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LEARNING ALGORITHMS WITH REGULARIZATION CRITERIA FOR FUZZY REASONING MODEL

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Abstract. *This paper describes two learning algorithms using regularization terms for fuzzy reasoning model. The proposed algorithms are learning ones for parameters of the antecedent and the consequent parts. In the first algorithm, the entropy function as a regularization term for parameters of the antecedent part in fuzzy reasoning rule is introduced. Then, the parameters of the center and the width are adjusted so as to be* 0.5 *for each membership value. In the second algorithm, the weight elimination function as a regularization term for the weights of the consequent part is proposed. The model to have a few weights of large absolutes or many weights of small absolutes is constructed. Some numerical simulations are performed to show the validity of the proposed methods. Specially, it is shown that the use of the weight elimination function decreases learning time.*

Keywords: Entropy term, Weight elimination term, Regularization term, Fuzzy reasoning model, Learning method

1. **Introduction.** There have been many studies on self-tuning fuzzy systems [1-7]. The aim of these studies is to construct automatically fuzzy reasoning rules from input and output data based on the steepest descent method. Obvious drawbacks of the steepest descent method are its computational complexity and the problem of getting trapped in a local minimum. Therefore, ineffective systems with an reasoning error and a number of rules are constructed. It is known that generalization ability with the steepest descent method is mainly influenced by three factors [4, 7]: the number of data and performance of the learning data, which represent how well the problem at hand is characterized, the complexity of the learning algorithm employed, and the network structure such as the number and the assignment of fuzzy reasoning rules. Generally speaking, a large amount of learning data can provide a better representation for the underlying problem, and if a suitable learning algorithm and network structure is used, a better solution to the problem should be obtained. The third factor, the network structure for fuzzy reasoning model, is discussed in the following. In order to construct effective networks, some novel methods have been developed which 1) create fuzzy rules one by one starting from a small number of rules [8], 2) delete fuzzy rules one by one starting from a sufficiently large number of rules [9, 10], 3) use a genetic algorithm to determine the structure of the fuzzy model [11, 12], 4) use a self-organization or a vector quantization technique to determine the initial assignment of fuzzy rules [13-17], 5) use generalized objective functions [18-20], and