Foreword

The inauguration of the *Journal of Intelligent and Fuzzy Systems* marks an important milestone in the evolution of the theory of fuzzy sets and, especially, in its role in the conception, design, and analysis of intelligent control and information systems.

When I wrote my first paper on fuzzy sets in 1965, my expectation was that the theory of fuzzy sets would find its main applications in the realm of systems in which the dependencies between variables are too complex or too ill-defined to be amenable to analysis by conventional methods. Such systems are the norm in the social sciences, psychology, philosophy, linguistics, the biological sciences, and economics. And yet, reflecting the deep-seated quest for precision in Western cultures, it was and still is politically correct to employ traditional mathematical techniques for dealing with systems of this type, disregarding the imbalance between the precision of the analysis and the imprecision of the systems to which it is applied. Not surprisingly, the results of such analyses are in many cases much too precise in relation to the imprecision of the underlying data. When this is the case, the analysis may be rigorous and elegant, but its results are likely to be of limited relevance to the research for a solution to a real-world problem.

Today, contrary to my expectation in 1965, most of the applications of what is broadly subsumed under the label of fuzzy logic relate to control in the context of industrial and consumer products. In such systems the dependencies between variables are generally well-defined and traditional methods are applicable. The question then is: Why is the use of fuzzy logic in the realm of control rapidly gaining in popularity? The answer in a few words is: Precision carries a cost. More specifically, what fuzzy logic offers, above all, is a collection of concepts and techniques that make it possible to exploit the tolerance for imprecision. My favorite example that illustrates the point succinctly is the problem of parking a car. A human being can park a car without any quantitative knowledge of its dynamics and any measurements of size and distance. We can do this because the final position of the car is not specified precisely. If it were prescribed to within, say, a millimeter and a tenth of a degree, it would take hours or days to achieve the objective. Thus, in this case, as well as in most of what we do, we exploit the tolerance for imprecision to reduce the cost of solution or make the problem tractable.

In many of the current applications of fuzzy logic what is achieved is a higher level of what might be called *machine intelligence quotient*, or MIQ. This is especially true in the realm of smart appliances and consumer electronics products. Indeed, I believe that it is only a matter of time before MIQ will emerge as a key determinant of product performance, since high MIQ products and systems are not only more user friendly but are also more robust and more adaptable to changes in mode of use.

An important trend that is becoming discernible is the progression of fuzzy logic control from device and small system control to supervisory control involving large scale systems. Such systems are exemplified by power plants, nuclear reactors, vehicular and air traffic control systems, health care delivery systems, and the management of economic, financial, corporate, and communications systems.

In the case of control systems, what we use today is a small subset of fuzzy logic that involves straightforward manipulation of unqualified fuzzy if–then rules. By contrast, in the applications of fuzzy logic to expert systems, the rules are generally probability and/or possibility qualified and their structure is much more complex. What this suggests is that in the realm of supervisory control—in which expert systems are likely to play an important role—the full power of fuzzy logic will have to be employed to achieve a solution. Furthermore, in the applications of fuzzy logic to the analysis and conception of large scale industrial systems, it may be advantageous to use fuzzy logic in combination with neural network techniques, genetic algo-

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rithms, probabilistic reasoning, and other techniques falling under the rubric of *soft computing*. Soft computing is distinguished from the traditional modes of computation in that its basic objective is to derive an acceptable approximate solution rather than a solution that is precise, optimal, and demonstrably correct in all cases. In effect, in soft computing a solution is acceptable if it is dispositionally approximate and correct in the sense that it is valid preponderantly, but not necessarily in all cases. Solutions of this type are likely to play an increasingly important role in the design of high MIQ systems in the years ahead.

One of the basic objectives of the *Journal of Intelligent and Fuzzy Systems* is to provide a forum for the dissemination of ideas and results relating to the conception and design of systems that are far more intelligent than the systems in use today. The idea to inaugurate the Journal was conceived by Professors Mo Jamshidi and Timothy Ross. Professor Jamshidi is a man of imaginative vision and boundless energy. We owe him our thanks, congratulations, and support.

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Honorary Editor