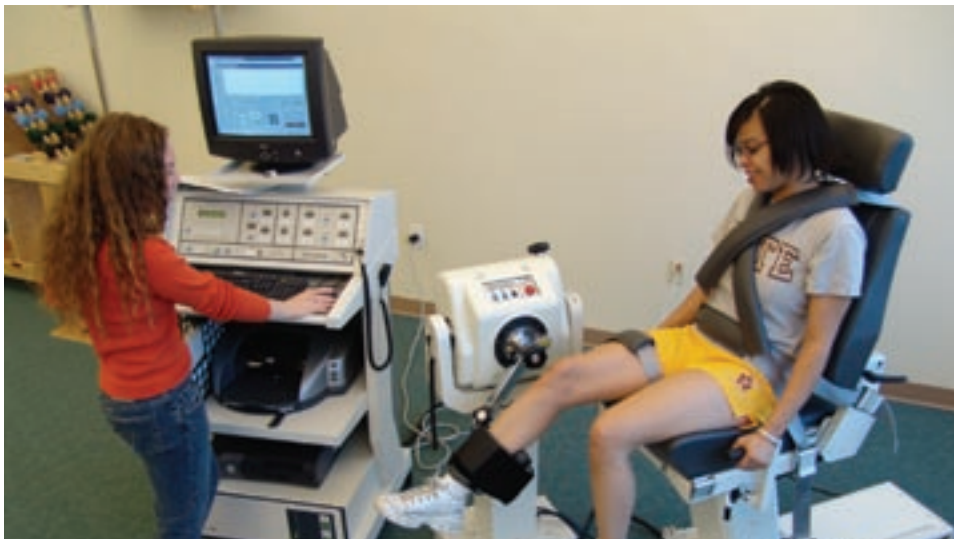
Center for Rehabilitation Neuroscience and Rehabilitation Engineering

The goal of this center is to improve the quality of life of individuals with disabilities by designing and developing technologies to counter the effects of neurological disorders.

This research program uses a multi-faceted approach to address the impact of disability at several different levels. At the most basic level, our research seeks to understand neural system function and to characterize the effect of neurotrauma and neuropathology on the nervous system. In this work, we utilize basic neuroscience as well as advanced engineering techniques, such as nonlinear dynamical systems analysis. At the applied level, we design and develop systems to activate neural tissue in order to enable individuals to achieve a desired function or to elicit a desired therapeutic effect. In this work, our focus has been on the development of adaptive and neuromorphic control algorithms. Although our interventions often are implemented at the cellular level, our approach to evaluation is decidedly at the systems and behavioral levels. Facilities for this research provide capabilities for a variety of neurological interventions as well as neurological, biomechanical, and physiological assessment of function in animal models and human subjects. Applications in the early stages of development in animal or human models are currently funded through the R01 mechanism, while others are funded through SBIR/STTR grants to startup companies (customKYnetics, Inc.) and (AdveNSys, LLC) that Abbas and Jung and co-workers have respectively formed. In on-going and planned projects, an important aspect of our research approach is to engage researchers from ASU (Bioengineering, Kinesiology, Electrical Engineering, Mechanical Engineering, Speech and Hearing Sciences, etc), medical centers (Good Samaritan Regional Medical Center, TGen, Mayo Clinic Scottsdale and Rochester, Barrows Neurological Institute), other universities (Case Western Reserve University, University of Illinois, Chicago, University of Michigan, Indiana University/Purdue University, University of Kentucky) and from biomedical industry (customKYnetics, Inc.



Students demonstrate muscle rehabiliation equipment at the Center for Rehabiliation Neuroscience and Rehabilitation Engineering lab.

and Three Rivers, LLC, etc.) in collaborative projects. Activities of the Center contribute to the overall mission of Biodesign primarily through the development of new technologies applied to neurological rehabilitation. We also contribute to the mission by providing support facilities for other Biodesign Centers that are interested in performing quantitative evaluations of physiological function in human subjects and/or small animal models.

Research Areas

Our technological strengths include expertise in designing and developing electrical stimulation systems. Our focus has been on the design of control systems with particular emphasis on adaptive and neuromorphic control systems. A fundamental contribution of our work has been the design of algorithms that automatically customize stimulation parameters for an individual. This development, which addresses a major limiting factor in clinical implementation of many rehabilitation systems, is currently being incorporated into systems for exercise, neuromotor therapy, and posture control. Another important contribution has been the design and development of electronic hardware that simulates the neural activity of the spinal circuits and a demonstration (in an animal model) that this neuromorphic hardware can control the activity of spinal circuits in real-time. Future versions may provide high fidelity replacements for damaged spinal circuits.

Our facilities for quantitative evaluation in human subjects and in acute and chronic small animal models form an integral component of our approach to the development of medical technology. Our laboratories are equipped for behavioral and biomechanical analysis of movement and

> The goal of the center is to improve the quality of life of individuals with disabilites

for monitoring neurological, cardiovascular, respiratory and metabolic function. Advanced biomedical signal processing techniques and computational modeling are used in data analysis and interpretation. These facilities and our expertise are used to evaluate technology developed in our center, but they also provide opportunities for evaluating technology that is developed in other Biodesign Centers, other ASU research labs, as well as research labs in regional medical facilities.

Contact Information

James Abbas and Ranu Jung, Directors
james.abbas@asu.edu
jung@asu.edu

PO Box 879709
Arizona State University
Tempe, AZ 85287-9709
(480) 965-9521
(480) 965-9052

http://www.azbio.org/centers/rehabilitation.html

Researchers

Dr. James Abbas shown above

Ira A. Fulton School of Engineering

James Abbas, Ph.D. Associate Professor, Harrington Department of Bioengineering

Jiping He, PhD; Professor, Harrington Department of Bioengineering

Sandeep Gupta, PhD; Associate Professor, Computer Science and Engineering

Leon Iassamedis, Ph.D. Associate Professor, Harrington Dept of Bioengineering

Ranu Jung, Ph.D. Associate Professor, Harrington Department of Bioengineering

Jitendran Muthuswamy, Ph.D. Assistant Professor, Harrington Dept of Bioengineering

Alyssa Panitch, PhD; Assistant Professor, Harrington Department of Bioengineering

Stephen Phillips, PhD; Professor, Electrical Engineering

Thomas Sugar, PhD; Assistant Professor, Mechanical Engineering

James Sweeney, PhD; Associate Professor, Harrington Department of Bioengineering

Gary Yamaguchi, PhD; Associate Professor, Harrington Department of Bioengineering

College of Liberal Arts and Sciences

Edward Castaneda, PhD; Associate Professor, Psychology

Kim Huey, PhD; Assistant Professor, Kinesiology

Marco Santello, PhD; Assistant Professor, Kinesiology

Wayne Willis, PhD; Professor, Kinesiology