A Comparative Experimental Study of Robust Sliding Mode Control Strategies for Underactuated Systems


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Abstract
This paper presents a comprehensive comparative study for the control tasking of a class of underactuated nonlinear uncertain systems. A given nonlinear model of the underactuated system is, at first stage, transformed into an input output form and the driving applied control input of the transformed system is then designed via four sliding mode control strategies, i.e., conventional first order sliding mode control, second order sliding mode, fast terminal sliding mode, and integral sliding mode. At second stage, a ball and beam system is considered and the aforementioned four control design strategies are experimentally implemented. A comprehensive comparative study of the simulation and experimental results is then conducted which take into account the tracking performance, i.e., settling time, overshoot, robustness enhancement, chatter-free reduction, sliding mode convergence, and control efforts.

Keywords
Author Keywords: Electromechanical system; sliding mode control; Lyapunov method; robust control; nonlinear systems

KeyWords Plus: PASSIVITY-BASED CONTROLLER; MECHANICAL SYSTEMS; INVERTED PENDULUM; TRACKING; DESIGN; STABILIZATION

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