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MODEL PREDICTIVE CONTROL WITH STATE ESTIMATOR FOR POLYTOPIC UNCERTAIN SYSTEM WITH ACTUATOR SATURATION

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Abstract. *A novel model predictive control with state estimator is proposed for polytopic uncertain systems with actuator saturation in which the actuator saturation is described as a convex hull composition. At each sampling time, a state feedback control law is obtained such that the upper bound of the quadratic objective function is minimized. The intrinsic relationship between infinite horizon control problem and finite horizon control problem is derived. And the robust stability of proposed model predictive control is proved. Furthermore, considering the state is partial measurable, a state estimator is designed. And the robust stability criterion for closed-loop system combined controller and estimator is given. Finally, the numerical example demonstrates the effectiveness of the proposed model predictive control with state estimator.*
Keywords: Model predictive control, State estimator, Actuator saturation, Polytopic uncertainty, Linear matrix inequality

1. **Introduction.** Model predictive control is a popular technique for the control of dynamical systems, such as those encountered in petrochemical, pulp and paper industries [1,2]. Although different names and model forms are adopted, the underlying concept of model predictive control is the same, that is, at each sampling time, model predictive control uses an explicit plant model to compute control inputs so as to optimize future plant behavior over the prediction horizon [3-5].

Since models are only an approximation of the real plant, it is extremely important for model predictive control to be robust to model uncertainty [6]. Recently, new predictive control methodology which uses the uncertainty description explicitly in the command computation have been proposed in [7]. This new methodology was first used for designing robust predictive control schemes for Finite Impulse Response plants [8-10], where the uncertainty model was given in terms of bounds on the impulse response coefficients. And then, a more realistic polytopic model of uncertainty was used for solving different control problems based on a receding horizon strategy [2,11,12]. Specially, a robust model predictive control synthesis using linear matrix inequality was proposed in [2]. In their study, at each sampling time, a feasible state feedback was designed by minimizing a worst-case infinite horizon quadratic cost and only the first command was applied. In [11], a command governor strategy was proposed for polytopic uncertain systems in the presence of persistent bounded disturbances and input and state-related constraints.