Design and Stability Analysis of a Robust Impedance Control System for a Robot Manipulator

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Abstract: This paper presents a novel impedance control approach for a robot manipulator and analyzes its stability. In order to achieve desired impedance for the robot manipulator subject to applied force on the end-effector, a hybrid position/force control in the task space is developed. For this purpose, the both cases of known and unknown bounds of uncertainties are considered to design the nonlinear robust controller. It is proven that the closed loop control system shows global exponential stability under known bounds of uncertainties. In the second case, an adaptive controller is used to estimate the bounds of uncertainties. It is then proven that the closed loop system has a global asymptotically stability. The case study is a two-link elbow manipulator which is simulated. The simulation results confirm good performances of proposed control approaches.

Keywords: Robot Manipulator, Uncertainties, Robust Impedance Control, Adaptive Control.