An Overview of Neuroengineering and Two Examples of Virtual Reality Systems Combined Combined with Electrophysiological Data: Insect Navigation and Human Therapeutics

(Talk #1)

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The recent significant advances in three scientific and technological domains – neuroscience, computing and device development – has lead to the emergence Neuroengineering, a discipline that focuses on (1) revealing the principles by which neural systems accomplish the computations they carry out, (2) developing tools and technologies that allow us to interact with, learn from and assist neural systems and (3) creating systems that are inspired by neural system function. At the University of Washington Institute of Neuroengineering we support a broad range of research activities that revolve around the above three foci. In this talk we give a brief overview of those research activities. We then focus on two specific research projects that utilize virtual reality systems interacting with either humans or insects. In the insect system, a virtual reality flight arena is used to ask what sensory features underlie decision making in the control of flight through a complex environment and what muscle activity is associated with flight maneuvers. Using a combination of Markov decision processes and gaming analogs, we find that object detection and avoidance along with balancing visual optic flow are key determinants of navigational decisions. We draw a parallel to this work in recent related research on human interaction with gaming systems [1]. In that study virtual reality systems combined with real-time electromyography is used to assist individuals suffering from cerebral palsy. Significant improvement in control of wrist extension following EMG-controlled gaming is seen a several individuals.

References:

[1] Rios, D.C., Gilbertson, T., McCoy, S.W., Price, R., Gutman, K.F., Miller, K.E.F., Fechko, A., and Moritz, C. T. (2013) NeuroGame Therapy to improve wrist control in children with cerebral palsy: A case series. *Developmental Neurorehabilitation.* Published Online April 25, 2013 (doi:10.3109/17518423.2013.766818). [2] A. Fang, Th. Koschny, M. Wegener and C. M. Soukoulis, Phys. Rev. B. 79 241104(R) (2009).