International Journal of Innovative Computing, Information and Control
Volume **4**, Number **9**, September **2008**

 ISSN 1349-4198
pp. 2139–2145

A SUFFICIENT CONDITION FOR STABILITY ANALYSIS OF GREY DISCRETE-TIME SYSTEMS WITH TIME DELAY

Wen-Jye Shyr[1] and Chao-Hsing Hsu[2]

[1]Department of Industrial Education and Technology
National Changhua University of Education
No.2, Shi-Da Road, Changhua 500, Taiwan
shyrwj@cc.ncue.edu.tw

[2]Department of Electronic Engineering
Chienkuo Technology University
No.1, Chieh-Shou N. Road., Changhua 500, Taiwan
chaohsinghsu@yahoo.com

Received August 2007; revised December 2007

Abstract. *This study presents a stability analysis of grey discrete-time systems with time delay involving interval-based state matrices. A sufficient condition is derived to ensure the stability of grey discrete-time systems with time delay. Mathematical analysis reveals that the stability criterion of the proposed is less conservative than that of previous result. Examples are provided to illustrate the application of the result. The result of this study provides an additional option for the stability examination of the grey discreet-time systems.*

Keywords: Stability analysis, Grey system, Discrete-time system, Time delay, Interval matrix

1. **Introduction.** Uncertainties in a control system may be attributed to modeling errors, measurement errors, parameter variations and a linearization approximation. Most physical dynamical systems and industrial process can be described as discrete-time uncertain subsystems. Similarly, the unavoidable computation delay may cause a delay time, which can be treated as time delay in the input component of the original systems. The stability of systems with parameter perturbations must be examined. The issue of robust stability analysis of a nominally stable system subject to perturbations has attracted extensive attention. Stability analysis attempts to determine whether a system that is pushed slightly from a steady-state will return to that steady state. The robust stability of linear continuous time delay system has been investigated [1-3]. The stability analysis of an interval system is very helpful for the robustness analysis of nominally stable system subject to model perturbations. Hence, the stability analysis of interval systems has attracted interest [4-6].

Time delay is frequently observed in various engineering systems, including the turboject engine, microwave oscillator, nuclear reactor, rolling mill, chemical process, manual control, and long transmission lines in pneumatic and hydraulic systems. It is often a source of the generation of oscillation and a source of instability in many control systems. Therefore, stability testing for time delay has received significant attention [7-9]. The time delay system has been examined [10,11].

Grey system theory was first investigated in the early 1980s [12] and has been the subject of considerable research on theory development and applications since then. Lu and Wevers have described the current state of development of grey system theory and