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EDITORIAL

Focus on the neural interface

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The possibility of an effective connection between neural tissue and computers has inspired scientists and engineers to develop new ways of controlling and obtaining information from the nervous system. These applications range from 'brain hacking' to neural control of artificial limbs with brain signals. Notwithstanding the significant advances in neural prosthetics in the last few decades and the success of some stimulation devices such as cochlear prosthesis, neurotechnology remains below its potential for restoring neural function in patients with nervous system disorders. One of the reasons for this limited impact can be found at the neural interface and close attention to the integration between electrodes and tissue should improve the possibility of successful outcomes.

The neural interfaces research community consists of investigators working in areas such as deep brain stimulation, functional neuromuscular/electrical stimulation, auditory prostheses, cortical prostheses, neuromodulation, microelectrode array technology, brain–computer/machine interfaces. Following the success of previous neuroprostheses and neural interfaces workshops, funding (from NIH) was obtained to establish a biennial conference in the area of neural interfaces. The first Neural Interfaces Conference took place in Cleveland, OH in 2008 and several topics from this conference have been selected for publication in this special section of the *Journal of Neural Engineering*.

Three 'perspectives' review the areas of neural regeneration (Corredor and Goldberg), cochlear implants (O'Leary *et al*) and neural prostheses (Anderson). Seven articles focus on various aspects of neural interfacing. One of the most popular of these areas is the field of brain– computer interfaces. Fraser *et al*, report on a method to generate robust control with simple signal processing algorithms of signals obtained with electrodes implanted in the brain. One problem with implanted electrode arrays, however, is that they can fail to record reliably neural signals for long periods of time. McConnell *et al* show that by measuring the impedance of the tissue, one can evaluate the extent of the tissue response to the presence of the electrode. Another problem with the neural interface is the mismatch of the mechanical properties between electrode and tissue. Basinger *et al* use finite element modeling to analyze this mismatch in retinal prostheses and guide the design of new implantable devices. Electrical stimulation has been the method of choice to activate externally the nervous system. However, Zhang *et al* show that a novel dual hybrid device integrating electrical and optical stimulation can provide an effective interface for simultaneous recording and stimulation. By interfacing an EMG recording system and a movement detection system, Johnson and Fuglevand develop a model capable of predicting muscle activity during movement that could be important for the development of motor prostheses. Sensory restoration is another unsolved problem in neural prostheses. By developing a novel interface between the dorsal root ganglia and electrodes arrays, Gaunt *et al* show that it is possible to recruit afferent fibers for sensory substitution. Finally, by interfacing directly with muscles, Jung and colleagues show that stimulation of muscles involved in locomotion following spinal cord damage in rats can provide an effective treatment modality for incomplete spinal cord injury.

This series of articles clearly shows that the interface is indeed one of the keys to successful therapeutic neural devices. The next Neural Interfaces Conference will take place in Los Angeles, CA in June 2010 and one can expect to see new developments in neural engineering obtained by focusing on the neural interface.

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