New Perspectives on Impedance and Admittance Control for Physical Robotic Interaction

Interaction control of robotic manipulators seeks to control the dynamic relation between position and force at the endpoint, making the robot behave like a linear mass-spring-damper. Applications of such controllers include robot machining, haptics, rehabilitation robotics, robotic surgery, and exoskeleton control. There are two common implementations based on causality: Impedance control and Admittance control. In this seminar, a new perspective on such controllers is presented in which Interaction controllers are related by their sensitivities to model parameter error and force sensor errors. The trade-off between these two types of sensitivities motivates the design of controllers which can effectively interpolate between Impedance and Admittance control, allowing the designer to specify levels of robustness appropriate for their application. Examples of the utility of interpolation is given for robots with inherently low force sensing accuracy and for accurate haptic rendering on high-impedance robots (e.g. for lower-limb rehabilitation robotics), as well as more general situations such as contact with stiff environments. In all these cases, interpolation can allow for increased accuracy beyond what is possible using the traditional types of Interaction control.

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