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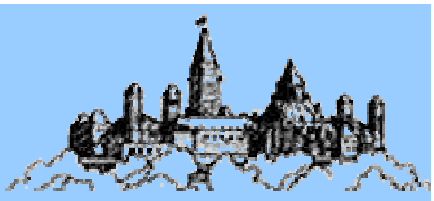

Environment-Robust Brain-Computer Interfaces:

Can Insights be Used for Biologically-Inspired Speech Processing

Dr. Tiago H. Falk

Assistant Professor, Institut National de la Recherche Scientifique (INRS-EMT)

Brain-computer interfaces (BCIs) have emerged as a useful tool for individuals with multiple and severe disabilities to communicate and interact with their environment. Electroencephalogram (EEG) based BCIs are the most common type but require lengthy and cumbersome training sessions, as well as skin preparation and electrode gels. To overcome these limitations, near-infrared spectroscopy (NIRS) based BCIs have gained momentum. NIRS assesses functional activity in the brain via measured hemodynamic responses with spatial resolutions similar to those obtained with EEG. NIRS-BCIs commonly probe the motor or the pre-frontal cortices in order to harness useful control signals. Monitoring the prefrontal cortex, however, presents two major shortcomings: i) the performance of the mental tasks can be severely affected by ambient noise, and ii) the prefrontal cortex is known to be involved in the processing of distracting auditory startle stimuli.

In this talk, I will discuss experiments we have conducted to ascertain the effects of environmental factors on NIRS-based BCI technologies. In order to take the first step towards the development of noise-robust tools and to enhance the classification of mental activity under noisy conditions, two strategies were investigated. The first strategy proposed the development of a "hybrid" BCI, which incorporated signals harnessed from the autonomic nervous system (ANS) as complementary information to brain hemodynamic responses. While shown to improve BCI performance in continuous background noise environments, ANS-harnessed signals were shown to be extremely sensitive to auditory startle stimuli. To further improve performance, an acoustic monitoring technique termed "environment sniffing" was used to suppress classification errors caused by such startle stimuli. I will conclude the talk by describing some of the ongoing work we are conducting at the Institut National de la Recherche Scientifique (affiliated with the University of Quebec) in Montreal, on using BCI insights to develop biologically-inspired speech/audio signal processing technologies.

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admission is free

14:00 – 15:00

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Carleton University

Tiago H. Falk received the BSc degree from the Federal University of Pernambuco, Brazil, in 2002, and the MSc and PhD degrees from Queen's University, Canada, in 2005 and 2008, respectively, all in electrical engineering. In 2007, he was a visiting Research Fellow at the Sound and Image Processing Lab, Royal Institute of Technology (KTH), Sweden, and in 2008 at the Quality and Usability Lab, Deutsche Telekom, Germany. From 2009-2010 he was a Postdoctoral Fellow at Holland-Bloorview Kids Rehabilitation Hospital, affiliated with the University of Toronto. Since Dec. 2010, he has been an Assistant Professor at the Institut National de la Recherche Scientifique (INRS-EMT) in Montreal where he is Director of the Multimedia/Multimodal Signal Analysis and Enhancement (MuSAE) Laboratory. Dr. Falk is also an Adjunct Scientist at Holland-Bloorview and a Research Advisor for InteraXon Thought Controlled Computing. His research interests include speech quality measurement and enhancement, neural correlates of speech quality perception; assistive technologies; speech communication disorders; and human-machine interfaces. He has published over 70 journal manuscripts, conference papers, and book chapters in these topics.

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