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A NONLINEAR ADAPTIVE OBSERVER BASED ON NEURAL NETWORKS FOR NONLINEAR SYSTEMS INCLUDING SECURE COMMUNICATION PROBLEMS

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Abstract. *This paper presents a nonlinear adaptive observer based on multilayer perceptron (MLP) neural networks, which is indeed a nonlinear-in-parameters neural network (NLPNN), for a class of nonlinear systems including chaotic systems in which all MLP weights are tuned on-line. These systems can be decomposed into linear and nonlinear parts. It is assumed that the linear part is known while the nonlinear part is represented as an unknown piece-wise continuous function. The ultimate boundedness of the observer is guaranteed through the Lyapunov stability analysis. These observers are suitable in nature for secure communication problems. As a case study, the proposed neuro-based observer is applied to the Chua's system in a master-slave synchronization problem. Some numerical simulations are performed. The results are very promising and approve the efficiency and robustness of the proposed robust neuro-based adaptive observer.*

Keywords: Nonlinear adaptive observer, Chaotic systems, Radial basis neural networks (RBNN)

1. **Introduction.** In many engineering applications, it is desirable to measure quantities (states) without having to install all actual measurement equipment. To do so, an observer as an important tool, which combines system knowledge in the form of a mathematical model with information in the form of indirect measurements, plays a crucial role for estimating the non-measurable quantities of interest. Since its introduction by Bestle & Zeitz in 1983 [3], nonlinear observer design has received increasing attention due to its theoretical challenge and its great potential applications in secure communication, chemical reaction, biological systems and so on. Various approaches and extensions to this problem are available in the literature. In [27], a technique is developed to examine the parameterization of all disturbance observers. The problem of observer linearization for single-output dynamical systems in the presence of output-dependent time-scaling changes is studied in [9]. In [15], the use of variable structure methods in state estimation of nonlinear systems based on feedback linearization and extended linearization is