Title:
From legged dynamics to motor control of human locomotion

Abstract:
This talk explores simple models of legged dynamics and their consequences for human and artificial leg control.

We start by modeling human locomotion with a point mass that rebounds on two passive spring legs. Exploring its parameter space, we find the model reproduces the center of mass dynamics of human walking and running, unifying both gaits in one theory. To understand how human legs can behave like springs in locomotion, we expand our mechanical model into a neuromuscular one, and show that a simple muscle reflex, positive force feedback of the extensor muscles, could be enough control to generate and stabilize spring-like behavior of the human leg in stance. Using this and other control principles derived from the passive spring-mass model as our guides, we then build a more detailed muscle-reflex model of human locomotion, which requires neither central rhythm generators nor desired joint trajectories to walk and almost run, and to manage random ground and stairs. Finally, we discuss current efforts to apply this flexible and self-adaptive reflex control to artificial leg control in prosthetics and neurorehabilitation.