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Uniformly ultimately bounded tracking control of linear differential inclusions with stochastic disturbance☆

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Abstract

The tracking control of linear differential inclusions with stochastic disturbance is considered. The feedback law is constructed by the convex hull Lyapunov function. The design objective is to make the error system uniformly ultimately bounded in mean square. Finally, a numerical simulation is given to illustrate the effectiveness of the proposed method.

Keywords: Linear differential inclusions; Tracking control; Convex hull Lyapunov functions; Stochastic disturbance

1. Introduction

By the development of scientific investigation, differential inclusion (DI) has been widely studied [2,5,21]. DI is a generalization of differential equation and can be applied in many engineering fields, such as population growth problems [15], neural networks with discontinuous neuron activations [7], electrical circuits with ideal diodes [1], dynamical systems with Coulomb friction [3] and so on. The study mainly focuses on the linear DI (LDI), because the LDI is simpler than the DI but can include numerous nonlinear systems. Ref. [12] defined the convex hull Lyapunov function (CHLF) and proved that the CHLF holds less conservative than the traditional Lyapunov function in the studying of the LDI. Recently, many authors have studied the stabilization problem of the LDI via the CHLF, such as [11,4,16,14]. Ref. [11] designed the nonlinear feedback law to stabilize the LDI, [4] investigated saturated control for the LDI subject to disturbance, [16] extended the result of [11] to the LDI with time delay and [14] discussed the robust stabilization for the LDI with affine uncertainty.

On the other hand, tracking control attracts much attention in the control theory, many works have been published in this subject [17,6,10]. However, due to the restrictions of some practical problems, we cannot realize the complete tracking, this time we expect to keep the tracking error in a bounded interval or make the tracking error uniformly ultimately bounded (UUB), such as [9,18,20,22]. We also know that stochastic disturbance which can be described by the Gaussian white noise always appears in the real systems and affects the performance of the systems. Refs. [11,4]

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