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Predictive Biomechanics for Ergonomic Control in Human-Robot Interaction

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(Workshop Presentation)

Abstract

How can robots physically interact with humans in a meaningful and healthy way? Existing approaches to specifying close-contact, physical interactions between humans and robots focus solely on successful task completion. However, these approaches completely neglect the biomechanical and ergonomic ramifications of robot actions on the human body. An action which may seem momentarily effective may result in stresses to the human musculoskeletal system and even serious injuries. In this talk, I will discuss how machine learning enables healthy, bi-directional, and biomechanically-safe interactions between humans and machines that can be sustained over long periods of time. Specifically, I will present Bayesian Interaction Primitives – a probabilistic framework that enables learning and inference for HRI scenarios. Bayesian Interaction Primitives encode the mutual dependencies between interaction partners and can be used to 1.) predict human motion and sensor values, 2.) infer task-relevant biomechanical variables, and 3.) generate appropriate robot responses. Used within a model-predictive control loop, Bayesian Interaction Primitives generate actions that minimize long-term impact on the musculoskeletal system of the human partner. To demonstrate the approach, I will present a number of applications in prosthetics and social robotics.

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