

DIRECT FUZZY MODEL REFERENCE CONTROLLER FOR SISO NONLINEAR PLANTS USING OBSERVER

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ABSTRACT. *In this study, using a model reference adaptation law, a direct stable controller for nonlinear systems is developed. A stable procedure is used to estimate the parameters of the fuzzy controller whose structure is known but its parameters are unknown. A model free observer is also designed to estimate the states of the system under control. The controller is designed based on model reference control technique. The fusion of adaptive fuzzy system with model reference controller makes it possible to take advantage of the flexibility of fuzzy system and stability analysis and tracking performance of the model reference control system. Lyapunov method is used to guarantee the stability of fuzzy system training algorithm and model following of the system under control.*

Keywords: Fuzzy control, Approximate reasoning, Model reference adaptive fuzzy control, Robust control

1. **Introduction.** In parallel with developments in adaptive linear and nonlinear control, there has been a tremendous amount of activities in neural control and adaptive fuzzy approaches. In these studies, neural or fuzzy neural networks are used to directly or indirectly control the dynamical systems with unknown nonlinearities. Recently, the stability analysis of such fuzzy neural control systems is being considered [1-7]. Some of these techniques use an identifier to find the parameters of the controller and are generally called indirect adaptive control systems. Examples of such controllers are indirect fuzzy neural adaptive control systems which use sliding mode controller [1], back-stepping method [2], Model reference control systems [3], and other linear or nonlinear control design techniques [4]. Another approach is to derive a stable adaptation law for neural or fuzzy neural system which can control the plant. This approach is known as direct adaptive methods [5-7]. The model reference adaptive system (MRAS) may be regarded as an adaptive servo system in which the desired performance is expressed in terms of a reference model, which gives the desired response to a command signal [8]. The parameters of the controller change on the basis of the error to maintain the desired performance. The reference model determines the desired states of the system under control and then the adjustment mechanism tunes controller's parameters such that state variables of the system follow the desired states determined by reference model. In this paper we will introduce a novel fuzzy model reference based controller for controlling nonlinear plants. A direct adaptation law based on lyapunov function is derived to adaptively estimate the parameters of controller. A model free observer is also used to estimate the states of the system under control. Using the model free observer, it is just necessary to measure the output of the system. This would reduce the cost of sensors considerably.