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13. ABSTRACT (Maximum 200 words) The research has been focused in the main on the development of fuzzy logic and its applications in three problem areas: (a) qualitative systems analysis; (b) imprecise knowledge representation; and (c) neural network control of fuzzy rule-based systems. These problem areas are of direct relevance to the analysis and design of both control and knowledge-based systems which operate in an environment of uncertainty or imprecision. In the realm of qualitative systems analysis, a basic problem which we have studied is the following. Assume that a system is comprised of an interconnection of n components, with the qualitative input-output relation of each component characterized by a collection of fuzzy if-then rules involving linguistic variables. The problem is to compute the qualitative input-output relation of the system from the specifications of the qualitative input-output relations of its components. An effective solution to this problem has been obtained through the use of what might be called FA-Prolog. FA-Prolog is a subset of Fuzzy Prolog in which the certainty factors are assumed to be equal to one. With this simplifying assumption, the fuzzy if-then rules can be handled in a straight-forward way and the determination of the qualitative input-output relation reduces to the execution of an FA-Prolog program.							
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Development of Probabilistic and Possibilistic Approaches to Approximate Reasoning and Its Applications

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SUMMARY

Our research has been focused in the main on the development of fuzzy logic and its applications in three important problem areas: (a) qualitative systems analysis; (b) imprecise knowledge representation; and (c) neural network control of fuzzy rule-based systems. These problem areas are of direct relevance to the analysis and design of both control and knowledge-based systems which operate in an environment of uncertainty or imprecision.

In the realm of qualitative systems analysis, a basic problem which we have studied is the following. Assume that a system is comprised of an interconnection of n components, with the qualitative input-output relation of each component characterized by a collection of fuzzy if-then rules involving linguistic variables. (A simple example of such a rule might be: *if the pressure is high then the volume is low.*) The problem is to compute the qualitative input-output relation of the system from the specifications of the qualitative input-output relations of its components.

An effective solution to this problem may be obtained through the use of what might be called FA-Prolog. FA-Prolog is a subset of Fuzzy Prolog in which the certainty factors are assumed to be equal to one. With this simplifying assumption, the fuzzy if-then rules can be handled in a straight-forward way and the determination of the qualitative input-output relation reduces to the execution of an FA-Prolog program.

In the realm of imprecise knowledge representation, we have focused our attention on the representation of commonsense knowledge. The basic idea underlying our approach is that such knowledge may be assumed to consist of a collection of dispositions: that is, propositions which are preponderantly but not necessarily always true. Unlike the approaches which have become popular in AI (circumscription, non-monotonic reasoning, and default reasoning), our approach is based on fuzzy logic and, more specifically, on the theory of usuality.

In the realm of neural networks, a doctoral student, C.C. Lee, has opened a new direction with the development of a self-learning fuzzy control system which is tuned by a neural network. Simulation studies involving a pole-balancing system have shown that Lee's system learns significantly faster than the systems described in the literature and is substantially more robust.

It should be noted that fuzzy logic is finding its way into a wide variety of commercial products ranging from automobile transmissions and autofocus cameras to VLSI chip design and robot eyes. A representative sample of such applications is included in the Appendix.

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