Neuroergonomics in Aviation: Assessing Human Performance from Lab to Operational Environment

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Abstract / Short description

The recent widespread use of wearable physiological sensors and real-time analytic techniques enables objective assessment and monitoring of operators' cognitive and physiological states. This is especially prevalent in the aviation field, where measuring constructs such as attention, mental workload, and situational awareness is critical for mission success. However, the proliferation of neuro-technologies can baffle newcomers and experts alike: which neurotechnology to use, and for which purpose? This workshop will focus on know-how exchange and discussion on the most common and frequently used techniques for monitoring brain function, including functional magnetic resonance imaging (fMRI), electroencephalography (EEG), eye-tracking, and functional near infrared spectroscopy (fNIRS). The speakers will share in-depth knowledge on pros and cons of these select techniques, their potential implementation in aviation and data processing and analysis. Upon completion of the workshop, participants will know which measurement technique to implement, what to measure, and which analysis technique to choose from.

The workshop will include three lectures. The first lecture, titled "Neuroimaging in Aviation Research" (speaker: Assaf Harel) will introduce the neuroergonomics approach and its importance for the field of aviation, describing current neuroimaging research in the field of aviation with a focus on electroencephalography (EEG) and functional magnetic resonance imaging (fMRI). The second lecture, titled "Eye Tracking Research and Applications" (speaker: Cengiz Acartürk) will discuss eye-tracking research and applications in the context of neuroergonomics research. including domains of compatible use, lab and natural settings, data analysis, and metrics. The third lecture, titled " Wearable Optical Brain Imaging Sensors to Quantify Performance and Skill Acquisition" (speaker: Kurtulus Izzetoglu), will discuss the utility and promise of functional near-infrared spectroscopy (fNIRS) systems and advanced neural signal analysis in studying operator performance and training in the field of aviation and other operational settings. The three lectures will be followed by a panel discussion with the speakers.

Keywords

Tentative Schedule:

Tuesday, July 9th am

Workshop – chair: Assaf Harel	
8:00 am	Welcome and introduction
8:15 am	Assaf Harel
9:15 am	BREAK
09:30 am	Cengiz Acartürk
10:30 am	BREAK
10:45 am	Kurtulus Izzetoglu
11:45 am	Conclusion

Presenter Biographies

Assaf Harel, PhD

Assaf Harel is a cognitive neuroscientist with over 25 years of research experience, specializing in research partnering academia, industry, and government, primarily DoD. He currently leads the Human Performance Lab, a neuroergonomics lab in Israel's leading defense company, *Rafael Advanced Defense Systems*. Before joining *Rafael Advanced Defense Systems*, Dr. Harel was an Associate Professor in the Human Factors program at Wright State University's Department of Psychology and headed the Human Neuroscience and Visual Cognition Lab (HNVCL). His research at the HNVCL employed a neuroergonomics approach, harnessing cognitive neuroscience techniques (EEG, fMRI, and eye-tracking) to investigate how visual recognition occurs in the real-world, and determine how this knowledge can be used to augment learning and performance. Topics of his research include visual expertise, overhead imagery analysis, attention, performance, and top-down control. Dr. Harel received his PhD in Cognitive Neuropsychology from the Hebrew University of Jerusalem, Israel in 2009, and was a research fellow at the Laboratory of Brain and Cognition at the National Institute of Mental Health (National Institutes of Health/Department of Health) between 2009 to 2014.

Cengiz Acartürk, PhD

Cengiz Acartürk is a faculty member at the Cognitive Science Department of Jagiellonian University, Krakow, Poland, since 2021. He was a faculty member at the Cognitive Science and Cybersecurity Graduate Programs of the Informatics Institute, Middle East Technical University (METU), Ankara, Turkey. He received a Ph.D. from Hamburg University, Institute Knowledge and Language Processing Institute, Centre for Intelligent Systems and Robotics (ISR), Department of Informatics, in 2010. He has been conducting eye-tracking research in various domains for the past two decades. His current research interests cover eye-tracking applications, oculomotor control in reading, and NLP applications. He has taught graduate courses on visual cognition, psychology of reading, AI, and machine learning at the Cognitive Science Program

Kurtulus Izzetoglu, PhD

Kurtulus Izzetoglu is an Associate Professor in the School of Biomedical Engineering, Science & Health Systems, and affiliate faculty in the School of Education at Drexel University, Philadelphia, PA, USA. Dr. Izzetoglu's research and teaching interests are in neuroengineering, functional brain imaging, biomedical signal processing, human performance, learning and training. He has a background in both electrical and biomedical engineering coupled with experience of developing and adopting highly portable optical brain imaging systems, e.g., functional near infrared spectroscopy (fNIRS) for the field use in applications ranging from medical to aviation domain. His current research projects related to human performance assessment include integration of the fNIRS and other biosensors to enable personalized training in safety critical tasks; brain-in-the-loop studies to improve human autonomy teaming and training both in clinical (nurse, surgeon training) and in aviation (autonomous systems); effects of immersive VR manipulative interventions on learning. Dr. Izzetoglu has been the institutional principal investigator and the university lead in two U.S. Federal Aviation Administration (FAA) Centers of Excellence (COE) - COE for Technical Training and Human Performance and COE for Unmanned Aircraft Systems. He also serves on the boards and program committees, including International Conference on Augmented Cognition / International Conference on Human – Computer Interaction, International Conference for Research in Air Transportation (ICRAT) and International Symposium on Aviation Psychology.