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AN H_∞ CONTROL BASED RECEDING HORIZON CONTROL SCHEME FOR LINEAR SYSTEMS SUBJECT TO INPUT SATURATION

Xiongjun Wu[1], Zongli Lin[2], Yugeng Xi[1] and Dewei Li[1]

[1]Department of Automation, Shanghai Jiao Tong University, Shanghai, China. Email: west3013@gmail.com,ygxi@sjtu.edu.cn,dwli@sjtu.edu.cn

[2]Corresponding author, Charles L. Brown Department of Electrical and Computer Engineering, University of Virginia, P.O. Box 400743, Charlottesville, VA 22904-4743, U.S.A.. Email: zl5y@virginia.edu

Abstract. This paper proposes an H_∞ control based receding horizon control design scheme for discrete-time linear systems subject to input saturation and external $\mathcal{L}_2$ disturbances. Conditions are established under which the state trajectories of the closed-loop starting from an ellipsoid remain within another larger ellipsoid and the restricted $\mathcal{L}_2$ gain from the disturbance to the controlled output over a class of $\mathcal{L}_2$ disturbances with a given bound on their energies is no greater than a given number. These conditions allow the saturation to occur and reveal a clear trade-off between the sizes of the ellipsoids and the level of the restricted $\mathcal{L}_2$ gain, which motivates the adoption of the receding horizon control design approach. At each time instant, the control design is formulated as a constrained optimization problem. Both state feedback and output feedback are considered.

Keywords. Actuator saturation, disturbance rejection, LMI, receding horizon control, set invariance.

1 Introduction

Receding horizon control (RHC), otherwise referred to as model predictive control (MPC), has proven to be an effective control strategy due to its ability to take various constraints into account in the design of control actions (see, for example, [1, 19], and references therein). As a result, it has been attracting a lot of attention from the control theorists (see, for example, [4, 5, 7, 14, 18], for a small sample of the literature).

An important line of research on model predictive control deals with the issue of guaranteed stability of the resulting controlled system. In the traditional MPC design, the stability issue can be satisfactorily addressed by introducing the so-called stability constraint and the terminal penalty (see, for example, [1, 2, 6, 18]). As pointed out in [24], the stability issue with the popular min-max design, where the performance minimization is carried out over the worst scenario (maximization) among a set of uncertainties