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BOOK REVIEWS

EVOLUTION EQUATIONS. Lecture Notes in Pure and Applied Mathematics Vol. 168. Edited by Guillermo Ferreyra, Gisèle Ruiz Goldstein, Frank Neubrander. Marcel Dekker, Inc., New York-Basel-Hong Kong, 1994, 464 pages, bound illustrated. Price: $ 150.00.

This volume contains Proceedings of the International Conference on Evolution Equations held at Louisiana State University in Baton Rouge, Louisiana, January 7–11, 1992. It covers a variety of topics concerning both evolving and (to a lesser extent) stationary systems. A great deal of these written talks treat partial differential equations (mostly nonlinear) of elliptic, hyperbolic, parabolic or dispersive type, and functional differential equations. Both well-posedness and blow-up questions are considered. Volterra integral equations and reaction-diffusion systems are treated. In control theory, boundary control and identification problems are studied. Schrödinger operator theory and some other mathematical physics topics are also included. Among qualitative features discussed we can find for example bifurcation and asymptotics. Linear operator theory is represented by semigroups of operators and related solutions of functional equations, spectral operators and spectral theory. This very representative collection of papers requires postgradual and higher level readers and is desirable to be present in mathematical libraries of universities with mathematical departments and other related research institutions. Specialists in any part of evolution equations theory will find most contributions interesting and motivating.

Ivan Straškraba

COMPOSITE MEDIA AND HOMOGENIZATION THEORY. An International Centre for Theoretical Physics Workshop, Trieste, Italy, January 15–26, 1990. Edited by G. Dal Maso, G. F. Dell'Antonio, Birkhäuser, Boston-Basel-Berlin, 1991, 273 pp., US $ 49,–.

Proceedings of the first international workshop on the topic held in Trieste (the second was organized in 1993) contains 14 invited lectures. The main topics are mathematical tools for modelling composite materials, from both mathematical and physical point of view.

The contributions cover wide area of problems. Most of them deal with homogenization of various problems: convection-diffusion equations, stochastic P.D.E., quasilinear equations, homogenization models of flow in porous media, models of composite media, etc. The homogenization approach consists in considering a sequence of problems with diminishing period of the coefficients describing the structure and investigating its behavior as period tends to zero. Generalizing the procedure leads to notions of Γ-, G- or H-convergence. Estimates of the homogenized coefficients form another group of the problems. Homogenization found an unexpected application in shape optimization, since optimal materials have composite structure. Contributions on nonlinear behavior of composite materials represent the view from the opposite side.

The organizers succeeded in gathering leading experts in the field from the whole world including U.S.A. and U.S.S.R. The proceedings give an insight into the contemporary research in this developing area on the interface of mathematics and physics.

Jan Franců

Emil Vitásek: ZÁKLADY TEORIE NUMERICKÝCH METOD PRO ŘEŠENÍ DIFERENCIÁLNÍCH ROVNIC. Academia Praha 1994, 409 stran, cena neuvedena

Recensovaná kniha podává podrobný výklad numerického řešení obyčejných diferenciálních rovnic a rovnic parciálních eliptického a parabolického typu. Byla sepsána na základě dlouhodobého působení RNDr. E. Vitáska, CSc., na Matematicko-fyzikální fakultě University Karlovy. Autor předpokládá pouze znalosti základních pojmů z reálné analýzy, algebry a na některých místech také z teorie funkcí komplexní proměnné. Kniha je zaměřena především na teoretické aspekty studovaných metod. Přiložená cvičení slouží k ilustraci a k prohloubení vyložené toeire. Pro orientaci v literatuře a pro hlubší porozumění látce autor uvedl pro čtenáře cenné poznámky a komentáře na konci každé kapitoly.

První kapitola je věnována problematice numerického řešení obyčejných diferenciálních rovnic s počátačními a okrajovými podmínkami. Autor kromě globální existenční věty podává ucelený výklad teorie jednokrokových a mnohokrokových metod a uvádí vlastnosti konkrétních metod (Eulerova metoda, metody typu Runge-Kutta, Adams-Bashfortha, Adams-Moultona, metoda Nystromova, Metody Milne-Simpsona, metody založené na numerickém derivování). V knize jsou podrobně rozebrány otázky stability, konvergence, odhadů chyb, šíření zaokrouhlovacích chyb, volby optimální formule a změny integračního kroku. Autor uvádí porovnání mnohokrokových a Runge-Kuttových metod z hlediska stability, velikosti lokálních chyb a složitosti programování, což je pro výběr metody velmi cenné.

V druhé kapitole autor studuje metody řešení okrajových úloh především lineárních. Přehledně jsou zde popsány metody založené na přesunu okrajových podmínek a uvedeny přednosti a obtíže studovaných metod. Podstatná část této kapitoly je věnována metodě sítí a variačním metodám (včetně metody konečných prvků) řešení rovnic 2. a 4. řádu. V knize je také pojednáno o metodách řešení vzniklých soustav lineárních rovnic. V případě nelineárních rovnic autor ukazuje na nové vzniklé problémy. Pro čtenáře jsou zajímavé uvedené aspekty praktické realizace studovaných metod.

V třetí kapitole jsou popsány metody sítí a variační metody (včetně metody konečných prvků) řešení parciálních diferenciálních rovnic eliptického typu 2. a 4. řádu. Značná pozornost je věnována přepisu okrajových podmínek a také problematice řešení vzniklých soustav lineárních rovnic. Při popisu metody konečných prvků autor uvádí některé typy prostorů konečných prvků, odhady chyb interpolace a některé další aspekty této metody.

Poslední čtvrtá kapitola je věnována metodám řešení parciálních diferenciálních rovnic parabolického typu. Především jsou zde podrobně popsány metody sítí (explicitní, implicitní) a použití metody střídavých směrů. Autor stručně popisuje metody semidiskrétní a metodu Rotheovu.

V předložené publikaci se autor u jednotlivých metod zabývá nejen otázkami konvergence a stability, ale také upozorňuje na obtíže spojené s jejich užitím. Na numerických testech jsou ilustrovány vlastnosti studovaných metod. Tuto knihu považuji za vynikající vysokoškolskou učebnici vhodnou nejen pro studenty Matematicko-fyzikální fakulty, ale také pro všechny, kteří se s numerickými metodami řešení diferenciálních rovnic chtějí seznámit. V recenzované knize chybí pouze metody řešení parciálních diferenciálních rovnic hyperbolického typu, a to z důvodu, že tato problematika nebyla až dosud zahrnuta do učebních osnov.

Karel Najzar

Zhenyuan Wang and George J. Klir: FUZZY MEASURE THEORY. Plenum Press, New York 1992, pp. ix+354, price US$ 69.50

Fuzzy measure is a set-function vanishing at $\emptyset$, monotone and continuous. The notion is a very natural generalization of a positive, σ-additive measure. Of course, although the term fuzzy measure has been fixed in the literature, its using in this relation is problematic, actually it is not a fuzzy notion. On the other hand, among many examples of monotone and continuous functions there are many, which are inspired and motivated by the problems of the fuzzy sets theory and its applications. In this direction more adequate to fuzzy sets is the matter presented in the Appendix E (New Directions in Fuzzy Measure Theory), where some functions on families of fuzzy sets are considered.

After two introductory chapters, fuzzy measures are studied in Chapters 3–5. The main attention is devoted to some important special cases (λ-fuzzy measures, quasimeasures, belief and plausibility measures, possibility and necessity measures) together with extension theories for some of them. Also null-additive functions are exposed (i.e. such functions that $m(F) = 0$, $E \cap F = \emptyset$ implies $m(E \cup F) = m(E)$). On the other hand the results from the theory of so-called non-additive measures (where the usual operation $+$ in R is replaced by a more general operation) are mentioned only marginally. (Of course, the terminology here is also problematic, because according to it every additive measure is an example of a non-additive measure.)

In the additive case one has $m(E \cap A) = 0$ if and only if $m(A \setminus E) = m(A)$. Of course, for non necessary additive set functions it need not be true. Therefore in the theory of measurable functions (Chapter 6) it is reasonable to consider e.g. almost everywhere convergence on A (the set of those x from A, for which the sequence does not converge, has measure zero) and so-called pseudo almost everywhere convergence on A (the set of those x from A, for which the given sequence converges, has the same measure as A). Therefore the theory of measurable functions is reexamined.

Of course, the culminating point of the book is the theory of fuzzy integrals (Chapters 7 and 8). Here the theory of Sugeno integral is developed (roughly speaking, it is based on infimum and supremum instead of usually used product and sum) and then Pan integral is exposed (the usual sum and product of non-negative real numbers are substituted by some axiomatically characterized operations).

Although the purpose of the book is to present the mathematical foundations of fuzzy measure theory, the authors discuss also the applicability of the theory (Chapter 9 as well as Appendix F). Let us mention some areas of use of fuzzy measure theory: systems, computers, information, cognitive sciences, artificial intelligence, quantitative management, mathematical social sciences and some areas of engineering. Appendix F consists of 3 recent papers published by M. Strat, by H. Prade and C. Testemale, and by H. Tahari and J. M. Keller, respectively, Appendix E also consists of 3 recent papers published by W. Zhenyan, Q. Zhang and J. Yen.

In every new theory, some of its ideas can be found in some previous papers. In this relation we should like only to mention some papers by J. Šipoš (Math. Slovaca 29 (1979), 141–156, 257–270, 333–346). From the latest literature recall the monograph by D. Denneberg, Non additive measure theory (1994).

The book is self-contained (some necessary knowledge is presented in Appendices A and B), and can serve not only for specialists in a wide area but also for graduate courses.

Beloslav Riečan

Dobrivoje Popovic, Vijay P. Bhatkar: METHODS AND TOOLS FOR APPLIED ARTIFICIAL INTELLIGENCE. Marcel Dekker, Inc., New York-Basel-Hong Kong, 1994. xviii+523 pp., price $ 150.

Artificial intelligence (AI) is a scientific domain the position of which in the scale of applied sciences is rather strange and its contemporary situation deserves also a more detailed explication. In distinction to more classical scientific domains, the field of interest of AI has never been precisely defined, at least at the level of rigorosity comparable to the classical sciences, and it is very doubtful, whether this can be done in principle. In fact, all the attempts to define what AI is or should be turn either into more or less deep and sophisticated philosophical essays touching from various sides the notion of intelligence, or such attempts result in introducing a list of more special applied sciences which are proclaimed to be taken as parts of AI by referring to some authority or to a tradiciton, or simply according to the personal opinion of the author in question supported by some more or less sophisticated argumentation. It is also the case of the introductory part of the referred book, when some rather vague philosophical remarks concerning the question what is in common life considered as "intelligent„ are followed by declaration of the domains of applied science which will be, at least for the purpose of this book, taken as a part of AI.

After a few decades of development, AI as a scientific domain is now, perhaps, in a rather peculiar situation in the sense that it seems to be necessary, for AI, to look for a new "raison d'etre" of its existence as a sufficiently compact and self-justifying scientific domain, or to abandon its positions in favour of new branches originating from AI and taking profit, for a long time, from its attractive and even phantasy-spurring label, but preferring now their independent further development under their own paradigms. By the way, this history and problems seem to be very similar to that of cybernetics which arrived at the same position perhaps one or two decades earlier than AI. Perhaps we have devoted too much time and space to our preliminary general considerations concerning AI, but because the reviewed book deals mainly with applied AI, where the problems of the contemporary status of AI are more visible, it is perhaps recommendable to ask the reader of the referred book to keep in mind, what we have mentioned above.

The reviewed book is conceived as a survey of all fields of applied sciences usually considered to be parts of AI; to be more precise, in each such domain the authors introduce the simplest and most often used methods of AI applied in it. The methods in question are presented rather in the form of algorithms and hints, while their mathematical, methodological and philosophical foundations, backgrounds and motivations are introduced only very briefly. As far as the justifications of particular methods are concerned, argumentation based on good practical experiences and on implementational and practical advantages and facilities is preferred to argumentation based on theoretical models of the investigated methods and on the proofs of relevant formal assertions or optimization results. Moreover, argumentation of both types is presented at the same level without taking into account the principal philosophical and methodological differences between these two kinds of justification. This approach of the authors agrees with their main orientation as far as the potential reader is concerned: the book is oriented rather towards specialist in some domain of application of AI who is relatively highly skilled when working with computer and who seeks for an AI method solving her/his particular practical problems. The presented AI methods are introduced in such a way that the reader/user is able to implement the chosen method (at least its simplest variant), to apply it to the practical problem in question and to evaluate and classify the obtained results. In case the solution is not satisfactory, the reader/user should be able either to modify the used method herself/himself, or to find, perhaps on using the rich lists of references, some alternative and possibly better solution. On the other side, the reader/user is not expected to be able to understand all details and theoretical foundations

of the used or modified methods, or to distinguish the theoretically founded parts from the heuristic ones. Following this applicational approach, the introduced methods and tools are presented in a rather categorical way, i.e., the conditions and assumptions under which the method or tool is applicable, good, or the best are not always explicitly stated and discussed; stated in another way, the methods are mostly fitted for typical or average cases of applications and possible nontypical or outlying cases when the method or tool may give bad results or when it may even fail are not introduced, or at least not discussed in detail.

Let us briefly survey the contents of the reviewed book. After the introductory chapter dealing with the notion of intelligence in general, with the motivation of the former as well as the contemporaty and the future research in AI, and offering a review of what follows, the next chapter briefly introduces some models for knowledge representation. The paradigms and resulting tools for knowledge acquisition and maintenance are discussed, on a rather informal level, in Chapter 3. Various approaches to reasoning in AI are presented in the next chapter, including also nonmonotonic and default reasoning as well as some very introductory comments concerning the reasoning under uncertainty, when the data or outcoming premises are charged by a portion of uncertainty or vagueness which projects into the uncertainty or vagueness of the drawn conclusions. Chapter 5 deals with machine learning including the empirical methods like learning from examples or from failures, but also methods of concept learning or connectionist learning. The next two chapters deal with planning (automated plan generation) and scheduling and with problem solving at a very high degree of generality. The last two chapters are grouped under the common title "Tools„ and are devoted to programming AI languages (Chapter 8) and to shells and enviroments including a survey of empty expert systems being at the disposal, at least up to the authors' knowledge. AI languages are presented in such a way that their basic philosophy and the field of problems to which they are successfully applicable is emphasized. All the chapters are closed by lists of references and other relevant books, papers and other sources. Their choice is subject to the main philosophy of the reviewed book, so that applicationally and practically oriented sources are preferred to more theoretical and mathematical ones.

The conclusion which can be drawn from what we have said and which is perhaps almost self-evident is as follows. The reviewed book can serve as a good introductory source at the level of the first contact with the AI for a skilled practitioner from the field of possible application or for a specialist working in one of the particular domain of AI and wanting to obtain a very brief outline of some other fields of AI close to that of her/his own domain of work or interest. However, if one wants to get familiar with some domain at the level enabling a creative work in the field in question a much more detailed study will be necessary. Because of the rapidly increasing number of practical applications of AI we believe, however, that the reviewed book will still find a great number of satisfied readers, and that its publication should be considered as an act of great scientific merits.

Ivan Kramosil

PARTIAL DIFFERENTIAL OPERATORS AND MATHEMATICAL PHYSICS. International Conference in Holzhau, Germany, July 3–9, 1994. M. Demuth, B.-W. Schulze (editors), Operator Theory Advances and Applications Vol. 78, Birkhäuser Verlag Basel, Boston, Berlin 1995, ix + 429 pp. Price SFr 148,–.

This volume consists of proceedings of the conference intended to bring together specialists from different areas of modern analysis, geometry and mathematical physics to discuss not only recent progress in the respective disciplines but also to encourage interaction between these fields. Over 40 contributions cover large spectrum of problems concerning

semigroups of operators, hyperbolic and elliptic operators, Schrödinger operators, quantum theory, spectral issues, etc. List of participants and talks is included.

Ivan Straškraba

THEORETICAL, EXPERIMENTAL AND NUMERICAL CONTRIBUTIONS TO THE MECHANICS OF FLUIDS AND SOLIDS. Zeitschrift für angewandte Mathematik und Physik, Vol. 46 (1995), A collection of papers in honor of Paul M. Naghdi. James Casey and Marcel J. Crochet (editors). Birkhäuser Verlag, Basel, Boston, Berlin 1995, 847 pp., Price SFr. 378,–.

This special issue contains Bibliographical sketch and List of publications of Paul M. Naghdi (1924–1994), professor of the University of California at Berkeley, and almost forty papers from continuum mechanics. The volume is divided into six parts: I. Nonlinear and linear elasticity, II. General continuum mechanics, III. Plasticity, IV. Biological and new technological materials, V. Fluid mechanics, VI. Dynamics. A great deal of special problems from continuum mechanics is covered. The problem analysis reaches from engineering point of view through physical insight to purely mathematical approach. This memorial volume would be a representative issue for all libraries collecting (among other) literature on continuum mechanics.

Ivan Straškraba