Bioengineering Seminar

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The Role of Robotics in Rehabilitation Medicine

Over the past decades, technology has gained a key role in rehabilitation science. Some of the systems originally developed in research laboratories have become part of standard clinical practice, whereas others are still used only as part of experimental interventions. An example of broadly adopted technology is functional electrical stimulation. Systems to correct foot drop via peroneal nerve stimulation are a prominent example of technology that has witnessed broad use in the clinical setting. Other technologies such as invasive and non-invasive brain stimulation are of great interest to physiatrists and other rehabilitation specialists but still looked upon as experimental. Our research team has focused its efforts on two technologies that we see as relevant to rehabilitation medicine, namely motion tracking technology (i.e., traditional camera-based systems and recently developed wearable sensor-based systems) and robotics (i.e., assistive devices and systems to retrain motor functions). The primary goal of the lecture is to discuss the adoption of robotics in rehabilitation medicine and emphasize how the introduction of new technologies in the clinic has to be based on careful consideration of the clinical needs to be met and awareness of the technical challenges associated with the design of systems to be used in clinical practice. Besides, the lecture will show how the development of new rehabilitation technologies has the potential for enabling scientific discoveries of great clinical relevance. We will discuss recent results of robot-assisted gait training in children with Cerebral Palsy (CP). CP is a group of neurological disorders caused by damage to the brain at birth, during infancy or in early childhood that affects about 1 in 500 newborns. Diminished gait proficiency is one of the main physical disabilities in children with CP. Several studies have demonstrated the beneficial effects of intensive gait training in children with CP. Robotics has been looked upon as a means to facilitate the administration of interventions in this population. Clinical outcomes of robot-assisted gait training in children with CP are encouraging but they are marked by high variability across individuals. While very large motor gains are observed in some children, in others the intervention leads to modest or no motor gains. Motor gains are mediated by learning, which in turn is the result of adaptations that occur as part of the interaction between the child and the robot. We have hypothesized that children who do not respond to robot-assisted gait training have an impaired ability to generate motor adaptations. We will discuss robot-based methodologies to quantify motor adaptations, their applicability to children with CP, the relationship between motor adaptations and learning, and the use of emerging techniques to facilitate the generation of motor adaptation strategies.

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3:00PM-4:00PM, Room 3507

Nguyen Engineering Building

BIOGRAPHY

Paolo Bonato, Ph.D., serves as Director of the Motion Analysis Laboratory at Spaulding Rehabilitation Hospital, Boston MA. He is an Assistant Professor in the Department of Physical Medicine and Rehabilitation, Harvard Medical School, Boston MA, a member of the Affiliated Faculty of the Harvard–MIT Division of Health Sciences and Technology, Cambridge MA, an Adjunct Professor of Biomedical Engineering at the MGH Institute of Health Professions, Boston MA, and an Associate Faculty Member at the Wyss Institute of Biologically Inspired Engineering at Harvard University, Boston MA. Dr. Bonato is Founding and Current Editor-in-Chief of Journal on NeuroEngineering and Rehabilitation, an Associate Editor of the IEEE Transactions on Information Technology in Biomedicine, of the IEEE Transactions on Biomedical Engineering, and of the IEEE Journal of Translational Engineering in Health and Medicine. Dr. Bonato served as an Elected Member of the IEEE Engineering in Medicine and Biology Society (EMBS) AdCom (2007-2010) and he was recently elected IEEE EMBS Vice-President for Publications. He served as President of the International Society of Electrophysiology and Kinesiology (2008-2010). He also served as Chair of the 33rd Annual International Conference of the IEEE Engineering in Medicine and Biology Society (2011) and as Chair of the IEEE EMBS Technical Committee on Wearable Biomedical Sensors and Systems in 2008, a committee of which he has been a member since its inception in 2006. He received the M.S. degree in electrical engineering from Politecnico di Torino, Turin, Italy in 1989 and the Ph.D. degree in biomedical engineering from Universita` di Roma “La Sapienza” in 1995. His research interest is focused on rehabilitation technology with special emphasis on wearable technology and robotics. To learn more about Dr. Bonato’s work, visit http://srh-mal.net/.

For any questions please contact Claudia Borke at cborke@gmu.edu, (703) 993-4190