UAVs in Civil Airspace: Toward a Human-Centered Concept of Autonomous Flight Operations. ***Berglund, A.*** [1]***, Tyseng, M.*** [1]***, Westin, C.*** [2]***, Nisser, T.*** [2]***, & Hilburn, B.*** [2]***; Saab Aerosystems*** [1]***, Lund University of Aviation*** [2]***.***

Background

Among the various challenges (e.g. technical, legal and even political) faced in integrating Unmanned Aerial Vehicles (UAVs) into civil airspace, perhaps none are as daunting as those having to do with human factors. As part of its *Core Autonomy* program, Saab is developing technology aimed at enabling autonomous flight CNS capabilities, with minimal intervention from a ground commander. Such capabilities include automated supervision, fault mitigation, critical decision-making in-flight, and collision avoidance using sense and avoid. Alongside technical developments toward a so-called Core Autonomy module have been human factors assessments of the potential impact of such an operational concept, in particular the potential impact of non-nominal scenarios. This aspect of the work started from a review of potential human factors impacts, and proceeded through a cognitive task analysis (CTA) of the developmental user interface.

Introduction

Saab has developed a prototype real-time simulation facility for concept evaluation-- the UAV Control Station (or UCS)-- that embodies flight and control characteristics of the semiautonomous UAV, together with the command driven interface necessary to oversee either autonomous or remotely operated vehicle operations. As depicted in Figure 1, the user interface presents primary flight data, fault management data, flight planning and control interfaces, etc. As a first step toward assessing in the potential error paths and information requirements for the eventual UCS commander, we conducted a Cognitive Task Analysis (CTA) of simulated UAV operating sessions.

Figure 1. A prototype UAV Control Station (UCS) user interface

Method

Based on a defined search and rescue mission, standard scenarios were flown in the UCS, simulating takeoff and landing, and programmed en-route flight. The participant was a commercial pilot and highly experienced UCS commander. The scenarios flown were as follows: flight preparation and plan, re-planning the flight, missed approach, and sense and avoid functionality. To enable later task analysis and follow up, all sessions were video recorded from two different camera angles.

The next step in the CTA process was a card sorting exercise, in which potential tasks and sub-tasks were laid out in logical order. A standard Hierarchical Task Analysis (HTA) was then conducted to decompose the tasks as much as possible. Third, each of the main scenarios was stepped through in logical order. During this exercise, the controller was encouraged to think aloud about what information was required,

from where the information came, the mental and physical steps involved, potential sources of error, etc. A series of prompt questions, and a list of potential cognitive elements, was used to guide discussion. An audio recording was made of the CTA session, and was later transcribed for analysis.

Conclusion

This talk would provide a brief introduction to Saab's Core Autonomy project, as well as developments in its real-time simulation prototype facilities. On the basis of UCS development and CTA work to date, implications would be drawn for future development of both the UCS station and the concept of autonomous UAV operations.