# Symposium: Technology Meets Physical Disability II

**Friday, June 5 & Saturday, June 6 – 8:00 am-12:00 pm**
The Ritz-Carlton Ballroom

## Title Abstracts and Panel Bios

## <u>Friday, June 5, 2009</u>

8:10 am **Welcome**

Dr. Hugh Herr, Ph.D., Associate Professor, MIT Media Lab & MIT-Harvard Division of Health Sciences and Technology

Bart Chernow, M.D., MACP, Vice Provost for Technology Advancement, Vice President for Special Programs, and Professor of Medicine and Anesthesiology, University of Miami

Pascal J. Goldschmidt, M.D., Senior Vice President for Medical Affairs and Dean, University of Miami Miller School of Medicine, Chief Executive Officer, University of Miami Health System

8:40 am **Session 1: Technologies for the Visually Impaired**
Moderator: Virginia Jacko, President and CEO, Miami Lighthouse for the Blind

**Vision Substitution in the Blind by Means of Tactile Stimulation of the Tongue**

Retinitis pigmentosa and age-related macular degeneration are known causes of blindness. War-related lesions have produced scores of blind individuals among military personnel and civilians. In the hope of restoring vision in blind individuals, technologies have been developed over the past decades to implant microelectronic visual prostheses that, analogous to cochlear implants, would directly stimulate remaining retinal neurons with electrical current. These surgical procedures have had some success in producing visual percepts in some cases. Surgical approaches have inherent risks, and often may not be used due to the inability of the lesioned retina to withstand the implant or because the visual pathway has been severed altogether.

Visual function may be recovered using a non-invasive solution that does not need integrity of the visual pathway. The tongue is an exquisitely sensitive organ to perceive tactile information. Images collected by means of a small video camera placed on the forehead of subjects are transformed in electrical impulses that are transferred to an array of electrodes placed in a small mobile plaque on the tongue. Subjects perceive a feeling analogous to effervescing champagne bubbles. The feeling is locally more intense in tongue areas corresponding to areas with higher luminance in the visual images. Eventually the subjects learn to interpret tactile information as visual information. This property of the brain to use alternative information channels is called sensory substitution.

A group of scientists at Bascom Palmer Eye Institute is collaborating with Wicab Inc. to develop and test a sensory substitution device called BrainPort. Users of a BrainPort prototype have been able to discriminate between letters on standard eye charts, recognize and read short sentences, recognize objects, catch balls rolled across a table, and explore indoor and outdoor spaces.

<u>Dr. Ninel Gregori, M.D.</u>
Dr. Ninel Gregori, M.D. is an assistant professor of clinical ophthalmology at the Bascom Palmer Eye Institute and the chief of ophthalmology section at the Miami Veterans Affairs Medical Center. She completed her medical school at the University of Utah where she engaged in a year of full-time research focusing on the glial progenitor cells found in the optic nerve and the brain. She completed her ophthalmology residency and the vitreoretinal fellowship at the Bascom Palmer Eye Institute, University of Miami, Miller School of Medicine. She joined the Bascom Palmer faculty in 2007.

**Use of a Retinal Prosthetic Device to Restore Visual Perception in RP Patients**
The **IRIS**™ (Intelligent Retinal Implant System™) is an adaptive visual prosthesis – an "artificial retina" developed by IMI. It is a medical device that bridges and replaces the defective information processing function of the real retina in patients with retinal degeneration. The Intelligent Retinal Implant System™ has a modular design and consists of three main components: the Retinal Stimulator (the component implanted in the eye), the Visual Interface and the Pocket Processor. The Visual Interface includes a built-in camera that captures images from the wearer's surroundings. This image information is processed by the Pocket Processor and translated into stimulation commands. These commands are sent from the

Pocket Processor to the Retinal Stimulator inside the eye via wireless transmission. They are then transformed into electrical pulses by a microchip in the Retinal Stimulator. The electrical pulses generated by the Retinal Stimulator stimulate the retina electrically and provides the patient with visual perception. The clinical trial results have been very promising to date and result in a dramatic improvement in the quality of life of the patients.

Dr. Stephen J. McCormack
Dr. Stephen J. McCormack is a serial entrepreneur with more than two decades experience in the medical industry. He has been involved with fundamental research and technology development to intellectual property and commercialization of medical products. His spectrum of experience has given him the expertise required for the formation, capitalization and operation of businesses in healthcare.

Dr. McCormack co-founded NeuroSystec for the development of therapeutics to treat neurological diseases. Prior to NeuroSystec he founded AlleCure which was merged with two other biotechnology companies and taken public as MannKind Corporation (MNKD:NASDAQ). Previously, Dr. McCormack was part of the founding senior management at the Keck Graduate Institute responsible for all corporate and business development activities. At Keck, he built a corporate board with 20 senior executives from the biopharmaceutical and medical device industries. Prior to Keck, Dr. McCormack was involved in business development at American Type Culture Collection and reported to the general counsel. He has held academic positions at George Mason University, Georgetown University Medical Center, Rockefeller University and the University of Massachusetts Medical Center.

Among many honors, he earned the National Cancer Institute's National Research Service Award and National Institutes of Health SPORE Fellowship while at Georgetown University. He also received the International Society for Interferon Research Award and University of California Academic Senate Award. He is currently an affiliate faculty member of the Kennedy Institute of Ethics at Georgetown University and is actively involved in public policy issues related to commercialization and patenting in the biopharmaceutical industry. Dr. McCormack, born in 1964, received his PhD in the interdepartmental Biomolecular Science and Engineering program from University of California, Santa Barbara and completed the Advanced Management Program at Harvard Business School. He obtained a bachelor's degree in biology from the College of the Holy Cross in Worcester, MA.

**Crashing Through, Adaptive Technology, New Vision, Rehabilitation and Research**

Talking labels are being given to virtually every square foot of our planet through the use of GPS and other location technologies combined with massive databases of addresses, maps and businesses. Whereas blind people have depended upon sighted people for directions and for reading signs, a new way of getting around independently is emerging. Michael May of Sendero Group is a leader in these accessible technologies and will present the current computer-based GPS systems, hand-held options; GPS cell phones and other developments. May will also present his perspective on the integration of low Vision and the role of adaptive technology and sports in developing "quality of life" based on his unique circumstances, being totally blind from age 3 to 46 when he regained some vision. Mike May will tell you in person what contributed to his success as a world traveling blind business man, about using alternative tools and techniques and about the role that research and rehabilitation played and continues to play in his personal and career development.

Michael May
Michael May is co-founder and CEO of Sendero Group, developers of the first accessible GPS for the blind in 2000 and distributors of various adaptive technologies. He has been the principle investigator on several US federal grants as he works with numerous organizations to advance wayfinding technologies around the world.

May has been a pioneer in new product development since 1980. He has also worked for the CIA, Bank of California, TRW and Arkenstone. May has been on the boards of many nonprofits in the blindness field and currently serves on the boards of the Society for the Blind in Sacramento and the Seeing Eye. A story of Mike's adventures is told in Robert Kurson's best selling book, "Crashing Through" and a movie by Fox is in the works.

**Overcoming the Psychological and Social Barriers of Disability**
Those with disability have difficulty in setting goals and accomplishing them. This is due in part to their disability. But it also is due to a variety of psychological handicaps that they impose upon themselves, and also results from the stigma that society places on disability. This presentation will address these issues and provide insights for overcoming these obstacles. The presenter, a professor of law and of psychiatry, himself suffers from a serious visual disability, and uses a guide dog and assisted technology. He will discuss the concept of self-handicapping, something that the cognitive psychology literature documents as a series of obstacles we all impose upon ourselves when we fail at something or do poorly at it. This applies to non-disabled people, and even more for those with actual disability. Calling upon his own personal experiences, the presenter will offer suggestions for how to deal with this psychological aspect of disability. He also will discuss the social stigma imposed on those with disability, and the pernicious labeling and self-attributional effects that stigma imposes. An important agenda item for the

disability community is breaking down these barriers imposed by stigma. The presentation will discuss ways of accomplishing this.

Bruce J. Winik
Bruce J. Winick is Professor of Law and Professor of Psychiatry and Behavioral Sciences at the University of Miami in Coral Gables, Florida, where he has taught since 1974. The co-founder of the school of social enquiry known as therapeutic jurisprudence, Winick is Director of the University of Miami School of Law's recently established Therapeutic Jurisprudence Center.

Winick has authored numerous books, the latest of which are *Civil Commitment: A Therapeutic Jurisprudence Model* (*2005*), *Judging in a Therapeutic Key: Therapeutic Jurisprudence and the Courts (2003)*, *Protecting Society from Sexually Dangerous Offenders: Law, Justice, and Therapy (2003*), and *Practicing Therapeutic Jurisprudence: Law as a Helping Profession* (2000). He also has authored more than 100 articles in law reviews and interdisciplinary journals. Winick is co-editor of the American Psychological Association Books book series, *Law, and Public Policy: Psychology and the Social Sciences*. He is legal advisor and member of the board of editors of *Psychology, Public Policy & Law*, and serves on the editorial board of *Law & Human Behavior*. Winick has received numerous awards. On June 28, 2009, he will receive the Philippe Pinel Award of the International Academy of Law and Mental Health, the Academy's highest honor. In 2007, he was named Honorary Distinguished Member of the American Psychology-Law Society. He also has received the University of Miami Provost's Award for Outstanding Scholarship, the Thurgood Marshall Award of the Association of the Bar of the City of New York, and the Human Rights Award of the American Immigration Lawyers Association.

Professor Winick previously served as New York City's Director of Court Mental Health Services and as General Counsel of its Department of Mental Health and has practiced law in New York City. He currently is a member of the Miami Lighthouse for the Blind Board of Directors, where he heads up the Speakers Bureau and is a member of the External Relations Committee.

**Novel Technologies for Sensorimotor Substitution and Augmentation**
Recent work into human centered interface design has led to the development of anthro-centric multisensory interface (ACMI) systems for augmentation of human-machine performance. These interfaces seek to increase the interactivity between humans and assistive systems so that modern technologies can be tailored to match the specific needs of individuals with specific temporary or permanent sensorimotor losses. Such interfaces can augment cognition and performance for able- bodied individuals and help rehabilitate and/or compensate for cognitive and/or sensorimotor deficits in those with disabilities. The overarching goal of ACMI research and development at the Florida Institute for Human and Machine Cognition (IHMC) seeks to fill sensorimotor function gaps with appropriate technological solutions in order to improve interactions in the able-bodied world.

Anil K. Raj, M.D.
Anil K. Raj, M.D., is a Research Scientist, Florida Institute for Human and Machine Cognition (IHMC), Pensacola, Florida. He received his B.A. and M.D. from the University of Michigan. Following an internship in General Surgery, he completed a two-year fellowship as a National Research Council Resident Research Associate at the NASA- Johnson Space Center, Houston, TX. His interests in aerospace medicine research led him to the Naval Aerospace Medical Research Laboratory in Pensacola, FL. Dr. Raj's research since joining IHMC in 1996 centers around the human physiologic and psychological responses to external forces (physical and psychological), particularly how they affect individual and team situation awareness and performance. Dr. Raj focuses on the development of human centered interfaces and the development of automated systems for tracking, analyzing, manipulating and augmenting human response characteristics in dynamic environments.

10:40 am **Session 2: Spinal Cord Injury**
Introductory Remarks & Moderator – Dr. Barth A. Green, Chairman, The Miami Project to Cure Paralysis & The Buoniconti Fund to Cure Paralysis

## New Discoveries in the Pathophysiology and Treatment of Spinal Cord Injury

Miami Project investigators have conducted studies that have changed the way we think about spinal cord injury (SCI) and how best to promote recovery of function in patients. Scientists at The Miami Project continue to perform critical basic and clinical neuroscience research that is uncovering vital information so we can develop new treatments to change patient's lives.

In the past year exciting studies involving high content compound screening, SCI model development, the elucidation of novel cell death mechanisms and the identification of targets for anti-inflammatory approaches, cell transplantation, deep brain stimulation, the discovery of pain-relieving drugs, hypothermia, ways to overcome axon growth inhibitory signals as well as the establishment of novel regimens to improve function through rehabilitation and to address other problems such as obesity and male infertility are moving us forward in our goal to improve the lives of people with SCI. Importantly, we are translating these findings to therapeutic evaluation in larger animal models, addressing questions about the dose and potential toxicity of the treatments and providing data necessary to move them into the clinic, as well as planning with the FDA and implementing clinical studies to translate new treatments to the trauma patient.

Damien Pearse, M. Ed., Ph. D.
Dr. Damien Pearse is an Associate Professor within The Department of Neurological Surgery, The Miami Project to Cure Paralysis at The University of Miami Miller School of Medicine. He completed his doctoral work with Dr. John Leah at Griffith University, Australia before performing postdoctoral work focused on spinal cord injury repair with Dr. Mary Bartlett Bunge at The Miami Project. While in the laboratory of Dr. Bunge, he co-discovered a novel combinatory therapy involving the use of Schwann cell transplantation and the elevation of a signaling molecule called cyclic AMP that restored significant function following spinal cord injury - a major therapeutic breakthrough in the field. He was a fellow within The Christopher and Dana Reeve Foundation SCI Consortium from 2000 to 2006 and in 2005 received the Erica Nader Award, recognizing outstanding research in the field of spinal cord regeneration.

Currently his laboratory is focused on several key aspects of spinal cord injury repair: 1) preventing progressive tissue damage following the initial mechanical trauma through the application of pharmacological or biological neuroprotectants, 2) overcoming the physical impediment of the injury cyst through the implantation of exogenous cells or by harnessing endogenous cellular repair mechanisms and, 3) the promotion of axon regeneration by the stimulation of intracellular signaling pathways that are important in the initiation and/or maintenance of axon growth. In the last year, his laboratory has concentrated on performing studies essential to translating Schwann cell implantation and the delivery of the cyclic AMP modulating drug, Rolipram, to Phase 1/2 clinical trials in people with spinal cord injuries. These studies have examined the safety and potential toxicity of these interventions as well as their optimization before clinical implementation.

**Challenging the Nervous System to Restore Function**

Evidence suggests that spinal cord and brain mechanisms underlying the control of movement adapt in response to training, practice, and afferent input. This beneficial neural adaptation, or adaptive neuroplasticity, is supportive of function and may counter the maladaptive plasticity that is associated with pathology of the nervous system. Using what is known about neural plasticity, favorable treatment strategies can be selected and training can be structured to improve function in individuals with spinal cord injury. The goals of such an approach are to understand: 1) how training, practice, and afferent inputs (such as electrical stimulation and vibration), contribute to functional adaptation of the brain and spinal cord circuitry underlying motor control, and 2) how best to promote neural reorganization that is supportive of function in the presence of central nervous system pathology. These discoveries are intended to optimize the development of effective, individualized interventions. Ultimately, by bringing together basic and clinical sciences to understand the relationship between physiology and function, optimally effective interventions can be developed for men and women with spinal cord injury and other chronic disorders of the central nervous system.

Edelle Carmen Field-Fote, Ph. D., PT
Edelle Field-Fote, PT, PhD is Professor Department of Physical Therapy and Principal Investigator, The Miami Project to Cure Paralysis at the University of Miami Miller School of Medicine, where she directs the Neuromotor Rehabilitation Research Laboratory. Dr. Field-Fote has a BS in Physical Therapy and an MS in Environmental Health and Safety from the University of Miami. She obtained a PhD in Movement Science from Washington University in St. Louis, where her doctoral studies were directed at investigating motor output generated in an animal model of complete spinal cord transection. Dr. Field-Fote's research focuses on the using what is known about the neural control of movement and the influence of training to improve function, promote neuroplasticity, and optimize treatment strategies for individuals with neuropathology. Her publications address both clinical/rehabilitation findings as well as applied neurophysiology.

**Spinal Cord Injury: Exercise and Health in Virtual and Enhanced Environments**

Cardiometabolic disorders [CMDs] represent the sole chronic health condition whose speed of growth and widespread dispersion has paralleled pandemics of communicable diseases. Nearly 2/3 of Americans currently suffer from these conditions, with a growth rate exceeding an alarming 10% in the past decade and projected to worsen. While data examining CMDs paint a dismal and worsening picture, CMDs are four times more prevalent among persons with disabilities than those without, and are now among leading causes of early morbidity and functional decline. Co-morbid conditions bring about an overweight body habitus, atherogenic dyslipidemia, glucose intolerance, and insulin resistance, which hasten diminishing work capacity, skeletal decline, pain, worsening of neurological status, and progressive life dissatisfaction. These conditions and issues have wide-ranging effects on health and function, and are far more difficult to manage and reverse than the same disorders in persons without disability.

Considerable evidence confirms that habitual exercise undertaken by persons both with and without disability can reverse or lessen the impact of CMDs, although poor motivation and non-compliance is an accepted barrier to sustained training success and health attainment. To overcome this barrier and facilitate autonomous exercise, various technical strategies have linked the 'neutral' exercise stimulus with media-enhanced environments, virtual settings, and gaming incentives. However, as design of a health-specific exercise prescription is a *science* that demands specific attributes of activity, not all commercial systems satisfy these guideline-driven principles, and not all game-based exercise strategies have championed these authorities as benchmarks of intervention success. We have examined the physiological responses of several gaming systems in persons with disability from spinal cord injury, and find routines that would both succeed and fail in satisfying the guidelines and thus attaining best benefit. Knowledge of, and attention to these details by both ends-users and their health care providers will ensure that physical activity for persons with disabilities can truly satisfy compelling health needs and not just palliate gaming instincts.

<u>Mark S. Nash, Ph.D., FACSM</u>
Mark S. Nash, Ph.D., FACSM is a tenured Professor of Neurological Surgery, Rehabilitation Medicine, and Physical Therapy at the Miller School of Medicine (MSOM) of the University of Miami, Principal Investigator for The Miami Project to Cure Paralysis, and Director of Research for the Department of Rehabilitation Medicine. He is a Fellow of the American College of Sports Medicine. Dr. Nash has expertise in application of exercise interventions for persons with SCI. He has also studied causes of, and treatments for their cardiovascular dysregulation and lipid-related disease risks.

He has published over 100 manuscripts, scholarly monographs, and book chapters on these and related topics. He is Co-author of the leading text in Spinal Cord Medicine, and his national and international lectures number in the hundreds. Dr. Nash is a Founding Principal Investigator for the Miami Project to Cure Paralysis, and has served as a grant reviewer on disability topics for the National Institutes of Health, the U.S. Department of Education, the U.S. Veterans Administration, and the U.S. Centers for Disease Control and Prevention. He is a member of multiple Medical Advisory Boards including the Alan T. Brown Foundation, Shiners' Hospitals International, and the New Jersey Spinal Cord Commission. Dr. Nash is a peer-reviewer for all major rehabilitation and exercise journals in his professional sphere. He served as PI/Project Director for an NIDRR-funded multicenter RCT examining "Niaspan in Tetraplegia" and Co-PI on the NIDRR Rehabilitation Research Training Center in 'Exercise and Secondary Complications after SCI'. He is currently PI for a 3 year NIDRR-funded grant examining "Exercise and Obesity-related Complications after SCI."

## <u>Saturday, June 6, 2009</u>

8:20 am **Welcome**

Hugh Herr Ph.D., Associate Professor, MIT Media Lab, No Barriers USA Board of Directors
Commissioner Marc D. Sarnoff, City of Miami District 2

8:40 am **Session 3: Neural Prostheses**
Moderator: Bart Chernow, M.D., MACP, Vice Provost for Technology Advancement, Vice President for Special Programs, and Professor of Medicine and Anesthesiology, University of Miami

**Now They Can Hear: Cochlear Implants 2009**
Some of the earliest human records evince an interest in recognition and treatment of deafness. Even the most ancient and primitive tribes placed minerals and plant extracts in the ear, with empirical or magical intent. However, only in the last several decades has technology and surgery advanced to allow physicians to treat profound nerve deafness. Cochlear implants are computerized electronic prostheses that replace the function of the inner ear and allow many deaf infants, children and adults to hear. Hearing aids and cochlear implants are quite different. Hearing aids make sounds louder while cochlear implants change sounds into electrical stimuli to make them understandable. Surgery to insert a cochlear implant usually takes 1 to 2 hours and is done as an outpatient. An estimated 200,000 hearing impaired people have received cochlear implants and over the past decade advances in technology and surgery have brought about improved functional outcomes. Some of the advances to be discussed include implanting children less that 12 months old, conserving residual hearing during cochlear implantation with newer electrodes and insertion techniques, use of cochlear implants in patients with partial deafness and the use of cochlear implants in both ears and in combination with hearing aids.

<u>Thomas Balkany, M.D., FACS, FAAP</u>
Thomas Balkany, MD, FACS, FAAP is Hotchkiss Professor and Chairman of the Otolaryngology Department ( Double Board Certified, Otolaryngology and Neurotology). He is also professor of Pediatrics and Neurological Surgery. Dr. Balkany has published over 250 scientific articles and 3 books, has been visiting professor at 22 US and international universities and has served on the editorial boards of 7 peer review journals. He holds 13 U.S. and international patents, including 12 on cochlear implants. Dr. Balkany and his wife Diane live in Delray Beach and recently celebrated their 38th anniversary. They have two children, Jourdan and Sarah.

Honors received include: Barany Society (Sweden) Hallpike-Nylen Prize for Clinical Research; League for the Hard of Hearing Fowler Award (ethics of cochlear implantation in children); Teaching Award of the University of Miami Miller School of Medicine; Provost's Award for Scholarly Activity; the President's Honor Award of the American Neurotology Society; School of Medicine Hall of Fame and President's Award of the American Academy of Otolaryngology-Head and Neck Surgery. Dr. Balkany has been Senior Examiner of the American Board of Otolaryngology, President of the Florida Society of Otolaryngology and is currently Vice-President of the American Otological, Rhinological and Laryngological Society. This year he will receive the American Academy of Otolaryngology-Head and Neck Surgery President's Award.

**Challenges and Innovations in Rehab: Functional Electrical Stimulation in Evidence Based Practice**

The use of Functional Electrical Stimulation (FES) has been used to treat injuries of the central nervous system for over four decades. However, user-limitations in previously available FES devices and the lack of clinical evidence documenting the efficacy of FES over conventional treatments prevented its widespread use in rehabilitation.

Today, the use of FES is intensifying throughout the continuum of care as a primary treatment option as a result of medical companies providing easy to use and ergonomically friendly FES systems, supported by an infrastructure of product support and customer care. In addition, the rising number of clinical studies is supporting the use of FES in rehabilitation for both safety and efficacy.

Yitzhak Zilberman

Yitzhak Zilberman serves as President and CEO of Bioness Inc. since its founding in 2004. In his relatively short tenure at Bioness, he has assembled an extraordinary management team and Board of Directors and secured approximately $55 million in financing, with an additional $40 million committed over the next two years. Prior to his post with Bioness, Mr. Zilberman was Vice President, Business Development with the Alfred Mann Foundation (AMF) in Valencia, CA. While at the Foundation, he conceived and led BionTech™, a collaborative R&D program aimed at developing clinical applications based on the bion® neurostimulator. His experience includes various managerial positions with MiniMed Inc., Advanced Bionics Corporation and its European subsidiary, Advanced Bionics SARL, as well as consulting for various Alfred Mann companies such as Quallion, Medical Research Products and Second Sight. Prior to working for Alfred Mann companies, Mr. Zilberman served 14 years in the Israeli Defense Forces Intelligence Corps, concluding his service as a Major, during which his team won the Israel Defense Award.

Mr. Zilberman holds a number of patents in the field of implantable electronic medical devices, has authored numerous publications in peer reviewed medical and scientific journals, and has been a frequently invited guest to national and international scientific symposia. He is a Director on the Board of the Alfred Mann Institute at the Technion (AMIT) and Chairman of its Executive Committee. He has degrees in Computer Science and Archeology from Bar Ilan University (magna cum laude) in Israel and is a graduate of the UCLA Anderson School of Management Executive Program.

**Deep Brain Stimulation**

Neurological and psychiatric disorders affect over a billion people worldwide. In order to address these intractable problems, we are developing new technologies using light, magnetic fields, and other forms of energy, in order to modulate brain activity, thus enabling augmentation of sensory, motor, cognitive and emotional functions. We will describe new inventions, as well as new principles, emerging from our work.

Edward Boyden, Ph. D.

Ed Boyden is the Benesse Career Development Professor at the MIT Media Lab, and Assistant Professor of Biological Engineering and of Brain and Cognitive Sciences at MIT. He leads the Synthetic Neurobiology Group, which aims to discover principles for systematically repairing intractable brain disorders such as epilepsy, Parkinson's disease, post-traumatic stress disorder, chronic pain, and schizophrenia. In order to accomplish this, his group invents new tools for controlling and repairing the computations performed by brain circuits. He and his colleagues have developed molecular reagents and devices that enable specific neurons in the brain to be activated and silenced with light, in order to correct their activity. He has launched an award-winning series of classes at MIT that take students from learning the principles of neuroengineering, all the way to starting companies in the nascent neurotechnology space. For his work, he was named to the "Top 35 Innovators Under the Age of 35" by Technology Review in 2006, selected to the Discovery Science Channel's "Top 5 Best Science Moments" in 2007, and elected to the "Top 20 Brains Under Age 40" by Discover Magazine in 2008. He has received the NIH Director's New Innovator Award, the Society for Neuroscience Research Award for Innovation in Neuroscience, and many other honors for his scientific and engineering accomplishments, as well as his leadership in the growing field of neuroengineering. Ed received his PhD in neurosciences from Stanford University as a Hertz Fellow, where he discovered that the molecular mechanisms used to store a memory are determined by the content to be learned. Before, he received three degrees in electrical engineering and physics from MIT. To date, he has over 100 papers, patents, and pending patents, has given over 50 invited talks, and regularly writes for Technology Review magazine.

**Neuroprostheses for Movement Restoration**

Neuroprostheses are playing an ever increasing role in functional restoration of individuals with neurological disabilities.  Clinical progress is a result of fundamental research studies carried out in the 1970s and 1980s, primarily under the sponsorship of the Neural Prosthesis Program at NIH. This research enabled investigators to develop the fundamental standings involved in electrical excitation of nerves, including the techniques of safe stimulation, as well as the basic technology (for example, stimulators and electrodes) that could be safely implanted in the body and function for extended periods of time.   As a result of this research, neuroprostheses to provide hearing (Cochlear prostheses), bladder control, and respiratory  control (phrenic stimulators) have reached clinical usage worldwide.

Major efforts for research and clinical implementation of neuroprostheses are underway, with considerable fundamental studies ongoing as well as performing clinical trials.  One aspect of neuroprosthesis research and development that has been at the forefront is that of development of movement control for persons with paralysis.  Functional electrical stimulation is the technique of using low levels of electrical current to excite peripheral nerves to restore function.  Fundamental research demonstrated that it was possible to electrical excite muscles safely and generate sufficient force and strength in those muscles in order to provide coordinated movement for functional restoration.  Basic technological development resulted in the design of multi-channel implantable stimulators, leads, and electrodes which could be surgically placed within the body to electrically excite the appropriate nerves in response to the patient's command.

Future developments of motor prostheses are numerous and involve both augmenting the number of functions that a person can provide, and reducing the complexity of its use, as well as expanding the indications of the patients for whom it is most appropriately used.  Current research studies ongoing in the area of motor control involve implantable sensors to eliminate the external and improve the command control task for user,  and reduce the technological complexity  providing upper arm control including elbow extension and pronation/supination in addition to hand control for spinal cord injury, providing sending the capacity for standing/pivot transfer for persons with incomplete tetraplegia, providing level walking with individuals with paraplegia, and enhancing walking in individuals with stroke.

Future of the use of this technology, combining the use of functional electrical stimulation and surgical augmentation to restore function in individuals with motor paralysis, appears bright.  While there are many challenges in moving this technology to the marketplace and deploying into clinical practice, the function that is provided is considerable and is unlikely to be supplanted by alternative means in the very near future.

P. Hunter Peckham, Ph. D.

P. Hunter Peckham received his undergraduate degree in mechanical engineering from Clarkson College of Technology (now Clarkson University), Potsdam, NY, and his MS and PhD degrees in biomedical engineering from Case Western Reserve University (CWRU), Cleveland, OH.   He is currently the Donnell Institute Professor of Biomedical Engineering and Orthopaedics at Case Western Reserve University;  a Senior Career Research Scientist in the Department of Veterans Affairs; Director of the VA Center of Excellence in Functional Electrical Stimulation; and the Director of Orthopaedic Research at MetroHealth Medical Center.

The major area of Dr. Peckham's research is in rehabilitation engineering and neural prostheses.  Dr. Peckham's research effort focuses on functional restoration of the paralyzed extremities in individuals with spinal cord injury.   He and collaborators have developed implantable neural prostheses that utilize electrical stimulation to control neuromuscular activation.  They have implemented procedures to provide control of grasp-release in individuals with tetraplegia.  This function enables individuals with central nervous system disability to regain the ability to perform essential activities of daily living.

Dr. Peckham's present efforts concern the integration of technological rehabilitation and surgical approaches to restore functional capabilities. He is currently working on an advanced neuroprosthesis that employs implantable sensors for internal control and regulation of movement.

**Remarks**

Marc Buoniconti, President, The Miami Project to Cure Paralysis & The Buoniconti Fund to Cure Paralysis

10:40 am **Session 4:  Robots for Mobility**

Moderator: Bart Chernow, M.D., MACP, Vice Provost for Technology Advancement, Vice President for Special Programs, and Professor of Medicine and Anesthesiology, University of Miami

**Coming Crisis in America - Universal Design and Common Sense Mobility Solutions for Aging Baby Boomers and People with Disabilities**

There is nothing that affects the quality of life, and our ability to remain independent than mobility. Those who have mobility related disabilities are less likely to be employed than those with low vision. With the increase in our elderly population those in the United States who will have difficulty walking will reach staggering numbers in the next few years. The decision in 1976 by the United States government to regulate mobility devices as medical devices has become one of the single largest impediments to providing innovative, affordable, effective solutions to one of the greatest challenges affecting our seniors and those with disabilities.

There is no better example of the challenge facing those who seek to develop and deploy new and innovative mobility devices than the decision in December 2008 of Independence Technology to cease sales of the iBOT this January 2009. By developing mobility devices utilizing the principles of Universal Design coupled with the latest technological developments and regulating them as consumer products rather than medical devices we can better assure that our senior citizens and people with disabilities have access to innovative, effective mobility solutions which will allow them to extend their independent life, and enjoy a higher quality of life at a cost which is sustainable to our society as a whole.

Gerald Kerr

Jerry Kerr co-founded Disability Rights Advocates For Technology (DRAFT) an all volunteer organization representing people with disabilities who refuse to be defined by their disability and whose passionate enthusiasm for participating in life's activities is supported by Universal Design and new and emerging technologies. He is recognized as one of the leading authorities on the use of Segways by people with disabilities. In September 2005 Mr. Kerr started DRAFT's Segs4Vets program awarding Segways to men and women of the United States Military whose service to our country and Operation Iraqi Freedom and Operation Enduring Freedom resulted in permanent disability and difficulty walking. In 1998, Jerry Kerr's life was suddenly transformed from that of a physically active chief executive officer of a national award-winning home-building and real estate development corporation, avid outdoorsman and pilot; to that of a spastic quadriplegic. Mr. Kerr uses a Segway HT in addition to his wheelchair and following his injuries has dedicated his life to advocating for the rights of individuals with disabilities and championing the benefits that new technologies and universal design can bring to their lives.

Through his work with severely injured military personnel, Jerry Kerr has recently agreed to serve as a consumer member of a Scientific Advisory Panel of a Multidisciplinary Clinical Consortium for a major university in the United States researching solutions and treatment for Post-Traumatic Stress Disorder and Traumatic Brain Injury suffered by our returning combat veterans. He continues to be a featured speaker and presenter at international symposiums and national conferences focusing on issues which effect people with disabilities and addressing the benefits that technology and universal design can provide to them. He addressed the International Seating Symposium in March 2009 and has provided testimony before the United States Congress and the United States Department of Justice on civil rights issues affecting people with disabilities and the application of Universal Design and new technologies. In December 2008 Jerry Kerr was awarded the Secretary of the Army's Public Service Award for distinguished public service in providing outstanding support to our Nation's veterans.

**Powered Leg Prostheses and Orthoses**

A long-standing goal in rehabilitation science is to apply neuromechanical principles of human movement to the development of highly functional prostheses and orthoses. Critical to this effort is the development of actuator technologies that behave like muscle, device architectures that resemble the body's own musculoskeletal design, and control methodologies that exploit principles of biological movement. In this lecture, I discuss how agonist-antagonist actuation, polyarticular limb architecture, and reflex behaviors can result in quiet, stable, and economical leg prostheses and orthoses. Neuromechanical models are presented to examine the importance of limb morphology and neural control on locomotory performance. These models are then used to motivate design strategies for prosthetic and orthotic mechanisms.

Hugh Herr, Ph.D.
Hugh Herr is Associate Professor within MIT's Program of Media Arts and Sciences, and The Harvard-MIT Division of Health Sciences and Technology. His primary research objective is to apply principles of biomechanics and neural control to guide the designs of wearable robotic systems for human rehabilitation and physical augmentation. In the area of human augmentation, Professor Herr has employed cross bridge models of skeletal muscle to the design and optimization of a new class of human-powered mechanisms that amplify endurance for cyclic anaerobic activities. He has also built elastic shoes that increase metabolic economy for running, and leg exoskeletons for walking load-carrying augmentation. In the area of assistive technology, Professor Herr's group has developed powered orthotic and prosthetic mechanisms for use as assistive interventions in the treatment of leg disabilities caused by amputation, stroke, cerebral palsy, and multiple sclerosis.

**Therapeutic Practice: the Help of Robots**

Practice moving with the help of robots? The development of new, human-friendly robots that people connect with has led to opportunities training the nervous system to move, and is especially important to people recovering from brain injuries. These include coupled robotic systems, human-human interactions, "distorted" reality, and robotic diagnostics. This talk highlights the practical and clinical implications as well as recent progress for these new "thrusts."

James L. Patton, Ph.D.

James L. Patton, PhD is Associate Professor of Bioengineering at The University of Illinois at Chicago and is Associate Director of the Center for Rehabilitation Robotics at the Rehabilitation Institute of Chicago (RIC). He also holds an affiliate positions in Physical Medicine and Rehabilitation, Mechanical and Biomedical Engineering at Northwestern University. He was born in Ann Arbor MI, USA in 1965 but grew up in Racine, WI, USA. He was educated in Mechanical Engineering and Engineering Science (dual BS, University of Michigan) Theoretical Mechanics (MS, Michigan State University), and Biomedical Engineering (Ph.D., Northwestern University). He has worked for Ford Motor Company and in nuclear medicine before turning his attention to biomechanics and control of human movement. His general interests involve robotic teaching, dynamic balance control, haptics, modeling of the human-machine interface, and robot-facilitated recovery from a brain injury. His research has demonstrated how control is made robust by avoiding undesirable situations. His more recent research has demonstrated how one can exploit the nervous system's natural capacity to adapt in order to teach movements and help people recover from brain injury. Dr. Patton is a member of the IEEE Robotics and Automation and Engineering in Medicine Biology Societies, as well as the Society for Neuroscience. He is a reviewer of IEEE Transactions on Biomedical Engineering, IEEE Engineering in Medicine Biology magazine, IEEE Transactions on Robotics and Automation. He also chairs the IEEE-EMBS technical committee on biomedical robotics.