Control and synchronization of Hénon chaos via a novel variable structure control

Zhihong Yang , Qionghui Yao and Changhong Yang

Department of Electrical Engineering
Naval University of Engineering, Wuhan 430033, P.R. China.

Abstract. This paper proposes a novel discrete-time variable structure control approach, which not only can stabilize Hénon chaos to a desired equilibrium point but also can synchronize two Hénon chaotic systems. The control scheme initially defines a sliding surface in the error state space that prescribes the desired dynamics and then forms a switching state feedback control such that the error slides on the surface until it converges to zero. Numerical simulations demonstrate the validity and robustness of the proposed method.

Keywords. variable structure control, Hénon chaos, synchronization.

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1 Introduction

In the last decade, chaos control and synchronization problems have attracted increasing attention [1-3]. Many control methods have been proposed and tested for stabilizing a chaotic system to its equilibrium point (or a periodic orbit) or making two identical chaotic systems oscillate in a synchronous manner. Among these methods, the Linear Feedback Control method (LFC) is well studied because it is easily implementable and effective for most chaos systems [4].

However, it should be noticed that LFC is only a local control scheme and may fail when the system has parameter variations. This is due to the requirement of precise information about the system's steady state and the system parameter values. Moreover, LFC has no effect on solving the synchronization problem of two Hénon systems [5].

Variable structure control (VSC), on the other hand, is a nonlinear control approach, which initially defines a sliding surface in the error state space that prescribes the desired dynamics and then forms a switching state feedback control such that the error slides on the surface until it converges to zero, thereby achieving tracking control. Once in the sliding mode, the system is insensitive to parameter uncertainties and external disturbances. At least in this sense, VSC is superior to LFC.