Reviewed by
Dimitar P. Filev
Ford Motor Company
24500 Glendale Avenue
Detroit, MI 48239
e-mail: dfilev@ford.com

BOOK REVIEW

FUZZY SETS AND FUZZY LOGIC

BY GEORGE J. KLIR AND BO YUAN, PRENTICE HALL PTR, ENGLEWOOD CLIFFS, NJ, 1995, 574 PP.

During the past thirty years we have been witnessing the process of emerging and extensive maturing of fuzzy set theory as a paradigm shift in managing complexity, uncertainty, and subjectivity. This process has been accompanied by a growing number of books focusing on the theoretical and practical aspects of fuzzy sets—a clear indication that the fundamentals of a new scientific discipline were being built. Among the recently published monographic texts, the new book by George J. Klir and Bo Yuan, *Fuzzy Sets and Fuzzy Logic*, is an exceptional achievement. The major focus of this book is on the fundamental issues of fuzzy set theory (part 1, chapters 1–9). These issues are introduced in the environment of some well-established disciplines, e.g. classical set theory, probability theory, Dempster–Shafer theory, information theory, etc. Such an approach provides the reader with an efficient methodology for catching the essence of the subject by making association and comparisons with classical concepts, definitions, and terms. The comprehensive coverage of the overall fuzzy machinery is further supported by a nice set of examples and work problems, and by an overview of the major practical areas of application of fuzzy sets. The problem of managing uncertainty is used as a major vehicle for representing the power and the applicability of fuzzy set theory. Since this issue has an influence on a wide variety of engineering problems, the book presents a natural bridge from the abstract theoretical concepts to numerous real world problems (part 2, chapters 10–17).

Chapters 1 and 2 cover the basic concepts, terminology, and representation forms of fuzzy sets. These chapters provide a smooth transition from classical (crisp) set methodology to the area of fuzzy sets. This elegant introduction is accompanied by an interesting discussion on the birth and evolution of the fuzzy scientific paradigm from the viewpoint of philosophy of science. Chapters 3 and 4 are the key chapters for familiarizing with and understanding the basic operations used in fuzzy sets theory. Standard operations—complement, intersection and union, and aggregation—are overviewed in their traditional and parameterized forms. Fuzzy arithmetic operations are introduced by fuzzifying the classical arithmetic operations via the extension principle. Chapters 5 and 6 present a unified and homogeneous systemization of the main types of fuzzy relations and the methods for solving fuzzy relational equations, including approximate and neural based solutions. Chapter 7 is central to the overall understanding the relationship between alternative theoretical approaches dealing with uncertainty—probability theory, possibility theory, fuzzy set theory, and Dempster–Shafer theory of evidence. The common basis for the well-structured discussion of this matter is the fuzzy measure theory. Chapter 8 introduces fuzzy logic as a generalization of classical (binary) logic and multivalued logic. Chapter 9 deals with the uncertainty-based principles of information theory. The major idea here is to generalize the well-known entropy connection between uncertainty and probability theory to the much broader environment of fuzzy set theory, evidence theory, and possibility theory.

The second part of the book is devoted to application aspects of fuzzy set theory. Chapters 10 and 11 discuss the foundations of fuzzy knowledge engineering and related issues of

Journal of Intelligent and Fuzzy Systems, Vol. 4, 175–176 (1996)

CCC 1064–1246/96/020175-02

knowledge acquisition and approximate reasoning. Chapter 10 summarizes some of the major methods for constructing membership functions. Chapter 11 provides a detailed analysis of the methods of reasoning based on fuzzy production rules. Chapters 12–15 include more practically oriented developments of fuzzy theory related to the system, control, pattern recognition, data bases, and decision-making areas. Finally, chapters 16 and 17 review examples of particular fuzzy applications in engineering, medicine, economics, natural language, biology, etc. The material of the last six chapters (12–17) is essentially a condensed overview completing the thorough picture of fuzzy set theory as a scientific discipline valuable for practice. Although self-contained, these chapters can be viewed as introductory links to more specifically oriented texts on the respective subjects, e.g. Driankov et al., 1993, Kitainik, 1993, Pedrycz, 1993, Terano et al., 1994, Wang, 1994, Yager and Filev, 1994, Kruse et al., 1994, etc.

Among other features, this book contains a rich collection of reference comments, detailed bibliography, and a bibliographical index supplying considerable information on almost every subject related to fuzzy sets. Presentation is complemented by a set of appendixes introducing the basics of neural networks, genetic algorithms and rough sets, and glossaries of symbols and key concepts that are very helpful for readers.

In summary, *Fuzzy Sets and Fuzzy Logic* is unique in its depth of exposition, generality, methodological completeness, systematic organization, and encyclopedic information content. Its reader-friendly and logically sequenced structure produces both an excellent introductory text for beginners and a modern monographic volume providing further research inspirations for more advanced readers.

References

Driankov D, Hellendoorn H, Reinfrank M (1993): *An Introduction to Fuzzy Control*. Berlin: Springer–Verlag.

Kitainik L (1993): *Fuzzy Decision Procedures With Binary Relations: Towards a Unified Theory*. Boston: Kluwer.

Kruse R, Gebhardt J, Klawonn F (1994): Foundations of Fuzzy Systems. Chichester, U.K: Wiley.

Pedrycz W (1993): *Fuzzy Control and Fuzzy Systems*, 2nd ed. Taunton/New York: Research Studies Press/Wiley.

Terano T, Asai K, Sugeno M (1994): *Applied Fuzzy Systems*. New York: AP Professional.

Wang LX (1994): *Adaptive Fuzzy Systems and Control: Design and Stability Analysis*. Englewood Cliffs, NJ: Prentice–Hall.

Yager RR, Filev DP (1994): *Essentials of Fuzzy Modeling and Control*. New York: Wiley.