

# Applications of Mathematics

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## Book Reviews

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## BOOK REVIEWS

*A. Iványi*: MAGNETIC FIELD COMPUTATION WITH  $R$ -FUNCTIONS. Akadémiai Kiadó, Budapest, 1998, 260 pages, ISBN 963-05-7562-0, price USD 52,-.

The book deals with new information in the field of simulation and implementation of magnetic hysteresis to the numerical solution of electromagnetic field problems. The proposed numerical treatment of the analysis of an electromagnetic field in non-linear magnetic materials is the global variational method in conjunction with the  $R$ -functions. With the aid of the  $R$ -functions it is possible to create a potential function satisfying at the same time the prescribed Dirichlet and Neumann boundary conditions on the surface of the region independently.

The content of the book is divided into 10 chapters. The first two chapters summarize the ways of experimental studies on the single sheet tester and deal with the mathematical modelling. In particular, the scalar and vector representations of the Jiles-Atherton hysteresis models are described here in detail. Vector representation in a magnetic rotational field is referred to in a remarkable way here. In the next two chapters, basic equations of the electromagnetic field are given from which the equations expressed by potentials are derived for various kinds of fields. Then problems formulated by the global variational method are introduced for the numerical solution of the electromagnetic field with respect to the introduced potentials and to the prescribed boundary conditions. In further two chapters, the definition and operation on the  $R$ -functions are introduced and then some properties of the  $R$ -functions are investigated and  $R$ -functions for boundary conditions of Dirichlet and Neumann types as well as interface conditions are formulated. This theoretical part of the book is concluded by some examples of simple applications of the  $R$ -function method to the distribution of the static magnetic field in a two-dimensional region.

The remaining three chapters are devoted to some special questions of solution of the electromagnetic field by the  $R$ -function method. The solution of a magnetic field in the single sheet tester with two pairs of poles and with three pairs of poles is given here, as well as the derivation of the mathematical 2D model and later on also the 3D model for the single sheet tester, including the investigation of the eddy current. The last chapter deals with the investigation of losses in the magnetic system under the exposed circular polarised flux density.

In processing the reviewed book the author drew from the critical appraisal of an unusually wide range of references. In the closing part of her book she lists 367 bibliographical items. Also this bibliography is very useful for the reader.

The book is an excellent summary of contemporary knowledge in the field of numerical analysis of an electromagnetic field in non-linear environment with hysteresis and even with contingent anisotropy. It also contains very many valuable pieces of knowledge the author arrived at on the basis of her long-termed and very successful research. It is undoubtedly an important contribution not only in the field of applied mathematics, but also from the point of view of electrical engineering practice.

*Daniel Mayer*

*Martin Schechter*: LINKING METHODS IN CRITICAL POINT THEORY. Birkhäuser-Verlag, Boston, 1999, xvi+294 pages, ISBN 0-8176-4095-9, price DM 118,-.

The book is devoted to a systematic study of finding critical points of functionals. The basic idea is to find subsets  $A$ ,  $B$  of a given space such that any “nice” functional  $G$  satisfying  $\sup_A G < \inf_B G$  has a critical point. In this case we say that  $A$  links  $B$ . The original approach to linking required  $A$  to be of a special type, e.g. the boundary of a manifold. The author presents a more general concept. He proves that  $A$  links  $B$  in the general sense mentioned if the sets  $A$  and  $B$  are disjoint and  $A$  cannot be continuously contracted to a point without intersecting  $B$ . In fact, this can be used as the definition of linking. This approach gives a possibility to find many more examples of linking subsets than the original one. Many situations in applications are shown where the use of the new concept of linking leads to a solution of problems not solvable by the old one. Also situations when convenient linking sets cannot be directly found are considered and a certain generalization of the usual Palais-Smale condition is introduced. Applications to semilinear elliptic boundary value problems are given throughout.

The exposition is given in an interesting and understandable form. The text is more or less self-contained, only general knowledge of functional analysis concerning Banach and Hilbert spaces and the elementary theory of Lebesgue integration is supposed. The book can be recommended to mathematicians interested in the critical point theory itself as well as to those who are interested in applications to nonlinear PDE.

*M. Kučera*

*Robert C. Dalang, Marco Dozzi, Francesco Russo (eds.)*: SEMINAR ON STOCHASTIC ANALYSIS, RANDOM FIELDS AND APPLICATIONS. Progress in Probability, Vol. 45. Birkhäuser-Verlag, Basel, 1999, x+300 pages, ISBN 3-7643-6106-9, price DM 188,-.

The book under review represents proceedings of the Second Seminar on Stochastic Analysis, Random Fields and Applications, which was held in Centro Stefano Franscini in Ascona (Switzerland) in the year 1996. Twenty refereed papers are included, most of them with full proofs. Topics ranging from stochastic partial differential equations to the iterated Brownian motion and optimal control methods for a communications system are dealt with and it is not easy to characterize the subject of the book in a simple way. Applications to financial modelling provide motivation for several papers, which, nonetheless, employ rather different mathematical tools (e.g. generation of analytic semigroups by second order differential operators arising in no-arbitrage pricing theory is studied by E. Barucci *et al.*, while F. Delbaen and W. Schachermayer treat compactness principles for bounded sequences of martingales).

Let us note finally that the proceedings of the first Seminar (that took place in 1993) were published also by Birkhäuser in 1995 as Volume 36 of the same series.

*Ivo Vrkoč*