International Journal of Innovative Computing, Information and Control
Volume **3**, Number **4**, August **2007**

ICIC International ©2007 ISSN 1349-4198
pp. 839–851

CALCULUS OF INTERPOLATED FUZZY RELATION TYPE FUZZY REASONING METHOD

Manabu Shimakawa

Department of Information and Computer Sciences
Kumamoto National College of Technology
2659-2, Suya, Koshi, Kumamoto 861-1102, Japan
shima@cs.knct.ac.jp

Received October 2006; revised February 2007

Abstract. *When a human being has to interpret a result by fuzzy reasoning and takes appropriate action, the reasoning result should be shown as a simple shape fuzzy set. Interpolated Fuzzy Relation Type (IFRT) fuzzy reasoning method has the following two features: (1) the fuzzy set of a reasoning result becomes a simple shape, so it is easy to interpret its meaning, (2) if the fuzziness of an input fuzzy set increases, the fuzziness of the reasoning result fuzzy set also increases. Reasoning process of the IFRT method is simple when a real number is given as input. But in fuzzy number input cases, its reasoning process is not so easy when compared with a real number input case. This paper shows an overview of the IFRT fuzzy reasoning method and explains practical calculus technique of reasoning process for real number input cases and fuzzy number input cases with concrete example.*

Keywords: Interpolated fuzzy relation, IFRT fuzzy reasoning method, Fuzzy inference, Interpolation, Fuzzy relation

1. **Introduction.** A lot of fuzzy reasoning methods have been proposed by using various fuzzy implications and compositions [2, 4–8] since the Zadeh's paper "Fuzzy Sets" [1] was presented in 1965. Fuzzy reasoning methods are roughly classified into two types whether reasoning result is given as a real number or a fuzzy set. The simplified fuzzy reasoning method [9] is a typical one of the former. This method has a feature that the computational complexity can be few because the consequent part of fuzzy rule is composed of a real number. In addition, the reasoning process is simple, therefore it is possible to be materialized on LSI chip [18]. The Mamdani's method [3] that uses the max-min composition is a typical method of the latter. It is an origin of other fuzzy reasoning methods proposed later. The Mamdani's method still keeps being used for some applications, *e.g.* a literature [19]. Reasoning results by this method consist of some overlapped trapezoid-type membership functions. Because the membership function's shape is not simple, it is difficult to interpret the meaning that the reasoning result expresses. In general, some defuzzification techniques, *e.g.* the Center-of-Gravity method, are necessary to obtain a representative value of the result. As for the method by the product-sum composition [10] modifying the Mamdani's method, the membership function's shape of a reasoning result becomes a little simpler, but it is necessary to use a representative value too. Thus, in