Title: Learning control and its applications to rehabilitation robotics

Abstract: Practice makes perfect. Human beings can learn to perform a task perfectly by repeating this task sufficient times, which is the simple idea for rehabilitation robotics. For example, in post-stroke rehabilitation, the widely adopted concept of neurocognitive rehabilitation is an original application of motor re-learning theories imitating human learning; a highly intense and repetitive task routine delivered via robot-assisted therapy is shown to achieve improved motor function for post-stroke patients at different settings. This concept motivates the developments of various rehabilitation robots. In this regard, the well-known learning control (LC) strategy, which is specifically developed to achieve high tracking performance of repetitive tasks in industry since 1978, becomes a natural choice for controller designs to accommodate rehabilitation robots. It is noted that, different from many control algorithms using either output feedback or state feedback, the LC algorithms also use the information from previous trials or iterations to improve the performance in the current iteration. This talk summarizes the state-of-the-art in LC designs and provides examples how different LC algorithms can be applied to solve the challenging problems in rehabilitation robotics. Opportunities for integration of learning control into the rehabilitation robotics will be discussed and open research questions for control-theoretic advancements will also be presented.

Biography: Ying Tan is a Professor in the Department of Mechanical Engineering at The University of Melbourne, Australia. She received her Bachelor's degree from Tianjin University, China, in 1995, and her PhD from the National University of Singapore in 2002. She joined McMaster University in 2002 as a postdoctoral fellow in the Department of Chemical Engineering. Since 2004, she has been with the University of Melbourne. She was awarded an Australian Postdoctoral Fellow (2006-2008) and a Future Fellow (2009-2013) by the Australian Research Council. She is Fellow of the Institute of Electrical and Electronic Engineers (FIEEE), Fellow of the Institution of Engineers of Australia (FIEAUST), and Fellow of Asia-Pacific Artificial Intelligence Association. Her research interests are in intelligent systems, nonlinear systems, real-time optimization, sampled-data systems, rehabilitation robotic systems, human motor learning, wearable sensors, and model-guided machine learning.