Explaining and Exploiting Variable Impedance Strategies in Motor Control - in Humans and Robots

Sethu Vijayakumar

Institute of Perception, Action and Behaviour, The University of Edinburgh, UK

Email of Presenting Author: sethu.vijayakumar@ed.ac.uk

Variable Impedance refers to the ability to change stiffness and damping during task execution. Humans have an excellent capacity to modulate impedance in response to task demands. Is there some systematic optimality principles underlying this modulation? With novel prototype robotic actuators capable of fast impedance modulation, another crucial question is how we can maximally exploit this capability in an automatic and data driven manner? This talk will aim to elucidate principles that can be used to study and explain impedance modulation in a consistent manner, explaining stiffness adaptation from first principles of minimizing uncertainty. I will also describe an MPC based optimal control formulation for optimizing both the temporal profile of movement and impedance modulation in a way that is tuned to the dynamics of the plant. Implementation of dynamically energetic tasks such as throwing and brachiation will serve to highlight the benefits. This talk will draw upon concepts of stochastic optimal feedback control, dynamics representation and incremental learning.