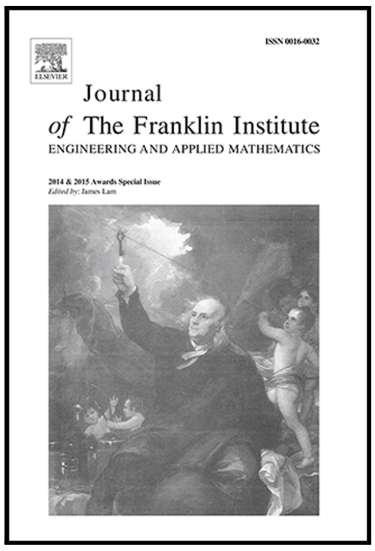

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Further results on delay-dependent stability criteria of discrete systems with an interval time-varying delay

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Abstract

This paper deals with stability of discrete-time systems with an interval-like time-varying delay. By constructing a novel augmented Lyapunov functional and using an improved finite-sum inequality to deal with some sum-terms appearing in the forward difference of the Lyapnov functional, a less conservative stability criterion is obtained for the system under study if compared with some existing methods. Moreover, as a special case, the stability of discrete-time systems with a constant time delay is also investigated. Three numerical examples show that the derived stability criteria are less conservative and require relatively small number of decision variables.

1. Introduction

During the past two decades, there is a growing interest in studying the systems with a time delay since time delays are often encountered in various industrial and engineering systems, such as neural networks, networked control systems, chemical processes, manufacturing and biology [1–4]. It is well known that the existence of time delays may lead to instability, oscillation and poor performance. For those problems, much attention has been paid to the stability problem of delayed systems, see, for example [1, 3, 5–8], and the reference therein. Recalling the existing results, there are two classes of stability criteria, i.e., delay-independent stability criteria and delay-dependent stability criteria. In general, delay-dependent method can usually provide less conservative results than that by delay-independent one especially when the sizes of time delays are small [9–12]. Thus, this paper also focuses on delay-dependent stability criterion for delayed systems.

For a delay-dependent stability criterion, one of main concerns is to obtain a maximum admissible upper bound of time delay such that the system can remain stable. The obtained maximum admissible upper bound is therefore regarded as an index to measure the conservatism of the stability criterion [13–15]. In order to derive a less conservative stability criterion, lots of efforts have been made: i) it is proved that a proper augmented Lyapunov functional can significantly reduce the conservatism of a stability criterion, see [13] for example; ii) Several approaches, such as Jensen inequality [16], free weighting matrix method [6,

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