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Uniform asymptotic stability of impulsive discrete systems with time delay

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ABSTRACT

This paper studies impulsive discrete systems with time delay. Some novel criteria on uniform asymptotic stability are established by using the method of Lyapunov functions and the Razumikhin-type technique. Examples are presented to illustrate the criteria.

1. Introduction

Over the past few years, considerable attention has been paid to the stability of discrete systems with time delay. For continuous-time systems with time delay, it is known that stability criteria can be obtained by using the method of Lyapunov functionals [1,2], comparison principle [3,4] and the Razumikhin technique [5,6]. Among these methods, the Razumikhin technique has the advantage that the Lyapunov function is not required to be decreasing on the whole state space, and has been applied successfully to the study of several stability problems. In the context of discrete systems with time delay, some stability conditions have been obtained by using the equivalent Lyapunov functional technique; see [7–10] and references cited therein. There are also several papers using the Razumikhin technique, see [11,12] and references cited therein.

Impulsive systems have been widely studied in recent years, see [13–18] and references cited therein. Such systems arise in many applied fields such as control technology, communication networks, and biological population management. Since impulsive dynamical systems provide a natural framework for mathematical modeling of many physical phenomena, their study is assuming a greater importance. The readers are referred to [13] for the basic concept and theorems of impulsive dynamical systems. Recently, there have appeared several papers devoted to the study of the impulsive system with time delay by using the Razumikhin technique; see [5,17] and references cited therein. The impulsive control of discrete systems with time delay was studied by Zhang and Sun etc. in [19] recently.

In [5], the author only considered continuous impulsive system. In [11], the author only considered discrete systems without impulse. Inspired by the ideas in [5,11], we establish in this paper some Razumikhin-type stability criteria for impulsive discrete systems with time delay. The criteria in this paper are less restrictive than that in [19]. To the best of our knowledge, there are very few results about the Razumikhin-type stability theorems previously reported in the literature for impulsive discrete systems with time delay.

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