Instruction for symposia presentation submission

**Neuroergonomics: The brain, mind, and body at work**
Raja Parasuraman
George Mason University, Fairfax, VA, USA

**Theme:** Neuroergonomics; auditory ergonomics; visual ergonomics; physical ergonomics

**Objectives:** Attendees will gain an understanding of how techniques such as event related potentials (ERPs), saccadic eye movements, functional Near Infrared Spectroscopy (fNIRS), electromyography (EMG), and Tympanic membrane temperature (TMT) can be used to examine ergonomic issues such as: assessment of mental workload in complex systems; design of auditory alarms; and assessment of the interactions between physical and mental fatigue. Traditionally, researchers and system developers have used behavioural, subjective rating, or peripheral physiological measures in addressing design issues in ergonomics, with a relative neglect of the brain, the source of human behaviour. Furthermore, physical and cognitive ergonomists typically work independently, even though a systems view of the human operator would indicate that both mind and body should be considered in an integrated manner. The recent development of neuroergonomics has provided an opportunity to rectify both these deficiencies and allowed for the dynamic functional analysis of brain activity during both cognitive and physical work. Some of these technologies are portable and use wireless communication, allowing for ambulatory monitoring of physical work and its interaction with cognitive work.

**Expected number of papers to be included (titles and authors if known):** 5

**Length of panel:** 2 hours

**Raja Parasuraman, George Mason University, USA,** “Functional Near Infrared Spectroscopy as a Tool for Mobile Neuroergonomics: Mental and Physical Workload”

Low-cost mobile brain imaging techniques, such as fNIRS can provide the means for examining interactions between cognitive and physical work. Two studies using fNIRS to assess changes in mental workload are reported, one in seated individuals and one in participants walking around a college campus in order to navigate to designated places with the aid of Google Maps, presented either on a handheld mobile phone or displayed with Google Glass. The results validate the utility of fNIRS as a tool for mobile neuroergonomics.

**Jason S. McCarley, Flinders University, Australia,** “Eye movements, Attention, and Workload.”

Monitoring oculomotor behavior in the workspace can provide a human factors researcher or practitioner with insights into the operator’s strategies, skills, knowledge, and workload. For instance, eye movement data can identify the source of human performance failures in visual search and driving, and may provide a gauge of cognitive overload or distraction in driving and supervisory monitoring tasks. In new applications, eye movements may also provide a method for cooperating operators to communicate and coordinate their attentional behavior within a visual workspace. These applications of oculomotor monitoring, and models of oculomotor behavior in visual workspaces, will be discussed.

**Ranjana Mehta, Texas A&M University, USA,** “Neuroergonomic Evaluation of Fatigue.”
Fatigue is a complex, multifaceted phenomenon and the contributors to fatigue may be either physical or psychological and the occurrence site may be the brain or the body, or both. Examining the role of brain functioning during fatigue development is critical to extend our knowledge on the etiology and potential mechanisms of fatigue. What is the role of the brain in fatigue development? How does it affect downstream peripheral responses? What are the potential mechanisms through which stress and other work-related cognitive factors can increase fatigability? To address these important questions, we employ an integrative brain-body approach to explore potential pathways of fatigue development under stressful conditions. Findings from our recent study on the impact of cognitive fatigue on neural correlates of muscle endurance will be discussed.

Carryl Baldwin, George Mason University, USA, “Using ERPs to Individualize Spatial Auditory Alerts”

Conveying spatial information through the auditory channel has been shown to speed response and improve accurate detection of time critical threats. Using ERPs, clear evidence has been obtained for the benefit of tailoring auditory spatial format to the individual spatial strategy of operators. Semantic spatial cues aid some operators more than spatially distributed location cues. Recent studies in this area are presented and their implications are discussed for improving auditory spatial displays in surface, air, and unmanned systems.

William “Deak” Helton, University of Canterbury, New Zealand, “Tympanic Membrane Temperature: Brain Imaging On a Very Tight Budget”

Many brain imaging techniques for use in neuroergonomic studies have high purchase or operational costs. In contrast, Tympanic membrane temperature (TMT) provides a low cost means to infer the blood supply to the nearest cerebral hemisphere. Under normothermic conditions the brain is hotter than the core; a decline in cerebral blood flow may induce an increase in TMT. The relationship between TMT and cerebral activity may however depend on the level of analysis: whether it is used to compare between subjects or used to compare changes within subjects. This level of analysis is often confused in the literature. This issue and some studies conducted on TMT as an indicator of cerebral activity will be discussed.

Length of panel: 2 hours

Target audience and expected level of interest: This panel will appeal to individuals with interests in either (or both) physical and cognitive ergonomics. The rapid rise of neuroergonomics and its growing application to design and training issues in ergonomics will also engender a high level of interest.

Type of room and/or facilities required: Room seating up to 100 people, projector with video and audio capability and screen.

Materials needing to be provided (if any): N/A