

## Book reviews

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FRANTIŠEK NEUMANN

**Global Properties of Linear Ordinary Differential Equations**

Academia, Prague in co-edition with Kluwer Academic Publishers, Dordrecht – Boston – London 1991.

336 pages; 27 figures; Kčs 220,-.

The book under review presents a selection of results in the theory of ordinary linear differential equations of the  $n$ th order in the real domain, obtained using the original unified approach. Namely the global properties of homogenous equations, their canonical forms, the distribution of zeros and the asymptotic behaviour of solutions are investigated. Many results follow from the study of introduced global transformations that are described in terms of Brandt and Ehresmann grupoids.

The book consists of 11 chapters and 1 appendix. In the first introductory chapter the author refers to a 150 years old work by E.E. Kummer, where the transformation between solutions of two given linear second order equations has been found. Further he mentions the stimulating results by O. Borůvka in linear differential transformations of the second order equations.

The second chapter contains notations, basic facts concerning algebraic structures such as category, Ehresmann and Brandt grupoids and some propositions about linear differential equations.

In the third chapter the author introduces the global transformations of ordinary linear homogenous differential equations. The adjective “global” expresses that the solutions of one equation are transformed into solutions of the other on the whole intervals of their definition. There is shown that the structure of a global transformation can be described in the frame of the theory of categories.

Some analytic, algebraic and geometrical aspects concerning global transformations are studied in the fourth chapter. The reader finds here among others the relations between coefficients of an original linear differential equation and its global transform.

The fifth chapter contains criteria of global equivalence, namely the Borůvka's criterion for second order equations and its generalizations for higher order equations. The most part of results presented here belongs to the author of the monography.

The sixth chapter presents a description of stationary groups, consisting of all global transformations that transform a given equation into itself.

The interesting and important problem of canonical forms of linear differential equations of the  $n$ th order is studied in the chapter 7. The list of canonical forms for  $n = 2$  and 3 is given in the last section of this chapter.

The eighth chapter deals with invariants of linear differential equations with respect to transformations, both local and global. We found here e.g. assertions about smoothness of coefficients as a global invariant.

The ninth chapter is devoted to applications of the previous results to the study of equations with prescribed properties of their solutions such as boundedness, asymptotic behaviour and periodicity.

The tenth chapter presents a new approach to the problem of distribution of zeros of solutions based on certain geometrical representation. This geometrical approach is also applied to the new proof of Borůvka's criterion of global equivalence for second order equations.

In the last eleventh chapter some of the previous methods are employed to the investigation of a relation between asymptotic properties and distribution of zeros of solutions of the second order equations, to the generalization of Blaschke's and Santaló's isoperimetric theorems and to some other topics.

Finally the Appendix introduces the Abel and Euler functional equations and their application to the proofs of two theorems from the second chapter concerning their solutions and their derivatives.

The monograph is self-contained, only a knowledge of basic facts from mathematical analysis, linear algebra and theory of ordinary differential equations and also some training in the reading of mathematical literature are supposed. The explanation is clear, detailed and precise. The most of results are obtained without complicated calculation, all not common terms and notations are carefully defined. The monography arised from the long-time activity of Professor F. Neumann and it brings to the reader a good deal of information about interesting and useful branch of the theory of ordinary differential equations. It can be recommended not only to mathematicians or students of mathematics at the universities, but also to specialists in areas of science and engineering where linear nonautonomous differential equations occur and where a qualitative analysis of their solutions is needed.

*Antonín Tuzar*

V. NOVÁK, J. RAMÍK, M. MAREŠ, M. ČERNÝ, J. NEKOLA, Eds.

### **Fuzzy Approach to Reasoning and Decision-Making**

Selected papers of the International Symposium held at Bečlíně from June 25 to 29, 1990.

Academia, Prague in co-edition with Kluwer Academic Publishers, Dordrecht – Boston – London 1992.

220 pages.

The International Symposium on Fuzzy Approach to Reasoning and Decision-Making was organized by the Mining Institute of the Czechoslovak Academy of Sciences in Ostrava, in co-operation with IEEE Computer Society, Institute of Information Theory and Automation of the Czechoslovak Academy of Sciences in Prague, and Research Institute for Regions and Macroeconomy in Ostrava, and supported by other academic and university institutions in Czechoslovakia. Especially valuable was the support by the International Fuzzy System Association and North American Fuzzy Information Processing Society.

It was the first fuzzy set theoretical conference in Czechoslovakia with really wide international participation. Its 82 participants came from 20 countries all over the world, and they presented more than 50 contributions. The editors of the referred volume have selected 18 of them which they found representative for the main trends in the development of fuzzy set theory and applications. Some other contributions are published as 1992 supplement of the journal *Kybernetika*.

The 18 papers incorporated in the Transactions are divided into three groups according to their orientation to particular problems.

The first group contains 7 contributions subjected to Approximate Reasoning and Fuzzy Logic, namely: D. Dubois and H. Prade: *The semantics of fuzzy "IF... THEN..." rules*, V. Novák: *On the logical basis of approximate reasoning*, J. Kacprzyk and C. Iwanicki: *Fuzzy logic with linguistic quantifiers in inductive learning*, H. Bandemer: *Fuzzy logical inference in fuzzy knowledge bases*, L. J. Kohout and W. Bandler: *Fuzzy relational products in knowledge engineering*, P. Berka, J. Ferjenčík and J. Ivánek: *Expert system shell SAK based on complete many-valued logic and its application in territorial planning*, G. J. Klir: *Multimodel representation and management uncertainty*.

The 8 papers forming the second part are focused to the Decision-Making problems. They are: D. Butnariu and E. P. Klement: *Triangular norms and some applications to*

*measure and game theory*, M. Mareš: *Linear dependence of fuzzy vectors*, J. Ramík: *LP problems with inexact and interactive coefficients*, M. Kovács: *A concept of optimality for fuzzified linear programming based on penalty functions*, M. Černý: *The possibilities of fuzzy dialogue in interactive vector optimization*, K. Nakamura: *On the nature of intransitivity in human preferential judgments*, J. C. Fodor and M. Roubens: *Aggregation of strict preference relations in MCDM procedures*, J. C. Bezdek: *Clustering in Banach spaces*.

Three of the papers selected by editors deal with fuzzy set theoretical Applications in Physics. They are presented in the third part of the Transactions, formed by: A. Kolesárová: *On the structure of fuzzy observables*, R. Mesiar: *General fuzzy observables*, B. Riečan: *On a fuzzy approach to quantum mechanics*.

The volume is completed by a sufficient index of used terms and concepts.

The quality and representativity of the Symposium as well as the narrow selection of the papers included in the Transactions volume promise to submit a good view on relatively new results achieved in some of the perspective branches of the fuzzy set theory.

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### QSB+

### Quantitative Systems for Business Plus

Prentice-Hall International, Inc., London - Sydney - Toronto - Tokyo 1989.

xiii + 290 pages, 2 floppy disks.

QSB+ (Quantitative Systems for Business Plus) is a software package of user-friendly manu-driven decision support systems with easy data entry and modification. The referred manual can contribute to easy learning or introductory steps of students or beginners, as well as to better orientation of experienced practitioners in the wide scale of possibilities offered by QSB+.

The explanation is divided into 17 chapters. Three of them are devoted to general introduction to the system. Namely, Chapter 1 summarizes its contents and capabilities, Chapter 2 describes the starting steps, and Chapter 3 presents a tutorial for the first-time users.

Next fourteen chapters deal with particular problem-solving algorithms in management sciences included into QSB+. The topics covered by the systems are: Linear programming, Integer linear programming, Transportation and transshipment problems, Assignment and traveling salesman problems, Network modelling, Critical path method (CPM), Program evaluation and review technique (PERT), Dynamic programming, Inventory theory, Queing theory, Queing system simulation, Decision and probability theory, Markov process, Time series forecasting. Chapters are completed by numerical examples, exercises (whose solutions are presented in Appendix), and basic references. The attached demo-diskettes contain illustrative examples and usefully complete the explanatory text.

The manual is written in a lucid but brief style with a lot of well chosen numerical examples. Very sympatic is its respect to the specific problems of beginners and non-routine users. The scale of problems covered by the system is representative. It concerns the typical optimization methods of mathematical programming, network analysis, and random processes connected with decision-making and management. The software is adapted to the standard personal computers.

*Milan Mareš*