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On the Dynamics and FSHP Synchronization of a New Chaotic 3-D System with Three Nonlinearities

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Abstract: This paper reports on a novel chaotic system with three nonlinearities. Firsltly, some properties of the system are studied including equilibrium points and their stability, the Lyapunov exponent and Kaplan-Yorke dimension. Also, the system dynamics are studied by numerical mathematical tools, namely, the Lyapunov exponent spectrum, bifurcation diagrams and 0-1 test. Also, we have studied a type of synchronization, a full-state hybrid projective synchronization (FSHPS), between master and slave chaotic systems. We design suitable controllers to achieve this type of synchronization by using the Lyapunov stability criteria of the integer-order linear system. Finally, the effectiveness of the proposed scheme for this type of synchronization is demonstrated by an illustrative example with numerical simulation in Matlab.

Keywords: *chaotic system; strange attractor; Lyapunov exponent; Lyapunov stability theory; adaptive control; synchronization.*

Mathematics Subject Classification (2010): 34C28, 34D08, 37B25, 37B55, 37D45, 93D05, 93D20.

1 Introduction

In the fields of nonlinear systems dynamics and Chaos theory, a chaotic system is a nonlinear deterministic system that displays a complex, unpredictable behavior and extreme sensitivity to initial conditions. Chaotic systems are applied in many disciplines such as biology, ecology, economics, science and engineering [1-4], etc. They have many different and common application areas such as neural networks, image and sound encryption, robotics, cryptography and secure communication [5-13]. In 1963, Lorenz discovered the

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