Department of
MECHANICAL ENGINEERING
THE UNIVERSITY OF UTAH

Distinguished Seminar Series

Bio-Cooperative Rehabilitation Robots

Robert Riener, PhD
Professor, **ETH Zürich** and
University of Zürich

Friday, Nov. 9th, 2012, 2:00 pm
Warnock Engineering Bldg. (WEB) 1230
Reception to follow at 3:00 pm

Abstract:
Robotic technologies and their clinical applications play an increasingly important role in neuroscience. Novel robotic applications are being developed or are already in standard clinical use within the different therapeutic phases ranging from diagnostic neuroimaging via neurosurgical technologies to therapeutic treatments in the acute, subacute, and chronic stage of neurorehabilitation. However, most "neuro-robotic" applications work with patients in a "master-slave" relationship, thus, forcing the patient or operator to follow a predetermined motion without consideration of voluntary efforts or behaviour of the patient. During such unidirectional communication, the loop is not closed by the human in order to adjust the device to the biomechanical or physiological state of the patient, or his/her engagement and intention. The possibilities of the human to intervene are reduced to "initiation" and "perturbation". In contrast, our rehabilitation robots offer a new approach by placing the human into the loop. The interaction becomes bi-directional and the technical system takes into account the patient's properties, intentions and actions in real-time. Integrating the human into the loop can be considered from biomechanical, physiological and even psychological viewpoints. Biomechanical integration involves ensuring that the robot assists in a compliant way, just as much as needed, so that the patient can contribute to the movement with own voluntary effort. Psycho-physiological integration involves recording and controlling the patient's physiological reactions so that the patient receives appropriate stimuli through a virtual reality scenario. In this way, the patient is challenged in a moderate but engaging and motivating way without causing undue stress or harm. In this talk, I will present examples of biomechanical and psycho-physiological integration of patients verified with different robots applied to the neurorehabilitation of gait and arm function.

About Dr. Riener:
Robert Riener studied Mechanical Engineering at TU München, Germany, and University of Maryland, USA. He received a Dr.-Ing. degree in Engineering from the TU München in 1997. After postdoctoral work at Politecnico di Milano (1998-1999) and TU München (1999-2003) in the field of Biomechatronics he was appointed assistant professor for Rehabilitation Engineering at the Automatic Control Laboratory of the ETH Zurich and Spinal Cord Injury Center of the University Hospital Balgrist ("double-professorship"). From 2006-2010 he has been associate professor and since June 2010 full professor for Sensory-Motor Systems at the Mechanical Engineering Department of ETH Zurich, while maintaining the double professorship with the University of Zurich. From 2008 till 2011 Dr. Riener was the head of the Institute of Robotics and Intelligent Systems (IRIS) at ETH Zurich. From 2009 till 2011 Dr. Riener was the deputy head of the Mechanical Engineering Department, ETH Zurich. In 2012 he moved into the newly founded ETH Department of Health Sciences and Technology. His research interests include rehabilitation robotics, virtual reality in medicine, biomechanics, and biomechatronics.