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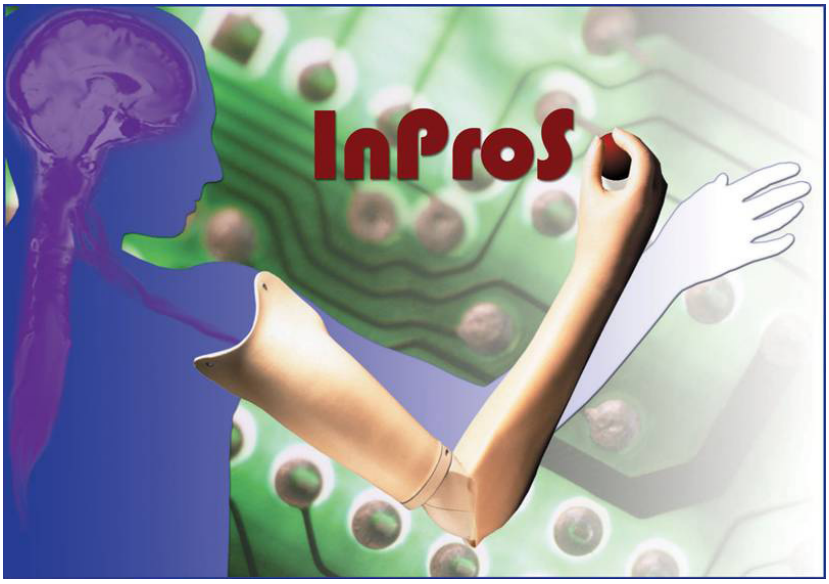
REHABILITATION ENGINEERING

Center for Adaptive Neural Systems

The focus of this research cluster is the practice of medical rehabilitation through the use of technology with specific emphasis on neurotechnology to offset the impact of spinal cord injury, orthopedic injury, Parkinson's disease and cerebral palsy. Researchers apply a multifaceted approach to investigate trauma and disorders of the nervous system, to replace damaged or lost functionality or to repair the system using advanced adaptive devices and therapeutic techniques.

The **Center for Adaptive Neural Systems** develops and utilizes new scientific knowledge and engineering technology at the cross-sections of bioengineering, neuroscience and rehabilitation. Problems are addressed at multiple levels, from molecular/cellular physiology, neural circuitry and systems neurophysiology to musculoskeletal physiology and behavior.



Funded by a partnership between NIH's National Institute of Biomedical Imaging and Bioengineering, the Center for Adaptive Neural Systems is embarking on the delivery of intelligent prosthetic systems (InProS) for amputees. These systems are designed to provide sensory perception to the user from the prosthesis as well as dynamic control of the prosthesis by capturing the intent of the user.

The goal is to deliver advanced medical technology to the biomedical industry and clinical practice arena. Core research areas under this cluster are:

Neural prostheses and advanced prosthetic systems for those with spinal cord injury, limb loss or Parkinson's disease that will help restore mobility and functionality. A new NIH funded project, for instance, will embark on clinically implementing an intelligent prosthetic system that uses electrodes implanted within the fascicles of peripheral nerves to provide upper extremity amputees with sensory feedback and active volitional control of the prosthesis.

Neuromorphic control systems uses biological designs, specifically architectural and operational principles of neural system function, in order to develop improved engineered systems. This involves designing algorithms and electronic circuits that mimic the functionality of neuromotor control systems. A recent U. S. Army funded project, for instance, focused on developing a suite of products in new orthotics and prosthetic options for people with lower limb dysfunction or lower limb amputation.

REHABILITATION ENGINEERING, cont....

Adaptive processes in neural systems enable biological systems to learn and to interpret sensory information and functional movements that will eventually maximize the recovery of function after trauma and neurological disorders. A current NIH-sponsored project, for instance, is studying ways to enhance existing locomotor therapies using timed electrical simulation of muscles for optimum therapeutic results. This work is in collaboration with the Banner Good Samaritan Medical Center.

Another NIH-funded project is a collaborative effort between researchers at the University of Michigan, the Barrow Neurological Institute and Exponent, Inc., investigating the interaction between neural and musculoskeletal systems in locomotion activities. Complex mathematical models of the biomechanics of traumatic spinal cord injuries are being developed to better understand the interactions amongst the impaired central drive and spinal reflexes and musculoskeletal changes for designing appropriate therapies.

Additional projects include study of motor deficits in cerebral palsy for developing therapeutic interventions, hormonal response to exercise after spinal cord injury and acquiring NIH funding for a one-of-a-kind nuclear magnetic resonance imaging (MRI) system in Arizona. The system will be used in small animal models to increase noninvasive and repeat procedures for testing disease treatments.

SELECTED PUBLICATIONS

Lynskey. J.V.,A. Belanger, R. Jung. "Activity dependent plasticity in spinal cord injury." Journal of Rehabilitation Research and Development, 2007 (In Press)

Gillette, J.C., C. A. Stevermer, N.E. Quick, and J.J. Abbas, "Alternative foot placements for individuals with spinal cord injuries standing with the assistance of functional neuromuscular stimulation", Gait and Posture, 2007 (In press). doi:10.1016/j.gaitpost.2007.04.005

Kanchiku, T, J.V.Lynskey, D. Protas, J.J. Abbas and R. Jung. "Neuromuscular electrical stimulation induced forelimb movement in a rodent model." J Neurosci Methods, 2007 (In press). doi:10.1016/j.jneumeth.2007.08.002J.

Venkatasubramanian, G., R. Jung, J. Sweeney. "Functional Electrical Stimulation", In: The Wiley Encyclopedia of Medical Devices and Instrumentation, 2nd Edition, Editor. J. G. Webster, Wiley March 2006. ISBN: 0-471-26358-3; 3666 Pages.

Abbas, J.J., "Neural Networks for Physiological Control" in Biomedical Engineering Fundamentals: The Biomedical Engineering Handbook, 3rd Edition, Edt. J.D. Bronzino, CRC Press, Inc., Boca Raton, FL, pp. 12-1, 2006.

Dhillon GS, TB Krüger, JS Sandhu, KW Horch (2005) "Effects of short-term training on sensory and motor function in severed nerves of long-term human amputees." J. Neurophysiol. 93:2625-2633.

Abbas, J.J., and Riener, R. "Using Mathematical Models and Advanced Control Systems Techniques to Enhance Neuroprosthesis Function", Neuromodulation, Vol. 4, No. 4, pp. 187-195, 2001.

Riess, J.A. and Abbas, J.J. "Adaptive Control of Cyclic Movements as Muscles Fatigue Using Functional Neuromuscular Stimulation", IEEE Trans. Rehab. Eng. Vol. 9, No. 3, pp. 326-330, 2001.

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