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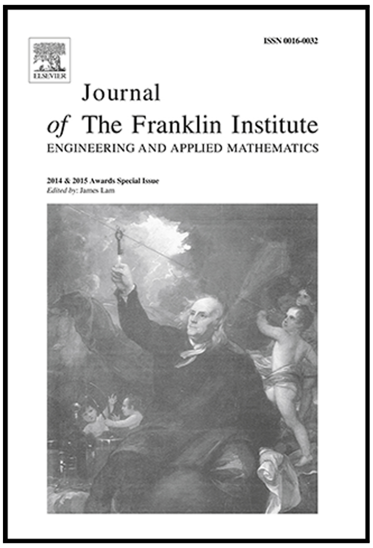

A Lyapunov-like functional approach to stability for impulsive systems with polytopic uncertainties

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A Lyapunov-like functional approach to stability for impulsive systems with polytopic uncertainties

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Abstract: This paper is concerned with a Lyapunov-like functional approach to stability for impulsive systems with polytopic uncertainties. At first, a Lyapunov-like functional approach is established to investigate the stability for impulsive systems, with the Lyapunov-like functional dependent on time explicitly, discontinuous, and not imposed to be definite positive. A specific Lyapunov-like functional is created by introducing the integral of the system state and the cross terms among this integral and the impulsive state. To estimate the derivative of the functional, a new inequality is proposed, and an integral equation of the impulsive system is employed. By the Lyapunov-like functional theory, a new asymptotical stability result is obtained for impulsive systems without uncertainties. Then, the stability result is further extended to impulsive systems with polytopic uncertainties. At last, some numerical examples are given to illustrate that the proposed stability results have less conservatism than some existing ones.

Keywords: impulsive systems, robust stability, polytopic uncertainties

1. Introduction

As a class of hybrid systems, impulsive systems [1-3] have discontinuous points on their trajectories at some certain instants. Due to the properties, impulsive systems have found applications in many fields such as forestry [4], power electronics [5], networked control systems [6,7], sampled-data systems [8-10], and so on. Therefore, it is of significance to study the stability for impulsive systems. Some approaches to the asymptotic stability for impulsive systems have been reported in the literature. The eigenvalue analysis method is one technique to analyze the stability of impulsive systems. However, this technique is not appropriate for aperiodic impulsive systems, nor for uncertain impulsive systems. Another method is the discrete time Lyapunov approach, by which the impulsive system was transformed into a discrete time system, and then a discrete time Lyapunov functional is constructed to deal with the stability for the discrete time system. However, when the impulsive system involves uncertainties or the impulse is aperiodic, the discrete time Lyapunov approach will lead to robust linear matrix inequalities with scalar uncertainties at the exponential, which is complex numerically. To deal with the stability of impulsive systems, a Lyapunov functional method was developed in [11], and an exponent stability