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MASTER-SLAVE CHAOS SYNCHRONIZATION USING AN ADAPTIVE DYNAMIC SLIDING-MODE NEURAL CONTROL SYSTEM

Chun-Fei Hsu[1,*], Chien-Jung Chiu[2] and Jang-Zern Tsai[2]

[1]Department of Electrical Engineering
Tamkang University
No. 707, Sec. 2, WuFu Rd., Hsinchu 30012, Taiwan
No. 151, Yingzhuan Rd., Danshui Dist., New Taipei City 25137, Taiwan
*Corresponding author: fei@ee.tku.edu.tw

[2]Department of Electrical Engineering
National Central University
No. 300, Jhongda Rd., Jhongli, Taoyuan County 32001, Taiwan
intel@ms63.hinet.net; jztsai@ee.ncu.edu.tw

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Abstract. *Since chaotic systems are important nonlinear deterministic systems that display complex, noisy-like and unpredictable behavior, synchronizing chaotic systems have become an important issue in the engineering community. This paper proposes an adaptive dynamic sliding-mode neural control (ADSMNC) system composed of a neural controller and a switching compensator. The neural controller uses a radial basis function (RBF) network to online approximate an ideal dynamic sliding-mode controller, and the switching compensator is designed to guarantee system stability in the Lyapunov stability sense. Moreover, the online adaptive laws with variable learning rate are derived to speed up the convergence rates of the tracking error and controller parameters. Finally, the synchronization problem between two chaotic gyros based on the mater-slave scheme is studied. It is shown by the simulation results that the chaotic behavior of two nonlinear identical chaotic gyros can be synchronized by the proposed ADSMNC scheme after learning of the controller parameters.*
Keywords: Adaptive control, Neural control, Sliding-mode control, Variable learning rate

1. **Introduction.** It is well known that sliding-mode control (SMC), which is one of effective nonlinear robust control approaches, can provide system dynamics with an invariance property to uncertainties once the system dynamics is controlled in the sliding mode [1-3]. However, the SMC strategy usually suffers from large control chattering caused by a switching function in the control law. It may wear mechanism coupling and excite unmodelled system dynamics. A common method to improve the chattering is to replace the switching function by the saturation function. A trade-off problem between chattering and control accuracy arises [2]. To tackle this problem, among several kinds of modern SMC schemes, the dynamic sliding-mode control (DSMC) system is an effective control scheme for eliminating chattering [4,5]. The additional dynamics in the DSMC system can be considered as compensators designed for improving sliding-mode stability. Meanwhile, since DSMC uses an integration method to obtain practical control effort, the chattering phenomenon can be improved effectively.

Though favorable control performance can be achieved by using the SMC and DSMC systems, they need exact dynamic characteristics of controlled plants to design the control