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NEW TIME-EFFICIENT STRUCTURE FOR OBSERVER-BASED ADAPTIVE FUZZY-NEURAL CONTROLLERS FOR NONAFFINE NONLINEAR SYSTEMS

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Abstract. *This paper proposes an observer-based adaptive controller with a merged fuzzy-neural network for nonaffine nonlinear systems under the constraint that only the system output is available for measurement. Using a conventional fuzzy-neural network leads to rule explosion which leads to huge computation time. Our proposed merged-FNN does not have this problem, and can take the place of the conventional fuzzy-neural networks under some assumptions while maintaining the property of stability. Moreover, the adaptive scheme using the merged-FNN guarantees that all signals involved are bounded and the output of the closed-loop system asymptotically tracks the desired output trajectory. Finally, this paper gives examples of the proposed controller for nonaffine nonlinear systems, and is shown to provide good effectiveness.*
Keywords: Direct adaptive control, Fuzzy-neural control, Output feedback control, Nonaffine nonlinear systems, Merged-FNN

1. **Introduction.** For linear systems, adaptive control theory [1-11] applied in adaptive observers [12,13] has been a popular area of research in recent years. Many researchers have proved that the adaptive controller can handle the presence of modeling errors and bounded disturbances [2,3]. For nonlinear systems, fuzzy control theory has had a tremendous impact on the control community because of the simple approach it provides, using heuristic control knowledge for nonlinear control problems. Moreover, adaptive fuzzy control technology has been systematically developed, and the stability of the controlled system is guaranteed by theoretical analyses [11,14,15]. Combining the available mathematical description of the system with its linguistic description results in fuzzy systems, adaptive fuzzy control algorithms provide good tools for controller design of nonlinear systems in a systematic and efficient manner.

Since neural networks and fuzzy logic systems are universal approximators [16,17], nonlinear functions approximated by these systems have been widely developed for many practical applications [14,18-20]. Moreover, many studies [14,21,22] combining fuzzy logic