Abstract:

Stability analysis in physical human-robot interaction requires consideration of human feedback behavior. In unpredictable scenarios, where voluntary cognitive feedback is too slow to guarantee desired task execution, the central nervous system relies on intrinsic and involuntary reflexive feedback. In this work, we present a method for the estimation of the combined effects of intrinsic and involuntary reflexive feedback in multi-joint arm movements, termed involuntary impedance. We apply external force perturbations that are specifically designed to evoke feedback jerk, which can be isolated by application of a high pass filter, and limit the duration of the estimation interval to guarantee the exclusion of voluntary feedback. The isolation of the feedback behavior is validated in simulation and the estimation of the involuntary impedance components is evaluated in an experiment with human participants.