Simulation Displays and Design

Overview: Research is needed on integration of UAVs in current simulations as well as research in displays for UAVs.

- Ability to take UAVs and integrate them into existing training and simulations is a major goal
  - What kind of approach should be taken to do this?
  - There is a lot of existing infrastructure in simulation and UAVs should be a part of it

- Additional tools are required
  - Programming tools need to be created to look at UAV performance
  - Operator tools need to be developed as well to help their understanding of UAV operations
    - This is especially relevant when different operator skill levels are considered
  - Supervisory level tools-tools for generals and other people in supervisory positions which will aid in understanding UAVs are needed
  - Better tools-generic but necessary all the way around

- Reduction of testing variability is needed
  - Obtained by use of standardized tools and measures and even data
  - There are existing UAV standard which we should link to
    - We need to find out if they are publicly available

- Displays
  - Standardization across platforms should be used where it can be applied
    - Mission and task dependent
  - As much standardization as possible should be used without being too restrictive
  - Control display technology-what is appropriate?
    - Depends on interaction level
    - What are the role of haptic and tactile displays?
    - Definition of UAV tasks is needed to help flesh this out
  - There are high levels of automation in UAVs today but what is needed is:
    - Methods to determine how much automation is needed and appropriate?
    - Determination of what the current state of automation in UAVs is and how much is really being used?
    - How do we begin developing displays?

Cognition and Perception

Overview: This discussion focuses on three main points to consider: When automation might intervene, a taxonomy of mission types, and quality of information in UAV operation.

- There are many questions concerning cognition and perception in UAV operations
  - One question is 'when should automation override the pilot?
    - Different views are the norm such as Boeing vs. Airbus
  - Is there really disorientation for UAV operators?
  - Situation awareness is also a top priority of which there are different types
    - Battlefield SA vs. specific task SA
  - What type of training might be necessary?

- When should automation take over?
  - Automation could intervene in riskier parts of missions where the pilot may be losing awareness
    - Automation would take on a supervisory role
  - A major goal here is to determine when and how automation would intervene
    - Mission type and goals would need to be considered

- A taxonomy of mission types and difficulties needs to be developed to aid in determining how and when automation should react
  - Different levels of autonomy will also need to established
    - See and avoid technology will also need to be addressed and falls under this category as well
  - The problem of loss of SA when automation intervenes must also be addressed—how should shifts to automation be handled properly?

- Quality of information and reliability needs to be upheld
  - Circadian rhythms and fatigue needs to be studied
    - Automation would take over when fatigue is high
  - Training is also important
    - Pilots and operators need to be trained to recognize when they are experiencing spatial disorientation

- Perceptual issues:
  - Display research is crucial as is display issues when looking at imagery

Team Process

Overview: The discussion lays out important questions that team researchers will need to answer in the near future.

- What constitutes a team?
  - There can be many types-teams of people, teams of UAVs, teams of UAVs and UGVs, are a few
  - Team size is also important
  - A taxonomy of classes is required that allows researchers to quickly identify what kinds of teams are being discussed or focused on in their communications with each other
  - Teams will also be distributed and dynamically changing which also changes the nature of what constitutes teams
  - A definition of teams vs. groups is needed

- Other important questions that will need to be answered:
  - How will priorities be set in how different members request and share information?
  - How will teams handle transitions (i.e. shift changes and UAV handoffs)?
  - How will individuals share their SA such that it becomes team SA?

- Group interaction processes need to be researched:
  - Crew resource management
  - Workload
  - Trust and expectations

- Methods are needed to evaluate teams
  - Applying methods to dynamic teams
  - How do we go through mission planning in command and control?

- What strategies will we use to mitigate and solve the problems of team process?

Selection and Training

Overview: More research is needed on how operators are selected, and what exactly should be trained.

- Different branches of the military select pilots based on differing criteria
  - This may in some way reflect the variation in UAVs operated today by different branches

- The continuum of UAVs and UAV 'devices' may mean that a continuum of selection and training for operators and/or pilots is required
  - Training and selection may reflect abilities and what the UAV is being used for

- Task analysis will need to be used for selection and training:
  - To identify the knowledge, skill, and abilities (KSA) used for selection
  - To identify what is going to be trained
  - Such task analyses have not yet been done and it must be decided whether a global or systems-specific analysis should be done

- The task analyses would allow for the identification of what common core KSAs operators should possess
  - This would then lead to a common core set of skills that operators would be taught regardless of the UAV they would ultimately end up operating
  - This training would be the equivalent of FAA ground school teaching UAV operators how to work in controlled airspace alongside passenger liners and other manned aircraft

- After the core training, operators would then move on to train on more specific skills
  - For example, some UAVs are controlled by point and click interfaces while others are operated by 'traditional' stick and rudder controls
  - Operator selection would differ based on these control schemes for motor coordination and other skills

- Actual training in light aircraft might also be beneficial to overall training
  - Operators would then have an idea of how aircraft are affected by weather, physics of flight, and other important points of flight
  - Further research and validation is needed on how operators should be selected

Systems Safety

Overview: There are four major components to making UAVs safer to operate: See and Avoid, UAV classification, operator classification, and documentation of mishaps.

- The most important issue in integration of UAVs in the NAS is the 'see and avoid' problem
  - UAVs cannot see and avoid like manned aircraft
  - Procedures for integration of UAVs must be worked out-not just technologies

- An important question in integration is defining what a UAV is
  - There is a continuum running from small, hand-sized UAVs to large UAVs such as the Global Hawk
  - UAVs must be classified much like airplanes are starting with small craft and moving up to larger, more complex craft
  - Ratings may need to be UAV specific
  - A UAV is not simply an aircraft—it is an entire system
  - They can be large, but simple to operate or small and complex. The same UAV can be totally autonomous or directly controlled. Operator skills would be different based on complexity

- Operator classification/qualification
  - Would have to mirror the UAV classification system and addresses what skills a UAV operator needs
  - Medical qualifications have two issues
    - UAV operators don't need the same medical qualifications as pilots
    - Or some may simply opt to obtain medical qualification rather than waiting for the debate on what should make up those qualifications to subside

- A system that deals with safety and UAVs must be established. There are two approaches:
  - Create a UAV category in the Aviation Reporting System
    - The UAV category would be further broken down into specific categories such as engine problems, etc.
    - The UAV community would get updates on what problems occur and would be better prepared to act when a similar problem arises
  - Capture what happens when a mishap actually occurs
    - Mishaps are well documented in the military, but not in the civilian sector