ABSTRACT

Stiffness Analysis and Hybrid Control for Parallel Manipulator

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This thesis presents static and dynamic stiffness analysis and proposes a hybrid force-position-stiffness control for a redundantly actuated parallel manipulator. Previous stiffness analysis focused on the static case where the acceleration and velocity are zero. By considering system dynamics in formulating stiffness, the evaluation of dynamic stiffness was possible. For redundantly actuated parallel mechanisms, null space torque can be used to improve stiffness not affecting motion or force of the end effecter. Therefore it is possible to build a control algorithm encompassing

force, position and stiffness at the same time. Based on a dynamic stiffness evaluation for redundantly actuated parallel manipulators, a hybrid control algorithm was constructed, improving stiffness with the desired force and trajectory. As in the simulation result with 6 bar closed chain, it was possible to achieve a stiffness improvement additional to force position control via nullspace redundant torque.

Keywords: Hybrid control, Stiffness, Parallel manipulator, Redundant actuation

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