

UNIFIED FORMS OF FUZZY SIMILARITY INFERENCE METHOD FOR FUZZY REASONING AND FUZZY SYSTEMS

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ABSTRACT. A novel fuzzy reasoning method, called FSI (fuzzy similarity inference) is investigated in this paper. Firstly, the unified forms of FSI which the diverse implication operators can be employed are proposed. And the computational formulas for both fuzzy modus ponens (FMP) and fuzzy modus tollens (FMT) are obtained. Secondly, the unified forms of α -FSI method are established, and the formulas for α -FSI FMP and α -FSI FMT are obtained respectively. Furthermore, it is proved that FSI method possesses reversibility properties. The analysis of response ability of fuzzy systems constructed by FSI indicates that such fuzzy systems are universal approximators. Finally a simulation experiment shows the effectiveness of FSI method.

Keywords: Fuzzy reasoning, Fuzzy control, Fuzzy similarity measure, FSI method, Regular implication operator

1. Introduction. Since fuzzy control achieved successful application in various fields, fuzzy reasoning as the mathematical and logical foundation of fuzzy control has gained much more attentions by scholars in [1-10,19]. CRI method is introduced by L. A. Zadeh [10]. It has been widely applied in various fields of industrial control. In [11], it is proved that fuzzy systems based on CRI can be regarded as interpolation functions. In [12], the sufficient and necessary conditions for two classes of fuzzy systems possessing interpolation properties are obtained. However, from the standpoint of logic semantics, there exist several problems in applying CRI method. For example, the approach does not possess reversibility property. Triple I method is proposed by Wang [13]. And Wang put it into the framework of fuzzy logic. Furthermore, based on regular implication operators generalized by left continuous t-norm, the unified forms of triple I method are obtained in [14]. Despite triple I method has provided logical foundation for fuzzy reasoning; it is proved that for many implication operators, the fuzzy systems constructed by triple I do not possess the universal approximation property [15]. It is well known that universal approximation capability of fuzzy systems is the basis of almost all the theoretical research and practical application of fuzzy systems, e.g., fuzzy control, fuzzy identification and fuzzy expert systems, and so on. How to establish reasoning method, which has strict logic foundation and by which fuzzy systems constructed have universal approximation property, is an interesting question.