Book reviews

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Fuzzy Logic With Engineering Applications

McGraw–Hill, Inc., New York – St. Louis – San Francisco 1995.
xx + 600 pages.
ISBN 0-07-113637-1

Fuzzy set theory and fuzzy logic become significant components of the applied mathematics. They have developed a long list of effective and well elaborated tools for technical application in control, identification of systems and other related branches. This fact is reflected by this work which offers a very good overview of results and methods created by fuzzy set theory for the engineering applications.

The referred book represents an advanced educational text. Even if it is a compact unit with logical inner structure, each of its chapters can be used as separate brief textbook of the branch of its subject.

The educational purpose of the book is evident also from the arrangement of the explanations. The theoretical paragraphs are completed by many numerical examples (about 120 of them are numbered, others briefly illustrate the general results), which include lots of figures (almost 400) and tables (almost 200). The formal independence of particular chapters is underlined by introducing relevant references after each of them. The reader can also test his understanding of the explanation by means of numerous exercises – they are headed *Problems* and their sum amounts over 340 – which are illustrative and well chosen. Even their including to each chapter supports the educational character of the publication.

The fifteen chapters of the book can be divided into four main groups. The first one of them is formed by chapters presenting the basic elementary concepts of fuzziness and, especially, determining their relation to their crisp patterns. Besides the heuristic *Introduction* chapters like *Classical Sets and Fuzzy Sets, Relations and Fuzzy Relations, Membership Functions, Fuzzy–to–Crisp Conversions* form this first group. The second one deals with more advanced but still general fuzzy set theoretical topics like *Fuzzy Arithmetics, Numbers, Vectors and the Extension Principle* and *Classical Logic and Fuzzy Logic* as well as *Fuzzy Rule–Based Systems*. The last one of these three chapters represents a continual transition to the third group. It includes more application-oriented chapters dealing with specific topics of fuzzification of some procedures and models being familiar in the control and information sciences or operations research, like *Fuzzy Nonlinear Simulation, Fuzzy Decision–Making, Fuzzy Classification, Fuzzy Pattern Recognition* and *Fuzzy Control Systems*. The last two chapters *Miscellaneous Topics* (fuzzy optimization, inverse fuzzy relational equations, fuzzy linear regression are included under this heading) and *Fuzzy Measures: Belief, Plausibility, Probability and Possibility* link the topic of the book to some other advanced models of uncertainty and data processing. The book is concluded by *Index*, references are (as mentioned above) attached to particular chapters.

The referred book is written in a lucid style, the theoretical ideas are illustrated and discussed by means of examples. The arrangement of chapters and presentation of Problems supports the initiative reading. The book can be recommended to advanced students of applied fuzzy set theory or control theory as well as to skilled specialists in both of those fields who wish to complete their knowledge in the subjects of some of the chapters.

Milan Mareš

BEN GOERTZEL

CHAOTIC LOGIC, Language, Thought, and Reality from the Perspective of Complex System Science

ISFR International Series on System Science and Engineering, Volume 9
Plenum Press, New York – London 1994.
xvii + 278 pages.
ISBN 0-306-44690-1

The author focuses his attention to the multilateral connection between real human thinking, language and their formal modelling by means of the tools of system science. In fact, such unifying approach bridging the gap between human and computer sciences appears highly desirable, and it can attract readers from both sides.

The book is divided into small units which simplify the orientation into particular ideas. Exactly, the text is structured into 12 chapters (which are further divided into 56 sections, almost 130 subsections, etc.) which can be clustered, besides the *Introduction* into four groups due to their main subject orientation. The first group includes chapters presenting the basic model of thought and language (*Pattern and Prediction, The Structure of Thought, Psychology and Logic, Crucial Connections*). More exact approach to the topic is applied in chapters presenting the system theory view on mind and logic (*Linguistic Systems, Self-Generating Systems, The Cognitive Equation*). The believability of thoughts and expressions viewed rather from formal or also system theoretical point is dealt in the third group of chapters (*Belief Systems, Biological Metaphors of Belief, Mind and Reality*), and the last chapter forming, by itself, the last one-element group is devoted to dissociation in mental and communicative situations (*Dissociative Dynamics*). The book is introduced by *Preface* and concluded by *Afterword, References* (171 items) and *Index*. The choice of references reaches from pure mathematics via computer science, biology, psychology and medicine to philosophy and metamathematics.

The author evidently stresses the typically human features of thinking and communication with its chaotism and vagueness. He shows their counterparts in the formal exact models and the endeavour of modern mathematics and theoretical computer science to reflect the entirely human intellectual processes. This helps the reader to understand the heuristics of artificial intelligence with respect to its relation to natural human thinking.

The book is consequently written with minimum of the mathematical formalism which appears in very small minority (evidently less than one tenth) of subsections. Such style opens the fundamental principles of artificial intelligence, non-standard logic, knowledge processing, reasoning, decision-making and other related topics of modern applied mathematics or theoretical cybernetics also for non-mathematical readers.

The referred book may address two sorts of readers. First, people with good background in human sciences who wish to get some non-trivialized information about the mathematical reflection of the real mental and communicative phenomena. Second, mathematically well prepared specialists in artificial intelligence and related branches of modern information sciences who would like to know more about the essential features of those natural intellectual processes which they endeavour to reflect in their exact formal models. Both sorts of readers can be satisfied.

Milan Mareš

DIETRICH STOYAN, WILFRIED S. KENDALL, JOSEPH MECKE

Stochastic Geometry and its Applications

Second Edition.
John Wiley & Sons, Chichester 1995.
436 pages.
ISBN 0-471-95099-8

In many applications in biology, medicine, geology and material research there is a need of quantitative description of geometrical structures. Analysis of spatial data from various measurements requires suitable mathematical models and special statistical methods. Stochastic geometry is a mathematical discipline which meets these demands. It arised in the seventies in systematic papers by D. G. Kendall, G. Matheron, K. Krickeberg and R. E. Miles using earlier achievements of geometrical probability and integral geometry. A part of stochastic geometry is stereology which studies problems of geometrical parameter estimation of three–dimensional structures from information of lower dimension, e.g. from sections and projections.

The aim of the enclosed monograph of three authors is to explain the methods of stochastic geometry to researchers in applied sciences, on the other hand the list of approaches is enough general and mathematically precise that it serves as a basic textbook for mathematicians. These two aims are in a small contradiction and the book results in a successful compromise. In many assertions the detailed proofs are omitted, they can be found by means of a large list of references. Some topics are illustrated by numerical examples with image input, others are completed by heuristic arguments. Further substantial parts are reduced to some remarks and references. The authors understand that the readers interested in the mathematical background will study related referenced papers, while non-mathematicians will be able to use and interpret most of formulas from the book only.

The structure of the text is characterized by going from special towards general. Therefore after presentation of mathematical background Chapters 2 and 3 are devoted to the Poisson point process and the Boolean model of random set. After that Chapters 4 and 5 explain general theory of point processes, while 6 and 7 the theory of random sets an random measures. Chapter 8 tends to the statistical theory of shape. In Chapters 9 and 10 further models of stochastic geometry, namely fibre processes, surface processes and random tesselations, are investigated. A large Chapter 11 is devoted to stereology, it makes use of some results of the whole previous text.

This is the second edition of the book. The readers acquainted with the first edition recognize that the structure, style and aims remained unchanged. They will be pleased by many new ideas and complementation by the recent development during last seven years. The progress from this period is apparent especially in parts devoted to the Boolean model, stereology, random shapes, Gibbs processes and random tesselations. However, the authors note that the topics of stochastic geometry and spatial statistics are not exhausted here with respect to the contents of further recent monographs: Cressie (1991) – spatial statistics, Falconer (1990), Stoyan and Stoyan (1994), Barden, Carne, Kendall and Le (1996) – random shapes, Schneider (1993) – integral geometry.

An excellent monograph of D. Stoyan, W. S. Kendall and J. Mecke is recommended for statisticians and mathematicians interested in stochastic modelling and geometry. It will help in laboratories of microscopy and image analysis, to mathematical physicists and research workers employed in above mentioned applied sciences.

Viktor Beneš

DONALD G. SAARI

Basic Geometry of Voting

Springer–Verlag, Berlin – New York – London 1995.
xii + 300 pages, 102 figures.
ISBN 3–540–60064–7

Voting systems and processes represent an interesting topic for mathematics in social and political sciences. Its serious consequences for everyday life of various communities motivates thorough discussion and re-considerations about particular aspects of voting procedures, namely about rational voting strategies and about voting systems avoiding impassing results. The referred book aims to show how the complexities and intricacies of elections can be transformed into quite lucid geometric concepts.

The main destination of the book is to be used in learning political sciences, and the arrangement of its text corresponds to it. It is parted into small but structured units: 119 subsections form 23 sections which are grouped into 5 main chapters (the sixth chapter, named *Notes*, brings marginal comments to previous chapters, mostly concerning their relations to some other works). The book is concluded by quite representative References (124 items) and Index. To enable the reader to test his understanding the explanation, each section is followed by exercises.

The first chapter, *From an Election Fable to Election Procedures*, catalogues some of problems connected with elections and illustrates them by an example of hypothetical academic chair. The second chapter, *Geometry For Positional And Pairwise Voting*, starts with the geometrical representation of standard terms of voting. The next chapter, *The Problem With Condorcet* presents an analysis (mostly critical) of some classical problems and standards, some of which are developed and discussed from the first serious attempts to give a consistent theory of voting. These attempts have been done in the last quarter of the 18th century and they are connected with the names of J.–C. Borda, J. Mascart and M. Condorcet. One of essential sections of this chapter analyses the sense and consequences of Arrow theorem on aggregation of votes. The analyses introduced in this chapter are interesting and in many cases suggesting new views on some traditional judgments. The fourth chapter, *Positional Voting and the BC*, where BC denotes the classical "Borda Count", introduces more advanced geometric methods developed to analyze positional procedures (generalizations of standard plurality vote). The geometrical approach simplifies the understanding of some classical results and the derivation of some new ones. Finally, the last chapter, *Other Voting Issues*, extends and generalizes the former voting issues. In addition to the single profile ones, dealt in the previous chapters, the issues involving several profiles are described. They include such problems like voting manipulated by pre-selection or robustness of voting and balance of compensating errors. The last chapter *Notes* was already mentioned above.

The referred book has contributed to the literature on voting systems and election problems by an interesting item. Even if it is supposed to be mainly used by students, the set of its potential readers can be much wider. It offers a comprehensive survey of various approaches to the voting situations, starting by the historical ones. Their geometrical presentation opens qualitatively new view on many of them and completes them by several new results. The book is evidently useful for anybody who is interested in the theory of voting systems, and it can be interesting for many others who study political sciences and use mathematical methods in the research of social phenomena.

Milan Mareš