NJIT New Jersey Institute of Technology

BME

Department of Biomedical Engineering
Graduate Seminar

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Subject: Modeling and Control of Unstable Physical Human-Machine Interactions: A Rider-Bikebot Example

Abstract:

Human with trained motor skills can fluidly and flexibly interact with machines while smart machines can also provide motor assistance and enhancement to facilitate human's motor skills learning. However, we currently lack theories and design tools to effectively model and tune human motor control and its interactions with machines. In this talk, I will discuss recent developments modeling and control of human motor skills through unstable physical human-machine interactions (upHMI). Rider-bikebot (i.e., bicycle-like robot) interactions is used as an upHMI paradigm to examine a sensorimotor theory for modeling of human motor control relevant to balancing motor activities. I will first present a novel control-theoretic physical/learning modeling framework of extracting and characterizing human control strategies in a lower-dimensional space. I will then present a balance equilibrium manifold (BEM) concept to study how a human rider balances a bikebot while maintaining tracking a desired trajectory. A performance metric is also introduced to quantify the balance motor skills using the BEM. Extensive experiments are conducted to validate the analyses and demonstrate the balance skill metrics. Finally, I will briefly present balancing stability analysis and motor skill control of the rider-bikebot interactions.

Bio:

Professor Jingang Yi received the B.S. degree in electrical engineering from Zhejiang University in 1993, the M.Eng. degree in precision instruments from Tsinghua University in 1996, and the M.A. degree in mathematics and the Ph.D. degree in mechanical engineering from the University of California, Berkeley, in 2001 and 2002, respectively. He is currently a Full Professor in mechanical engineering and a Graduate Faculty member in electrical and computer engineering at Rutgers University. His research interests include human-robot interactions and assistive robotics, autonomous robotic and vehicle systems, dynamic systems and control, mechatronics, automation science and engineering, with applications to biomedical, transportation and civil infrastructure systems. He has received several awards, including the 2017 Rutgers Chancellor's Scholars, 2014 ASCE Charles Pankow Award for Innovation, the 2013 Rutgers Board of Trustees Research Fellowship for Scholarly Excellence, and the 2010 NSF CAREER Award. He has coauthored several best papers in IEEE Transactions on Automation Science and Engineering and at IEEE/ASME AIM, ASME DSCC, ICRA, etc.

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