Monday 1st February 4pm – Maynooth University Psychology Department

Dr. John Butler (DIT)

Self-Motion Processing in Humans from Psychophysics to High Density Electrical Mapping

John S. Butler is a Lecturer in the School of Mathematical Sciences in Dublin Institute of Technology. His research interest is multisensory integration with an emphasis on self-motion. John received his PhD in Numerical Analysis from the School of Mathematics, Trinity College Dublin under the supervision of John Miller. Following this, he was a post-doctoral fellow at the Max Planck Institute for Biological Cybernetics for three years. During this time he collaborated with Heinrich Bülthoff on research in self-motion perception using a variety of methods from low level psychophysics to complex closed loop tasks to electrophysiological recordings. From 2009 to 2013 he worked with John Foxe and Sophie Molholm at the Cognitive Neurophysiology Laboratory where he expanded the scope of his work to include a translational research component, specifically investigating the neural developmental differences in multisensory integration between typically developing children and children with Autism Spectrum disorder. From 2013 to 2015 he worked with Prof Richard Reilly at the Trinity Centre for Bioengineering in Trinity College Dublin on movement disorders.

Abstract: This talk will present a series of studies which investigate the contributions of vestibular cues to self-motion perception using psychophysics combined with Maximum Likelihood models of sensory integration and electrophysiological recordings.

In the first set of studies, we investigated the relative contributions of visual and vestibular cues during self-motion. The results showed that even when there was a relatively large conflict between the visual and vestibular cues, participants exhibited a statistically optimal increase in reliability. On the other hand, the reliability of the unimodal conditions did not predict the weights in the combined cue condition. Specifically, visual–vestibular cue combination was not predicted solely by the reliability of each cue, but rather more weight was given to the vestibular cue.

In the second set of studies, we deployed high-density electroencephalographic (EEG) recordings to investigate the neural processes associated with passive and active self-motion. In the passive self-motion task, participants were translated diagonally to the left or right with a stimulus probability of 80–20%. Participants responded when they detected the infrequent direction change via button-press. Topographic analysis showed, for the first time, that the vestibular cues elicited typical cortical response to an infrequent stimulus. In the active self-motion task, participants walked on a treadmill while performing a visual response inhibition task. Robust evoked components were obtained under all experimental conditions - while participants were stationary, walking slowly, or rapidly. The EEG studies provide highly promising methods for gaining insight into the neurophysiological measures of self-motion under a more naturalistic environmental setting.