Tuesday, March 23, 2:30 pm

Speaker: Prof. Christopher Barrett

Institution: McGill University

Title: Bio-Inspired Materials for Neuro-Engineering the Brain-Machine Interface

Abstract: New developments toward creating a working 2-way communication between brains and machines offer exciting possibilities, yet are often limited simply by the basic bio-compatibility of the materials employed in their construction. Traditional electrical engineering semiconductors and metals are often quite poor choices for use in a real living wet biological environment, and much recent effort has been devoted to instead develop soft, squishy bio-polymer interface materials, that communicate via photons and not electrons. Inspired by the molecular mechanisms in our eyes that enable vision, photo-reversible azo visible dyes are incorporated into bio-polymers such as silk fibronin, to provide a stable transduction layer between live neural cells and optical fibres. Sensing neural activity selectively is achieved spectroscopically via subtle optical changes to the thin dye nano-layers at the fibre ends. Signaling back to a brain can be achieved by simple mechano-transduction via photo-mechanical layers, photo-chemical release of neurotransmitters from artificial vesicles embedded, or via light-reversible changes to surface energy and chemistry. Characterization of the structure and dynamics of these soft active nano-neuro-layers in situ is a key challenge, and results will be detailed from surface energy analysis, and 'underwater' Visible Ellipsometry, and Neutron Reflectometry techniques we have developed at McGill, and at Chalk River Laboratories. Some spin-off applications of these new materials can also be mentioned briefly, toward Canada's Sudbury Neutrino Observatory, NeuraLink Corporation (USA) BMIs, and remote optical sensing of neurotransmitter release field-tested by our Group in Montreal, during neurologically interesting events such as whitewater kayaking and skydiving.