

Fuzziness versus probability again

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Abstract

A construction of a fuzzy logic controller based on an analogy between fuzzy conditional rule of inference and marginal probability in terms of the conditional probability function has been proposed.

Keywords : probability, membership function, fuzzy logic

In [1] we found : Intuitively, a similarity is felt between the concepts of fuzziness and probability. However, between the concepts of fuzziness and probability there are also essential differences. Probability is an objective characteristic; the conclusions of probability theory can, in general, be tested by experience. The membership grade is subjective, although it is natural to assign a lower membership grade to an event that, considered from the aspect of probability , would have a lower probability of occurrence. The fact that the assignment of a membership function of a fuzzy set is "nonstatistical" does not mean that we cannot use probability distribution functions in assigning membership functions .

L.A. Zadeh [2] suggested an analogy between the expression for the fuzzy conditional rule of inference , given by

$$y = x \circ R \quad (1)$$

and the following expression for a conditional probability function

$$\Pr \{ Y=y(j) \} = \sum \Pr \{ X=x(i) \} \cdot \Pr \{ Y=y(j) | X=x(i) \} \quad (2)$$

where X and Y are random variables with values $x(1), x(2), \dots$ and $y(1), y(2), \dots$, respectively.

A realization in hardware of a fuzzy logic controller based on the noted analogy can be performed. Unfortunately, however, the described procedure is relatively slow because of the statistical nature of the result; a more detailed analysis is, therefore, necessary. It is the opinion of the author that the proposed realization has limited practical importance because the speed of operation is simply too slow.

References

- [1] A. Kandel and W.J. Byatt, Fuzzy Sets, Fuzzy Algebra and Fuzzy Statistics, Proceedings of the IEEE, vol.66, no.12, 1978
- [2] L.A. Zadeh, Outline of a New Approach to the Analysis of Complex Systems and Decision Processes, IEEE Trans. Syst., Man, Cybern., vol. SMC-3, no.1, 1973