Framework for Individualized Dynamical Modeling of Human Motion

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Abstract

We are developing individualized musculoskeletal models to model movement dynamics based on non-invasive multi-modal measurements (e.g., motion capture, accelerometry, EMG, other wireless sensors). The models are aimed to provide information on kinematic constraints and range of motion and dynamic parameters relating to exerted forces and torques during a movement. Individualized musculoskeletal models inform on which muscles or muscle groups a subject is using during observed movement. Furthermore, we are developing automatic segmentation methods that partition continuous movement into motion primitives. The obtained segmentation can be used to analyze particular motion segments, e.g. during an exercise. This also requires development of metric for comparison between subjects or to assess pre-/post-therapy differences. Our recent and current projects include the following: -Development of an automated exercise system for elderly based on the Kinect camera which we deployed in 7 homes of elderly users over the course of 18 weeks. -Motion segmentation of repetitive exercise data. -Use of individualized kinematic model for human-robot interaction. -Design and control of exo-skeletal assistive devices. -Visualization of real-time musculoskeletal models based on individual’s MRI data and multi-modal sensing. We are proposing to develop a framework for dynamical modeling of human motion to support physical therapy by providing detailed information on patient’s musculoskeletal performance obtained through non-invasive measurements. Such data could be applied to: -characterize and quantify impairments of an individual patient, -to monitor the minimal differences in performance -to assist the therapist in the assessment and therapy to obtain better outcomes -to determine which exercise contributes to the improvements -to support exercise at home via real-time or just-in-time feedback

Bio
Ruzena Bajcsy received the Master’s and Ph.D. degrees in electrical engineering from Slovak Technical University, Bratislava, Slovak Republic, in 1957 and 1967, respectively, and the Ph.D. in computer science from Stanford University, Stanford, CA, in 1972. She is a Professor of Electrical Engineering and Computer Sciences and NEC chair holder at the University of California, Berkeley, and Director Emeritus of the Center for Information Technology Research in the Interest of Science (CITRIS). Prior to joining Berkeley, she was a professor of the Computer Science and information department at the University of Pennsylvania, Philadelphia. There is founded the GRASP (General Robotics and Active Perception) laboratory in 1979 which is flourishing now. In 1999 she was appointed to be headed the Computer and Information Science and Engineering Directorate at the National Science Foundation. In 2001 after she finished her stay at NSF, she retired form University of Pennsylvania and joined the faculty at University of California, Berkeley. Dr. Bajcsy is a member of the National Academy of Engineering and the National Academy of Science Institute of Medicine as well as a Fellow of the Association for Computing Machinery (ACM), fellow of IEEE and the American Association for Artificial Intelligence. In 2001, she received the ACM/Association for the Advancement of Artificial Intelligence Allen Newell Award, and was named as one of the 50 most important women in science in the November 2002 issue of Discover Magazine. Since 2008 she is a member of the American Academy of Arts and Sciences. She is the recipient of the Benjamin Franklin Medal for Computer and Cognitive Sciences (2009) and the IEEE Robotics and Automation Award (2013) for her contributions in the field of robotics and automation.

Faculty Host: Dimitris Metaxas