Abstract

The operation of UAVs is dependent on automated subsystems providing several benefits, (1) increased flight safety; (2) simplified operations; (3) lower operating costs; and (4) reduced operator workload (Attar, 2005 in Arrabito et al, 2010). However, the human operator must now monitor the automation to ensure that it performs effectively, introducing implications for degraded human performance which should be addressed by the Human Machine Interface (HMI). The HMI of a system is any part of that system through which information is exchanged between the user and the system. Well-designed interfaces are critical for mission success, efficiency, and to minimize training requirements.

In UAVs, unlike manned platforms, there are unique challenges associated with command and control (C2) and intelligence, surveillance, and reconnaissance (ISR) tasks that should be considered in the HMI design. The following list is compiled from information gathered in UAV incident and accident reports (Tvaryanas et al., 2005, McCarley & Wickens, 2005, Pederson, Cooke, Pringle, & Connor, 2006) and the human factors theories and empirical research based on finding solutions.

1. Lack of sensory cues (i.e., ambient visual input, kinesthetic/vestibular information, and sound).
2. Bandwidth and latency limitations of the data links.
3. Frequent dynamic re-tasking/routing.
4. Ground control station environment.
5. Number of crew personnel.
6. Gaining or handing-off control.
7. Crew communication.

Utilizing a Human Factors (HF) Philosophy to design the UAV HMI entails designing around the operator population and their tasks, while considering the inherent abilities and limitations of human operators. Design guidance is available from published research, military and industry standards and guidelines, and from system subject matter experts (SMEs); however, it is equally important to retrieve information from the representative users of the system to apply that guidance effectively. Following User-Centered Design Principles, HF engineers attain the necessary information through formative and summative evaluations to produce an optimal product (HMI). The potential benefits of well-designed, user-centered HMI for the UAV operator are increased acceptance, satisfaction, efficiency, situational awareness, and safety, while reducing errors, training time and workload. There are cost-benefits associated with each, especially in terms of error and training time reduction.