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FUZZY ADAPTIVE SLIDING MODE OUTPUT FEEDBACK CONTROL FOR NONLINEAR SYSTEMS

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Abstract. In this paper, a new adaptive fuzzy sliding mode output feedback control scheme is proposed for SISO nonlinear systems. This kind of adaptive fuzzy sliding mode controller is obtained by the combination of fuzzy logic systems, adaptive control theory and recently proposed dynamic sliding mode controller design methods. Its main properties are (i) it does not need the assumption that all the states of the nonlinear system are available for feedback, but a semi-high gain observer is introduced to estimate them. (ii) It can not only guarantee the stability of the closed-loop system, but also ensure that the tracking approaches a neighborhood of the origin.
Keywords. Adaptive fuzzy control, sliding mode control, observer, stability and robustness.

1 Introduction

Modeling and control of nonlinear dynamical systems is one of the most challenging areas of system and control theory. Fuzzy logic control is an effective approach to handle nonlinear systems, especially in the presence of incomplete knowledge of the plant or the situation where precise control action is unavailable. It has found successful applications not only in consumer product but also in industrial processes. In recent years, fuzzy control, one of the important intelligent techniques, has been successfully applied to the modeling and control of nonlinear systems. Based on the universal approximation theorem [9], many adaptive fuzzy control schemes for unknown nonlinear systems have been developed to systematically incorporate the expert information and stable performance criteria have been achieved [8], [2], [4], [5], [6], [1]. These adaptive control systems can deal with increasingly complex systems without precise knowledge of the entire dynamic model. However, all these schemes are only limited to the systems whose states are assumed to be available for measurement. In practice, however, the states variables cannot be all available. Thus, the above adaptive fuzzy control algorithms cannot handle the nonlinear systems whose states are not available for measurement. Using a high gain observer, fuzzy and neural network adaptive output feedback controllers for nonlinear systems have recently been