IEEE INTERNATIONAL CONFERENCE ON FUZZY SYSTEMS

March 8-12, 1992

Town & Country Hotel
San Diego, California

IEEE

FUZZ-IEEE '92

IEEE INTERNATIONAL CONFERENCE ON FUZZY SYSTEMS MARCH 8-12, 1992 • TOWN & COUNTRY HOTEL

San Diego

California

Honorary Chair: **Lotfi Zadeh,** University of California, Berkeley

General Chair: **Jim Bezdek,** University of West Florida

PLENARY SESSIONS

Fuzzy Control: Principles, Practices and Perspectives
Michio Sugeno

Fuzzy Information Systems
Fred Petry
Bill Buckles

Possibility Theory as a Basis for Preference Propagation in Automated Reasoning
Didier Dubois
Henri Prade

Interpolative Reasoning in Fuzzy Logic and Neural Network Theory
Lotfi Zadeh

Fuzzy Sets and Approximate Reasoning in Decision Making
Ron Yager

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TUTORIAL SESSIONS

Basic Concepts of Fuzzy Control
Hamid Berenji

Basic Concepts of Fuzzy Sets and Logic
Enrique H. Ruspini

Engineering Applications of Fuzzy Systems
Michio Sugeno

Fuzzy Information Systems
Piero P. Bonissone

Hardware and Software Tools
Masaki Togai
Erik Horstkotte
Doug Leo

REGISTRATION

Full conference registration includes admission to all sessions, exhibit area, reception, banquet, and Proceedings. Register for TUTORIAL Sessions separately. For specific registration and exhibit information, please contact:

FUZZ-IEEE '92 Conference Headquarters
Meeting Management
5665 Oberlin Drive, Suite #110
San Diego, CA 92121
Tel: 619/453-6222
Fax: 619/535-3880

A MESSSAGE FROM THE GENERAL CHAIR

This proceedings and the presentations it represents are in some sense the culmination of 26 years of research and development about fuzzy sets and models. Indeed, years after Zadeh introduced the idea of fuzziness in 1965, many scientists and engineers felt that this was yet another new and bizarre technology with little to offer other than vacuous theories, uninteresting papers, and lots of graduate students! While (non-vacuous) fuzzy theories have indeed grown in almost all conceivable directions since 1965, the proof of any new technology ultimately lies in its utility for solving real problems. Models based on Zadeh's idea have emerged, in the last five years, as an enabling technology for many commercially successful products using fuzzy control and pattern recognition. Sophisticated applications to complex problems in many military and industrial domains are well on the way to becoming parts of fielded systems. This conference and its proceedings are the first evidence that the IEEE, the largest professional engineering society in the world, has recognized the significance of these developments. Readers of this proceedings will be able to confirm for themselves that fuzzy models have earned a place in the evolution of science and technology; this fact makes the rest of my introduction easy.

All that is left to do here is thank everyone who has helped make the conference and its proceedings a reality. The conference was put together very rapidly, and there have been, inevitably, some glitches in the processing of papers, assembly of the program, logistics of the meeting, and so on. On the whole, however, things proceeded smoothly, and this is directly attributable to the cooperation I received from a large number of helpful people. There are, of course, far too many people who had an active hand in this production for me to recognize each one individually. All that has been done would have been quite impossible without the able and professional help of the people on (and behind) the committees that appear following these pages. However, a few persons should be specifically mentioned. First, Bob Marks, Pat Simpson, Russ Eberhart and Toshio Fukuda, who had the vision to lead the IEEE Neural Networks Council towards their decision to sponsor this event at all. And I would be remiss if I did not single out for special thanks Didier Dubois and Henri Prade, who served as program co-chairs for the conference, and really did almost all of the hard work. Without them, none of this would have been possible. Finally, Nomi Feldman and her staff should be credited for accounting for many of the tedious details that go unnoticed when things work.

I hope you all enjoy this conference, and that you find this proceedings as valuable as I think it will be.

Jim Bezdek, General Chair
March, 1992

Conference Report: IEEE FUZZ-IEEE, 1992

Towards a synthesis of fuzzy logic and neural networks

James C. Bezdek
University of West Florida
General Chair

The First IEEE International Conference on Fuzzy Systems (FUZZ-IEEE '92)was held in San Diego on March 8-12, 1992. The conference was sponsored by the IEEE Neural Networks Council (NNC), the first organ of the IEEE which has shown a concentrated interest in fuzzy systems since their inception in 1965. Thus, it seems appropriate at this point to first thank the NNC (in particular, Russ Eberhart, Bob Marks, Pat Simpson, and Mike Roth) for their interest, enthusiasm and support for the conference.

The conference was commissioned in January, 1991, and was put together in a very short timeframe. Although there were a few glitches due to this, everything ran smoothly, due in no small part to the able and diligent work of the program cochairs, Profs. Didier Dubois and Henri Prade of the Universite Paul Sabatier. Local arrangements were handled by the local section of the IEEE, managed by Jim Bussert; his gang contributed greatly to the pleasant atmosphere at the conference.

Why an IEEE conference on fuzzy systems? And more particularly, why done under the aegis of the NNC? Here are some compelling answers.

There has been, in the last five years, a large and energetic upswing in research efforts aimed at synthesizing fuzzy logic with computational neural networks (CNNs). There are several reasons for this.

First, the enormous success of commercial applications which are at least partially dependent on fuzzy technologies fielded (in the main) by Japanese companies has led to a surge of curiosity about the utility of fuzzy logic for scientific and engineering applications.

Second, the marriage of fuzzy logic with CNN's has a sound technical basis, because these two approaches generally attack the design of "intelligent" systems from quite different angles. CNN's are essentially low level, computational algorithms that (sometimes) offer good performance in dealing with sensor data used in pattern recognition and control.

On the other hand, fuzzy logic was introduced in 1965 by Lotfi Zadeh as a means for representing, manipulating and utilizing data and information that possess non-statistical uncertainty. Thus, fuzzy methods often deal with issues such as reasoning on a higher (semantic or linguistic) level than CNNs.

Consequently, the two technologies often complement each other, CNNs supplying the brute force necessary to accommodate and interpret large amounts of sensor data; and fuzzy logic providing a structural framework that utilizes and exploits these low level results.

Third, there seem to be many ways to use either technology as a "tool" within the framework of a model based on the other. For example, the CNN is well known for its ability to represent functions. The basis of every fuzzy model is the membership function. So, a natural application of CNNs in fuzzy models is to provide good approximations to the membership functions that are essential to the success of any fuzzy approach.

Broadly speaking, then, we may characterize efforts at merging these two technologies as (i) fuzzification of conventional CNN architectures and models; and (ii) the use of CNNs as tools in fuzzy models. A large portion of the work described at FUZZ-IEEE '92 addressed one or more of these issues.

While the final tallies are not yet available, some preliminary data is. There were just over 500 registrants at FUZZ-IEEE '92, which is about 150 more than the largest conferences (the International Fuzzy Systems Association (IFSA) meetings) devoted to fuzzy systems have ever had in attendance prior to this meeting. A majority of attendees

Jim Bezdek and Lotfi Zadeh at FUZZ-IEEE 92

were affiliated with American industry, as opposed to the more usual representation of academics that are found at fuzzy sets meetings. This speaks well for the timing of the IEEE, which represents, in the main, engineering systems design and developers.

It was clear from the exhibits that hardware, software, and related technologies based on fuzzy logic are maturing rapidly. This conference is most certainly an harbinger of much larger meetings on this topic in the near future. Indeed, next year's conference (FUZZ-IEEE '93) will be held in San Francisco March 28-April 1, 1993, and will be the IEEE's first attempt at holding two major international conferences collocated in both time and space, because the 1993 IEEE International Conference on Neural Networks (ICNN) will be held simultaneously with FUZZ-IEEE '93.

There were a number of other activities associated with this meeting that were a direct result of NNC sponsorship. For example, 19 full and brief papers that were presented at the conference will be published in a special issue of the *IEEE Transactions on Neural Networks* entitled "Fuzzy Logic and Neural Networks in Pattern Recognition and Control"

which will appear in September, 1992. All of these papers were orally presented at the conference in San Diego, but by explicit design and arrangement, none of them were published in the proceedings, even in abbreviated form (the program of the conference gave the forthcoming special issue as a reference for these talks). Every paper in this issue thus had the benefit of full and complete refereeing.

In view of recent developments in the commercial arena, the IEEE in general and the NNC in particular should be congratulated on their vision for recognizing the timeliness of a special issue that contained papers on fuzzy sets methods, CNN methods, and the integration of the two.

A second activity arising from and tied to these events concerns a new flagship journal sponsored by the NNC, namely, the *IEEE Transactions on Fuzzy Systems*, which is scheduled to begin in January, 1993. The NNC felt that a special issue of TNN devoted to synthesis of fuzzy logic and CNNs would be a useful way to introduce readers of TNN to some of the many currents of cross fertilization between the two fields that are presently afoot. Indeed, this issue of TNN will reach readers just a few months before the inauguration of the *IEEE Transactions on Fuzzy Systems.*

Another activity coordinated with FUZZ-IEEE was NNC sponsorship of an IEEE Press milestone papers book entitled Fuzzy *Models for Pattern Recognition,* edited by J.C. Bezdek and S. K.. Pal. This book collects 51 key papers that trace the evolution of fuzzy pattern recognition from Zadeh's original paper to the present. The last chapter concerns itself with the integration of fuzzy logic with computational neural networks, a topic much in evidence at FUZZ-IEEE '92. This book was released for sale at FUZZ-IEEE '92.

All in all, the conference and activities associated with it have been hectic, exciting and rewarding. I think I can speak for the entire fuzzy community in saying that we welcome further opportunities to interact with the NNC and its constituents.

--JCB 4-11-92