Slippage Detection for Grasping Force Control of Robotic Hand Using Force Sensing Resistors

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Abstract

This paper presents the formulation of a nonlinear adaptive back stepping force control in grasping weight-varying objects using robotic hand driven by Pneumatic Artificial Muscle (PAM). The modelling and control problems arise from the high nonlinear PAM dynamics and the inherent hysteresis leading to a lack of robustness in the hand's performance. The robotic finger and the PAM actuator been mathematically modelled as a nonlinear second order system based on an empirical approach. An adaptive backstepping controller has been designed for force control of the pneumatic hand. The estimator of the system uncertainty is incorporated into the proposed control law and a slip detection strategy is introduced to grasp objects with changing weights. The simulation and experimental results show that the robotic hand can maintain grasping an object and stop further slippage when its weight is increased up to 500 g by detecting the slip signal from the force sensor. The results also have proven that the adaptive backstepping controller is capable to compensate the uncertain coulomb friction force of PAM actuator with maximum hysteresis error 0.18 degrees.

Keywords

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KeyWords Plus: ARTIFICIAL MUSCLE; SYSTEM; TACTILE

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