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New Design of Stability Study for Linear and Nonlinear Feedback Control of Chaotic Systems

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Abstract: This paper presents the control of chaotic dynamical systems by designing linear and nonlinear feedback controllers, the stability of chaotic systems has been studied by three methods, the Lyapunov function, Routh-Hurwitz criteria and finally, a new method which is based on the Jacobian matrix conditions, we proved that we can find stability by the third method and not by the Lyapunov function and Routh-Hurwitz methods, we have also found a good interval or exact value for the parametric control which stabilises the chaotic system at its equilibruim point. Numerical simulations show the effectiveness or non-effectiveness of the results for the three different methods, we apply the feedback control to the Sprott J system,a novel chaotic system and the Genesio system.

Keywords: *Lyapunov function; Routh-Hurwitz theorem; Jacobian matrix conditions; feedback control; chaotic systems.*

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1 Introduction

The term "control of chaos" is used mostly to denote the area of studies lying at the interface between the control theory and the theory of dynamic systems studying the methods of control of deterministic systems with non-regular, chaotic behavior [16]. Several techniques have been devised for chaos control, but most are the developments of two basic approaches: the OGY (Ott, Grebogi and Yorke) method [17], and Pyragas continuous control [18]. Both methods require a previous determination of unstable periodic orbits of the chaotic system before the controlling algorithm can be designed. Different

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