NOVEL HYBRID RULE NETWORK BASED ON TS FUZZY RULES

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Abstract: A novel hybrid rule network based on TS fuzzy rules is proposed to resolve the problems of fuzzy classification and prediction. The proposed model learns by using genetic algorithm and is able to cover the whole distribution regions of the samples. In the learning process: (1) fuzzy intervals of each dimension of the samples are partitioned evenly; (2) computing intervals (CIs) are established based on the even intervals; (3) linear weighted model of several normal probability distributions is used to describe the sample probability distribution on CIs; (4) membership degree of each CI is learnt to evaluate the importance of each CI, avoiding the problem that the optimal intervals are difficult to cover the original sample spaces; (5) dynamic rule selection mechanism is used to dynamically combine a small number of optimal rules linearly to achieve nonlinear approximation, reducing the computation load.

Three experiments are performed: the experiments on Iris and Mackey-Glass chaotic time series show that HRN can achieve satisfactory results and is more effective in terms of generalization ability, whereas the experiment on exhaust gas temperature demonstrates that HRN can predict the EGT of aero engine effectively.

Key words: *Hybrid rule network, dynamic rule selection mechanism, fuzzy classification, prediction*

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1. Introduction

Because the ability to handle the complex problems with strong nonlinearity or high degree of uncertainty, the fuzzy models have been widely employed in many real fields, such as system identification [24], automatic control [3, 26], pattern recognition [26], data mining [1], prediction [10], etc. Fuzzy model is proved to be a powerful model in complex system modeling [25]. There are at least two different kinds of rule-based fuzzy models, including the Mamdani fuzzy model [21] and the Takagi-Sugeno (TS) fuzzy model [24]. Recently, the TS fuzzy model has got more attention than the Mamdani fuzzy model, because the TS fuzzy model can approximate the complex nonlinear system with fewer rules and higher accuracy [13, 15].

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