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Reference model trajectory tracking in continuous-time sliding mode control

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Abstract: Controller design for a continuous-time system subject to nonlinear disturbance is a complex task with many challenges. One must ensure that the effects of disturbance on system dynamics are properly compensated, while at the same time keeping state and input constraints in mind. Disturbance rejection by itself is easily achieved using sliding mode controllers (SMC). However, such controllers give no insight into the dynamics of individual state variables, which may be subject to physical constraints. In this paper we propose a solution, which allows one to benefit from the disturbance rejection property of SMC and at the same time obtain better insight into system dynamics. The proposed approach involves a reference model obtained from a canonical form of the controlled system. A sliding mode control strategy is applied to the plant with the aim of driving its state alongside that of the model. Then, since model dynamics are inherently simpler, one can modify them to impose specific constraints on the motion of the system. It is demonstrated that, when the proposed SMC strategy is applied, individual states of the original plant always exactly follow those of the model, regardless of uncertainties.

Keywords: robust control, sliding mode control, trajectory tracking, continuous-time systems