

RETURNING TO THE STARTING POINT OF THE “FUZZY CONTROL”

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ABSTRACT. *The primary idea of fuzzy control is to employ the knowledge of experts to control a plant instead of the algorithm derived from the mathematical model of the plant. If the parameters in the fuzzy rules, which are based on experts' views, are changed at all, then fuzzy control loses its initiative. In this paper, we consider a few cases to show how to develop a real fuzzy control system with stability in which it persistently maintains the fuzzy rules in accordance with experts' views.*

Keywords: Fuzzy control, System stability, Experts' view, Lyapunov function

1. Introduction. The applications of fuzzy set theory to control systems have had innumerable successes in the industrial world. This shows that fuzzy control is a very useful approach to develop a control system. However, some researchers, especially those who have got used to using the traditional control theory such as adaptive control to design a system under an entirely theoretical proof of its stabilities, are always concerned if the fuzzy control system designed will continue to work stably all the time till the proof is given, even if the designed fuzzy system has worked well as expected so far. This is an important reason why active research on adaptive fuzzy control system, in which the guarantee of the stability of the control system is the first task to be solved, has been conducted. In the last decade or more, a large quantity of research on the adaptive fuzzy control system has achieved success in a sense. In order to develop a stable fuzzy control system, there are, in general, two ways:

(1) After using the so-called Takagi-Sugeno (T-S), also known as the Takagi-Sugeno-Kang (TSK) fuzzy models [1, 2], to represent certain complex nonlinear systems, the control design is carried out based on the fuzzy models by the so-called parallel distributed compensation (PDC) scheme [3]. For each local linear model, a linear feedback control is designed. The resulting overall controller is a fuzzy blending of the individual linear controllers. A sufficient condition for the system stability of the T-S fuzzy systems are obtained by solving a Linear Matrix Inequality (LMI) [4, 5]. Actually, in this case this is nothing to do with experts' knowledge except for the T-S fuzzy models, which also is difficult to be described by experts' views. (2) Another way is to adopt the Lyapunov synthesis approach, and considering the fuzzy rules involved in the approach as some approximators to deal with some unknown parts (functions) in the plant to be controlled. Furthermore, the traditional adaptive control theory has been merged to compose the