Dynamics of Continuous, Discrete and Impulsive Systems
Series **B:** *Applications & Algorithms* **16 (2009)** 887-900
 http://www.watam.org

DELAY-DEPENDENT STABILITY OF LINEAR TIME DELAY SYSTEMS: NECESSARY AND SUFFICIENT CONDITIONS *

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Abstract. This paper offers new, necessary and sufficient conditions for delay-dependent asymptotic stability of continuous and discrete linear time delay systems. The delay-dependent criteria are derived by Lyapunov's direct method and are exclusively based on the maximal and dominant solvents of particular matrix equation. Obtained stability conditions do not possess conservatism. Numerical computations are performed to illustrate the results obtained.

Keywords. Continuous time-delay systems, discrete time-delay systems, stability, Lyapunov stability, delay-dependent stability, necessary and sufficient conditions.

AMS (MOS) subject classification: 37B25, 39A30, 93D20, 93C55

1 Introduction

Time delay is very often encountered in various technical systems, such as electric, pneumatic and hydraulic networks, chemical processes, long transmission lines, etc. The existence of pure time lag, regardless if it is present in the control or/and the state, may cause undesirable system transient response, or even instability.

During the last three decades, the problem stability of continuous and discrete time delay systems has attracted considerable attention. The various techniques of stability analysis have been utilized by many researchers. However, there are much more published papers in the area of continuous than discrete time delay systems. One of the basic reasons for that lays in the fact that discrete time delay systems are of finite dimensions so, the augmented, high order model of system without time delay can be easily built from discrete time delay systems [1], [5], [10], [16].

*A preliminary version of this paper was presented at 17^{th} IFAC World Congress, which was held in Seoul, Korea during July 6-11, 2008., [14].