

IMPULSIVE CONTROL OF SECOND-ORDER DIFFERENTIAL EQUATIONS WITH TIME DELAY

Yu Zhang and Jitao Sun

Department of Applied Mathematics
Tongji University, 200092, P.R. China
e-mail: sunjt@sh163.net

Abstract. This paper considers the impulsive control of second-order differential equations with time delay. By using Lyapunov functions and analysis techniques, we get a criterion for stability of impulsive second-order differential equations with time delay. We also give an example to show the efficiency of the obtained result.

Keywords. impulsive, second-order differential equation, Lyapunov function

1 Introduction

Impulses can make an unstable system stable, so it has been widely used in many fields, such as physics, chemistry, biology, population dynamics, industrial robotics, and so on. In recent years, many results are obtained in control systems with impulsive effects or control systems via impulsive control laws [1-15 and references therein]. Impulsive control, which is based on the theory of impulsive differential equations, has gained renewed interests recently for controlling chaotic system [2-6 and references therein]. It allows the stabilization of a chaotic system using only small control impulses, even through the chaotic behavior may follow unpredictable patterns. Since time delay exists in many fields of our society, systems with time delay has received important attention in the last years[7-13 and references therein].

In [2], the authors have gotten some results for impulsive control of nonautonomous chaotic systems: the Duffing's oscillator. Instead of controlling the nonautonomous chaotic system to an equilibrium position, the stabilization of the chaotic system is achieved in a small region of the phase space using the notion of practical stability. In [5], the authors have gotten some criteria on uniform equi-boundedness and equi-Lagrange stability for impulsive systems. Then these criteria are used to synchronize two nonidentical chaotic systems. Finally, these results are applied to communications system security. However, there does not exist time delay in these systems. In the present paper, we will consider the impulsive control of second-order differential equations with time delay. By using Lyapunov functions and analysis techniques, we will get a criterion for stability of impulsive second-order differential equations with time delay.