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ROBUST ADAPTIVE TRACKING CONTROL OF MULTIVARIABLE NONLINEAR SYSTEMS BASED ON INTERVAL TYPE-2 FUZZY APPROACH

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Abstract. *A fuzzy logic controller equipped with a training algorithm is developed such that the H^∞ tracking performance should be satisfied for a model free nonlinear multiple-input multiple-output (MIMO) system with external disturbances. In this paper, a new indirect adaptive interval type-2 fuzzy controller by using fuzzy descriptions to model the plant is proposed to handle the training data corrupted by noise or rule uncertainties for nonlinear MIMO systems involving external disturbances. The Lyapunov stability approach is adopted to verify the stability of the adaptive type-2 fuzzy controller system, and the tracking error because of the matching error and external disturbance can be attenuated to an arbitrary desired level by using H^∞ tracking design technique. Simulation results show that in order to deal with noisy training data, the adaptive type-1 fuzzy controller must expend more control effort. Nevertheless, the interval type-2 fuzzy logic system can handle unpredicted internal disturbance and data uncertainties very well. In the meantime, the adaptive fuzzy controller can perform successful control and guarantee that the global stability of the resulting closed-loop system, and the tracking performance can be achieved.*

Keywords: Interval type-2 fuzzy set, Upper and lower membership functions, Indirect adaptive control, H^∞ approach, MIMO

1. **Introduction.** Adaptive controllers are reemerging as a timely and important class of controller design, as reflected in the recent surge of publications and development efforts in the industry. Some adaptive control schemes for feedback linearizable nonlinear systems have already been proposed [1-3,41]. The central idea of the feedback linearization is to transform algebraically a nonlinear system dynamics into a (fully or partial) linear one, so that linear control techniques can be applied. Adaptive controllers possess the essential ability to cope with the unavoidable challenges imposed by internal uncertainties, as well as by external environmental uncertainties. Therefore, it is an important subject to design a robust adaptive controller to deal with a nonlinear system with uncertainties. In order to deal with increasingly complex systems, to accomplish increasingly demanding design requirements and the need to attain these requirements with less precise advanced