Robust Control Design of Impedance Control for Industrial Robots

Dragoljub Surdilovic

Fraunhofer Institute for Production Systems and Design Technology (IPK)
Pascalstraße 8-9, D-10587 Berlin, Germany
dragoljub.surdilovic@ipk.fraunhofer.de

Abstract

A widespread application of impedance control in industrial robotic systems is still a challenging problem. One of limitations is the absence of a widely-accepted framework for the synthesis of the impedance control parameters that ensure stability of both contact transition and interaction processes and guarantee desired contact performance. The existing design procedures based on robot passivity appear to be exceedingly conservative in applications in which the interaction between an industrial robot and a stiff environment should be controlled. The proposed new interaction stability paradigm ensures contact stability during all phases of interaction. Moreover, the new design framework realizes low-impedance performance allowing considerable reduction of high apparent industrial robot inertia and stiffness. The novel stability criteria are established based on robust control theory and take into account estimates of environmental stiffness, tolerating thereby large uncertainties and variations in industrial environments. These criteria are proved by extensively testing in industrial and space robots and have been recently extended to control synthesis of human robot interaction systems (haptic admittance displays and rehabilitation robots).