**Determining the Impact of Auditory Peripheral Displays for UAV Operators.** ***Graham, H.*** [1]***, Fouse, A.*** [2]***, Cummings, M.*** [1]***, & Pfautz, J.*** [2]***; MIT*** [1]***, Charles River Analytics Inc*** [2]***.***

Unmanned aerial vehicle (UAV) operators work in an information-rich environment. As a result, there is a desire to improve operator performance by utilizing alternate modalities of information display, primarily auditory and haptic. An area in the audio domain deserving attention is the use of continuous peripheral audio displays, particularly in complex, time pressure domains such as UAV operation in command and control settings. Previous research has indicated that continuous auditory displays (in the form of sonifications) can aid anesthesiologists in monitoring patient status by matching deviations in breathing patterns to musical notes. This produces an emergent and continuous aural feature that allows doctors to detect key changes while visually focusing on other tasks. Drawing on this success in the medical monitoring domain, we propose using continuous auditory displays in a command and control setting, particularly the control of one or more unmanned vehicles by a single operator.

Developing continuous peripheral auditory displays to support the operation of UAVs requires consideration of the work environment and its acoustic properties. In anesthesia settings, operating rooms are generally not as noisy as those settings typically found in UAV command and control environments. For example, Shadow UAV operators work in the back of a truck with significant background noise due to nearby generators. Also, UAV operators wear headsets so that they can verbally communicate with both inter and intra team members, unlike doctors who only communicate with co-located individuals. In this communication, operators interact with team members, while contending with an air traffic control-like environment in which they must constantly scan the audio landscape for possible incoming communications and general radio "chatter" to maintain situational awareness. Given this noisy work environment, providing additional useful information through the auditory channel is a challenge. However, audio displays that exploit existing characteristics of the work environment (e.g., by continuously manipulating ambient noise or incoming communications to provide an additional way to present information) may represent one solution.

This presentation will describe an experiment (currently in progress) to test subject performance with audio display enhancements. In particular, a within-subjects experimental design is being used to compare the effects of continuous audio display methods on performance in a single and multiple UAV control task. The remaining independent variables are between-subjects tests to compare performance levels over four audio alert conditions: typical threshold alerts, sonification displays for continuous system variables, sonification displays for discrete system, and combined displays (with both the continuous and discrete alerting active). Finally, the dependent variables include various performance metrics, subjective workload, and secondary task performance. The results should show whether the continuous or discrete auditory alerts provide any measurable benefit over traditional alerts, and how they do or do not enhance performance between the four alert conditions in a typically noisy work environment. Other findings should include how much the sonification increases or decreases workload and situational awareness.