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Weighted Mamdani-type Fuzzy Inference System Based on Relative Ideal Preference System

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Abstract

This paper presents a new method of determining weight of the fuzzy IF-THEN rules in a Fuzzy Inference System based on human intuition or expert judgment, known as the Relative Ideal Preference Scheme (RIPS). In the proposed scheme, an ideal preference rule is chosen from the given set of available fuzzy IF-THEN rules in the system which will be set with weight 1. The threshold weight and the interval between rule's weight are calculated prior to the computation of the weight of other rules. Rules are rearranged based on their level differences with respect to the ideal preferred rule. Finally, the weight of each rule is determined using the calculated threshold and interval between weights. An illustration of its implementation in a fuzzy inference system is presented with a numerical example. The proposed scheme has an advantage where the weights of the rules are determined systematically and simple.

Keywords: Fuzzy inference system, Fuzzy logic, Weighted IF-THEN rules, Relative ideal preference system

1. Introduction

The introduction of fuzzy set theory by Zadeh (1965) has triggered immense interests of researchers and practitioners in various fields. It has been used and applied mostly to cater mathematically the vagueness, impreciseness and subjectivity of information and data (Zimmermann, 2004) . Instead of having just bi-values of 0 and 1 in logic concept, a fuzzy set is represented by a membership value in the real unit interval [0,1] that indicates the degree of belonging of an element in a particular set (Dubois, 1980). Due to their similarity in conceptual structure, fuzzy set has been used to generalize the definition of fuzzy logic and becomes one of important disciplines in soft computing. Fuzzy set has been extended theoretically and in applications due to its usefulness in imitating human thinking and perceptions.

Fuzzy Inference System (FIS) is one of the many applications of fuzzy set with fuzzy logic. It is a system that involves a process of formulating the mapping from a given input to an output (both in crisp form) using fuzzy logic (Stoffel et al., 2010). The main components of the fuzzy inference system are

i. Input fuzzification (rule antecedent);
ii. Fuzzy rules operator application (AND and OR) to antecedent;
iii. Antecedent to consequent implication (in Inference Engine);
iv. Aggregation process of consequents (in Inference Engine);
v. Defuzzification process to obtain the output.

FIS has already been successfully applied in many technology domains such as engineering, manufacturing and expert systems (He, 1980; Stoffel et al., 2010).

2. Related Works on Weighted Fuzzy Inference System

The concept of weighted fuzzy inference system is not new. In many situations, the rules in a fuzzy inference system cannot be treated as equal simply because human usually has preference on one setting or situation compared to others (He, 1980). This allows the weight to represent in many forms such as degree of belief, certainty or important factor. According to the argument given by Wong and Dong (2009), imposing weight on the rules will improve the decision obtained as it imitates human intuition and believe.

The weight of the rules in the FIS can be determined in many ways, but essentially it can be categorized into two types which are soft computing methods and human intuition or expert judgment.