
EDITORIAL

It is with great pleasure that we welcome our readers to the inaugural issue of the *Journal of Intelligent and Fuzzy Systems (IFS)*. We expect this new journal to become an important forum for the transfer of new intelligent and fuzzy systems technology from the research and development world into the engineering community for use in new products and processes.

We are especially grateful to the journal's Honorary Editor, Dr. Lotfi Zadeh, of the University of California, Berkeley, for providing this publication with his expertise and guidance. We have also assembled a team of very knowledgeable experts in various intelligent systems disciplines to help guide this journal. These experts comprise the Regional Editors, the Editorial Advisory Board, the Associate Editors, and the Book Review Editor. The Editorial Board will assist us in determining policy and future direction, the Regional Editors will act on behalf of the journal overseas to staff papers in various parts of the world, and the Associate Editors will assist us with their expertise in staffing papers for review and in locating appropriate reviewers. We are very grateful for the time and energy these individuals will devote to this journal to ensure its quality and impact on the engineering and scientific community at large.

Fuzzy logic was first subjected to technical scrutiny in 1965 when Dr. Zadeh published his seminal work, "Fuzzy Sets," in *Information and Control*. Since that time the subject has been the focus of many independent research investigations by mathematicians, scientists, and engineers from around the world. Unfortunately, perhaps because of the term's connotations, fuzzy logic did not receive critical acclaim in this country until recently. The current attention being paid to fuzzy logic is most likely the result of popular consumer products now employing fuzzy logic and of the United States again buying its own technology from overseas. Over the last several years, the Japanese alone have filed for well over 1000 patents in fuzzy logic technology, and they have already grossed billions of United

States dollars in the sales of fuzzy logic-based products to consumers the world over.

Whatever the reasons, the subject of fuzzy logic is receiving tremendous attention in the United States and in other nations around the world. Its integration with neural networks and genetic algorithms is now making cognitive systems the systems of choice in many intelligent disciplines. In fact, it might not be too far from the truth to say that artificial neural networks and genetic algorithms (for their abilities to learn) are seeing increased utility in the R&D world because they integrate technologies with systems that can reason, e.g., fuzzy systems, thereby bringing to commercial fruition products and processes that are reasonably effective cognitive systems (i.e., systems that can learn and reason). Fuzzy technology is so important in Japan that the word *fuzzy* was proclaimed by the Japanese as the "keyword" for the 1990s. The international marketing research firm of Frost and Sullivan devoted to the subject an entire 1989 study, which projected that fuzzy logic, with an annual growth rate of 20%, would be one of the world's ten hottest technologies going into the 21st century. In its 1990 and 1991 studies on foreign technology of interest to the United States, the National Technical Information Service (NTIS) found fuzzy logic to have a significant future impact.

We believe that, although relatively new, the technology involved in intelligent and fuzzy systems is of such a fundamental and ubiquitous nature that by the turn of the century it will be standard knowledge for all engineers and scientists. Interest in fuzzy systems is growing most rapidly in younger undergraduate students, because these students are contemplating a new field for their graduate and/or professional work. And because our nation's campuses are responsible for replenishing the worldwide supply of technical talent, we see the young professional as the second fastest-growing group of *IFS* readers.

Many of the contributions in fuzzy logic and

fuzzy set theory are dispersed over a broad range of scientific journals, and the dissemination of knowledge in these areas is limited and scattered. Engineers working in these areas, in different disciplines and on different continents, often do not know of each other or their contributions. *IFS* will concentrate the dissemination of this information, accelerating the progress of research and applications in the marketplace. Likewise, *IFS* will not restrict itself to fuzzy logic materials, since the integration of intelligent technologies (those that can reason, learn, or adapt) appears to be most promising in terms of advancing the development of new products and processes for worldwide industries and economies.

IFS is designed for the professional and academic audience interested primarily in applications of fuzzy logic and intelligent systems. In the last 3 years of teaching courses in Fuzzy Logic and Intelligent Systems on campus and in delivering short courses to industry and national laboratories, we have found that the overwhelming majority of students and practicing professionals are interested in applications of fuzzy logic in their fields. Many of these individuals have expressed frustration at finding it difficult to understand the abstract mathematical terms presented in much of the currently available fuzzy logic literature. Designed to interest a broad cross-section of technical disciplines over and above the academic and research institutions, *IFS* will present articles with a scholarly tone that will be labeled as state-of-the-art and, as such, will be of interest to academic professionals as well as working professionals. At the same time, we will include seminal works in the mathematics of intelligent and fuzzy systems to show our readers that these practical and useful systems also have a sound mathematical basis.

In this and subsequent issues, *IFS* will focus on current and potential applications, case studies, and education in intelligent and fuzzy systems for engineering and related technical fields. The journal has a broad interest in the disciplines of computer science, electrical engineering, manufacturing engineering, industrial engineering, chemical engineering, mechanical engineering, civil engineering, engineering management, and related technology fields such as mathematics, medicine, operations research, technology management, the hard and soft sciences, and technical legal issues. Typical fields of interest might be in applications in control theory and signal pro-

cessing, neural network applications, robotics and manufacturing, intelligent process control, expert systems, computer security, image processing, damage assessment, decision making, pattern recognition, cluster analysis, and a variety of learning methods, such as neural networks and genetic algorithms.

The contents of this inaugural issue typify the type of article for which *IFS* was conceived. The six articles in this first issue cover a broad spectrum of engineering and scientific disciplines ranging from structural engineering to electrical engineering. They address a wide range of technologies: pattern recognition, intelligent silicon chips, damage assessment, mathematics of memories, three-dimensional vision systems, and dynamical neural networks.

- Our first offering, by James C. Bezdek, is not only a quality article in the area of pattern recognition, but also an excellent review article discussing the synergism among probabilistic, fuzzy, and computational neural networks in addressing systems characterized by various types of uncertainty—not just random uncertainty, as has been the case for years. Bezdek's contention that the synthesis of statistical, fuzzy, and neural approaches to problems will continue to grow as the integration of intelligent processes becomes more important in solving complex problems will no doubt prove to be true. His review is most useful in this regard as our first article and as an indicator of trends in the field.

- The discussion of analog fuzzy processors embodied in silicon microprocessors by Tsutomu Miki, Hidetoshi Matsumoto, Keishi Ohto, and Takeshi Yamakawa is an excellent example of the type of application article that *IFS* will emphasize. It discusses the development of a high-speed hardware system capable of accelerating many control processes such that real-time applications involving ambiguous information will become possible. Because of their pure parallel architecture, these processors will become particularly useful in advanced computing machines. A review of this article will quickly convince most readers that digital processors may be swinging back to the analog approach where we started some 4–5 decades ago.

- Hitoshi Furuta's article is an application in structural damage assessment for the repair of bridges and also an important work in the area of multi-criteria decision analysis. Such analyses conform to the situations humans beings must deal with when they are faced with a plethora of

complex issues and subjective constraints. Furuta shows the advantages of extending beyond single-criteria decision analyses, and addresses the important problem of the decaying infrastructures that all industrialized countries are beginning to face.

- Ronald R. Yager presents a mathematical foundation for some types of associative memories, particularly holographic memories. Although it is not an application article, we believe the work represents a seminal contribution that will become extremely useful in intelligent systems in the near future. Most readers have dealt with matrix associative memories (although perhaps under a different label, such as mappings or relations) and many have been exposed to fuzzy associative memories in the development of rule-based systems. Holographic memories as models of human memory stimulus will likely become very useful because of their analogical relationship to physical holograms, photographic media that have been exposed to a single frequency of light at a specific angle. Interference patterns, which are imaged and stored physically, are repetitive on the media; thus the size of the pattern is infinitely scaleable, where a small pattern contains the same data as a larger pattern. Such ideas should become quite useful because here Yager presents a method of representing fuzzy information in the same manner.

- Koji Shimojima, Toshio Fukuda, Fumihito Arai, and Hideo Matsuura discuss the development of a cognitive system integrating fuzzy logic and neural nets to accomplish a three-dimensional measuring system for automated vision. This excellent application article represents the power of integrating learning systems with reasoning systems to tackle the difficult computer vision problem of improving a manufacturing process in curved metal surface carving. The article discusses the use of neural networks in compensating for a vision system and the employment of a sensor integration system based on fuzzy inference with information of the sensor's environments and the manipulator's pose.

- Finally, M. M. Gupta and D. H. Rao discuss

a neuronal model to emulate higher cognitive functions, such as sensor integration, learning, memory storage, control and vision. The article offers an excellent application of existing intelligent technology that illustrates the power of integrating technologies to solve complex mechanical problems—in this case, the adaptive control of nonlinear systems. Based on the topology of a reverberating circuit in a neuronal pool of the central nervous system which incorporates both synaptic and somatic adaptations, the neuronal model does not represent any specific anatomical region within the biological nervous system but it does emulate a reasonable facsimile of the functional dynamics of reverberating circuits in this system. The article deals primarily with a neural network approach to these adaptations, and it presents extensive simulation results to show its capabilities in adaptive control.

IFS will also discuss noteworthy items of interest to our readers such as communications between authors and readers, new books and professional references in related literature, important meetings, and other significant events or news items we believe are timely and important. In this first issue, for example, we present a review of Terano, Asai, and Sugeno's original book on fuzzy logic, recently translated from the Japanese. This English-language version shows the Western world's growing interest in the fundamentals of fuzzy logic and their applications to problems in many disciplines.

We hope that the following pages will show present and future subscribers *IFS's* intent to share with a broad audience of professionals the practical applications of various theories and methods developed in the fields of intelligent and fuzzy systems. We welcome comments from all interested readers in our quest to make this a truly useful and practical platform for debate and for the concomitant improvements in intelligent and fuzzy systems technology.

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