirements

Understanding pilots domain-specific information requirements directly inform display requirements

- Research on UAS information requirements is lacking
- Inferences can be made from task analyses of manned flight and UAS flight manuals

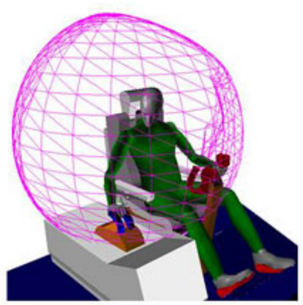
Human Factors Methods Applied

Ergonomics

Design for the 5th percentile female and 95th percentile male target population

- 5th percentile reach envelope to ensure access to all controls
- 95th percentile measurements to fit the environment to the user

Task: Extract anthropometric data from existing MIL- and NASA-standard resources



Human Factors Methods Applied

Contextual Inquiry

- One-on-one interaction with the users (UAS pilots) to define their roles, responsibilities, tasks, and needs
  - **Context –** interviews with pilots in the ground control station and other aircraft. Observation of work tasks, and discussion of procedures
  - **Partnership –** collaboration with pilots to understand the their roles
  - **Interpretation –** sharing my understanding, to allow pilots to expand and/or correct insights
  - **Focus -** directing interactions to topics applicable to the RGCS

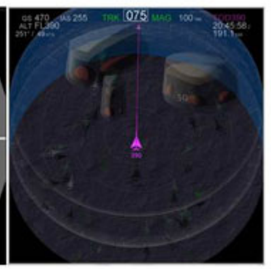
Recommendations

Displays

- Large 120 ° out-the-window view
- Centrally located 'Glass' cockpit displays to enhance information extraction
- Advanced displays for improved navigation, traffic, weather and terrain situation awareness

Multi-function / Engine Displays

Primary Flight Display



CSD – NASA Ames FDDRL

Controls

- Stick and throttle for manual control
- Hard controls for critical functions
- Touch screens / Keyboard / Mouse / Space mouse
  - For autonomous flight and less time critical functions dependent functions
  - Direct selection and entry of values
  - Flexibility / capability for various aircraft