Guest-editorial

Nearly forty years after its invention by Professor Lotfi A. Zadeh of the University of California, Berkeley, fuzzy logic is no longer an idea that only a few dedicated, and at times marginalized, mathematicians and computer scientists actively pursue. With the emergence of many practical applications of fuzzy logic in the late 1980s and through 1990s, fuzzy logic has truly come of age. Indeed one can view fuzzy logic, along with neural networks and evolutionary programming as being as close to the main stream of information technology as classical methods such as Boolean algebra and probabilistic modeling have been in the past half a century. Moreover, with the increasing emphasis on complex, data rich problems such as financial and economic modeling, medical diagnostics, and man-machine systems of various sorts, there is an increasing awareness of the need for methods and tools that rapidly render effective solutions in a cost efficient manner. By all indications, fuzzy logic is a viable technique in developing appropriate solutions to these problems.

In a more general sense, fuzzy logic can aid the development of intelligent systems that rely on automated pattern recognition, knowledge based decision making and flexible interaction with the human user. While classical methods such as probability theory can address certain aspects of building such systems, fuzzy logic is arguably the only tool that addresses every facet of developing intelligent information and decision systems. Moreover, the inherent ability of fuzzy logic to bridge the gap between symbolic and sub-symbolic processing enables this framework to interface with both classical logic based reasoning tools as well as numeric/algebraic frameworks. This is a key issue in development of intelligent systems. Indeed Professor Zadeh who coined the term MIQ or Machine Intelligence Quotient in the 1990s, often speaks of fuzzy logic in terms of the harmony with which this methodology can be integrated with neural networks, genetic algorithms as well as probability theory and classical AI methodologies.

The present issue of Integrated Computer-Aided Engineering (ICAE), focuses on fuzzy logic both as a tool and as an integrating element in the design of intelli-

gent system. Furthermore, this special issue is dedicated to Professor Zadeh in honor of his tireless effort to conceive, develop and promote fuzzy logic as an alternative framework to conventional information management and control methodologies. It is, in our view, particularly befitting that ICAE takes on this role as it effectively celebrates the fortieth anniversary of the inception of fuzzy logic. Indeed, while the first paper on fuzzy logic did not formally appear until June 1965 [1], Professor Zadeh had conceived of and indeed had made peripheral references to this concept in his earlier classic manuscript on Linear Systems as early as 1963 [2]. One is not therefore, too far off the mark, in calling this special issue a fortieth anniversary reminder of the birth of fuzzy logic.

It may be difficult to judge the impact that Professor Zadeh's multi-faceted educational background in Asia, Europe and the United States, may have had on the development of fuzzy logic. Nevertheless, it is evident that the notion of fuzzy logic did not arise in a vacuum. The 1950s and the early 1960s represented the culmination of much effort during and in the aftermath of World War II to formalize systems theory (in which Professor Zadeh had a significant role). This decade and a half also represented the early years of Artificial Intelligence following Norbert Wiener's early work on Cybernetics [3] and subsequent efforts by a number of researchers including Newell and Simon's work on the General Purpose Solver (GPS) in 1957 [4] and Rosenblatt, on neural networks [5]. Professor Zadeh's work on fuzzy logic in effect represented an attempt to bridge the gap between classical systems theory and what came to be classical artificial intelligence techniques, which relied on Boolean logic. In this process, Professor Zadeh's work also offered a connection with neural networks that was not well understood until late 1980s and early 1990s, which was highlighted by the emergence of neuro-fuzzy systems. Indeed the idea of interconnecting various, apparently disparate, methodologies has been a hallmark of fuzzy logic; fuzzy logic has come to interpolate across, as it were, a range of techniques from conventional systems theory to neural networks to genetic algorithms and evolutionary pro-

gramming with neuro-fuzzy systems as one of the key areas of research in the 1990s and up to the present.

This special issue, which was conceived by Professor Hojjat Adeli in early 2001 as a tribute to Lotfi Zadeh's contributions, resulted in a solicitation which attracted a number of high quality papers across the spectrum of applications of fuzzy logic. Given the quality standards maintained by ICAE under Professor Adeli's editorial leadership, however, as well as the limitations on the number of pages of any single issue, we could only select a handful of these submissions. We did insist, on the other hand, that the papers accepted for this special issue be of both the level of depth and breadth that a special issue such as this requires. In reviewing the table of contents of this special issue, it is evident that the special issue covers a number of topics that range from application of fuzzy logic to database management systems to the use of evolutionary methods in conjunction with fuzzy logic to theoretical issues in fuzzy control. The breadth of this issue is indeed symbolic of the range of areas that fuzzy logic has in the past forty years penetrated, and the further reflects the vitality of the field as it approaches its half century mark.

In closing we would like to thank the many reviewers (in all over 50 researchers from around the world) who took the time to carefully read and comment on the manuscripts that were considered for this special issue of ICAE. Without their effort and diligence this project would simply have not been possible. Finally we would like to thank Professor Hojjat Adeli, the Editor-in-Chief of ICAE, who conceived this special issue, remained patient as we completed this task, and was a continuing source of encouragement throughout the process.

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Witold Pedryzc
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Guest Editors

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References

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