

Unmanned Systems Research and a Framework of Autonomous and Automated Agents

Research on unmanned systems has addressed a need to identify and define autonomous system design requirements. The same work has surveyed system features that impose demands (workload) on human operators and has formulated models to predict workload outcomes of design. In this talk, I will differentiate the concepts of automation and autonomy within a framework of agents. The framework is complemented by observations on characteristics of automated vs. autonomous systems with examples. I will also discuss levels of system automation along with types of autonomy. A definition of autonomy is developed throughout the talk to a form with utility for engineering. Key requirements for design of autonomy in unmanned (and other complex) systems include agent viability in context, agent self-governance in goal formulation, and independence in defined task performance. The main findings of this research are that demands of automated agents on the human-task-environment system should be absent from design of autonomous agents. Furthermore, the design of automated systems is always automation-centric, despite our best efforts at human-centered approaches. Current empirical work on human-autonomy teaming design is summarized.

Cognitive Workload in Procedural Tasks

Complexities of human cognitive-motor tasks can include high step counts or working memory demands, the need for multitasking, time, pressure, and the need for difficult manual manipulations. Such characteristics can lead to operator experiences of heightened neurophysiological states and/or perception of high cognitive workload. Such responses can also be exacerbated by unexpected operational challenges or task errors. This situation can lead to transient workload responses or sustaining experiences of high cognitive load. For these task scenarios, a common practice is to structure step-by-step procedures that can be followed and possibly memorized or encoded to allow for subconscious performance or automaticity. However, even with procedures in place demands may be such that there remains a need for design of system automation or interfaces to manage operator workload. This requires the capability to sensitively measure/monitor and model cognitive workload responses. In this talk, I will cover one study that provides evidence of differential sensitivity of both subjective and physiological indicators of cognitive workload in assessing operator exposure to both transient and accumulated demands in variations on procedural tasks, involving unexpected operational challenges and time pressure. The research provides insight into what types of cognitive workload measurement methods may be best to use in combination to support application of adaptive automation for real-time workload management in procedural task performance.