KLINGLER
College of Arts & Sciences
MARQUETTE UNIVERSITY

Department of Mathematics, Statistics and Computer Science

SPECIAL COLLOQUIUM ANNOUNCEMENT

Healthcare wearables and computational neuroscience: applications of machine learning

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Abstract

Measuring the effect of therapies to improve mobility is a critical component to improving healthcare. Unfortunately, most measures require expensive and time-consuming clinical visits, specialized equipment, or periodic interruptions throughout the day (e.g. journals and diaries). Fortunately, wearable devices, including mobile phones, are packed with an array of sensors that can be used to infer health and mobility throughout the day, with little to no additional cost or effort. I develop machine learning algorithms to automatically track the activities of subjects throughout the day (e.g. walking, sitting, standing). I will identify the unique challenges in building tracking systems for patients with motor impairments, including those with Parkinson’s Disease, stroke, incomplete spinal cord injury, and lower-limb amputations. I have also used machine learning in a series of fall detection studies for amputees and stroke subjects to collect data for preventative care, to classify the type of fall, and aid in emergency response. Machine learning applied to wearable device signals allows us to continuously, conveniently, and objectively evaluate a large number of patients over an extended period of time. This provides information that is invaluable to researchers and clinicians in improving the care of patients with impairments in mobility.

I will also present preliminary work making inferences about the nature of visual development and human depth perception using machine learning. Prior to eye-opening, many animals, including humans, exhibit spontaneous, patterned neural activity in the visual system. My Ph.D. work demonstrated how the rest of the visual system can learn from these patterns to refine visual processing in a similar way to how animals learn from their visual environment after eye-opening - an “innate learning” view of visual development. To further establish the efficacy of this approach, I have created a system that generates binocular patterns of neural activity. The abstract, but physiologically-plausible, two eye-layer percolation model is capable of generating neural activity patterns that train a visual code resembling primary visual cortex (V1) receptive fields. More importantly, with a binocular visual system we can also select patterns based on the ability of the derived visual code to perform depth perception tasks on autostereograms (“magic eye” illusions). Matching expectations of an innate visual learning paradigm, optimal activity parameters for depth perception also produce simulated activity that closely resembled spontaneous activity measured in vivo. This work demonstrates how an ecologically relevant goal, like binocular depth estimation, can be used to directly estimate properties of binocular visual development using principles of computational neuroscience.

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POST-COLLOQUIUM REFRESHMENTS SERVED IN ROOM 342 AFTER 2:00 P.M.