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Book Reviews

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BOOK REVIEWS

N. D. Kopachevsky, S. G. Krein: OPERATOR APPROACH TO LINEAR PROBLEMS OF HYDRODYNAMICS. VOL. 1: SELF-ADJOINT PROBLEMS FOR AN IDEAL FLUID. Operator Theory Advances and Applications, Vol. 128. Birkhäuser-Verlag, Basel, 2001. ISBN 3-7643-5406-2, 384 pages, price sFr 248.

This book deals with functional-analytical methods applied to the study of small movements and normal oscillations of hydromechanical systems having cavities filled with either ideal or viscous fluids. It is a continuation and substantial extension of the previous volume entitled "Operator Methods in Linear Hydrodynamics: Evolution and Spectral Problems", by N. D. Kopachevsky, S. G. Krein, and Ngo Zuy Kan that was published by the Nauka publishing house in Moscow.

The present book includes several new problems on the oscillations of partially dissipative hydrosystems and the oscillations of visco-elastic or relaxing fluids. The contents almost does not overlap the already existing related books by O. A. Ladyzhenskaya, N. N. Moiseev, and V. V. Rumiantzev, by R. Temam, by S. M. Belonosov, and K. A. Chernous.

The book consists of two parts. Part I is entitled "Mathematical foundations of linear hydrodynamics" and is divided into two chapters. Chapter 1 is devoted to operators on Hilbert spaces with all basic notions and theorems characterizing this theory. Sobolev spaces, spaces with indefinite metrics, eigenvalue problems, evolution equations in Hilbert spaces, spectral theory of operator pencils, asymptotic methods for solving evolution equations with a small parameter at the derivative, and a general scheme for solving boundary value problems are also included.

Chapter 2 deals with "Fundamental spaces and operators of linear hydrodynamics". The following issues are tackled: Fundamental spaces and hydrodynamics operators for an ideal fluid and spaces and hydrodynamics operators for a viscous fluid. Part I is concluded by Appendix to both chapters.

Part II is entitled "Motion of bodies with cavities containing ideal fluids". It consists of Chapters 3–6 and Appendix to these chapters. The following themes are thoroughly discussed. In Chapter 3, oscillations of a heavy ideal fluid in stationary and nonstationary containers. In Chapter 4, problems on oscillations of capillary fluids and problems on hydroelasticity in immovable containers. In Chapter 5, other operator approaches to hydrodynamics problems if ideal fluids, and, finally, in Chapter 6, oscillations of an ideal rotating fluid.

A list of standard reference texts, bibliography, list of symbols, and subject index are attached at the end of the book.

This book is certainly fruitful and will serve to gain both the basic and advanced knowledge about linear operator theory as applied to hydrodynamical problems. It is relevant to universities and research institutions oriented to mathematical and physical theory of fluids.

Ivan Straškraba

R. Vandebril, M. Van Barel, N. Mastronardi: MATRIX COMPUTATIONS AND SEMISEPARABLE MATRICES. VOL. 1: LINEAR SYSTEMS. John Wiley & Sons, Chichester, 2007. ISBN 978-0-8018-8714-7, 584 pages, price USD 75.

In recent years there has been an increased interest in a certain class of structured matrices, among which the so-called semiseparable matrices are the best known. Roughly speaking, semiseparable matrices are matrices of which designated sub-blocks have a given rank. If this rank is low, such matrices can be stored and represented and manipulated upon in an efficient manner by using special algorithms. Semiseparable matrices arise in many applications, as discussed in one of the chapters of this book, which consists of three main parts.

The first part is called "Introduction to semiseparable and related matrices". It provides the basic definitions and properties and spends time on explaining different types of representations of such matrices. Also some historical applications are mentioned in this part.

The second part is central to the book and discusses the solution of linear systems with semiseparable and related matrices for which the ranks of the particular sub-blocks equal one. Gaussian elimination and QR- factorization in this particular context are discussed, as well as a Levinson-like and a Schur-like solver. The special properties of semiseparable matrices are exploited and optimal order algorithms result. A section devoted to inversion concludes the second part.

The third part of the book deals with higher order generalizations of the first two parts, by which it is meant that the ranks are now allowed to exceed one.

This book is the first of its kind and therefore a valuable addition to the existing linear algebra literature. The authors are well known for their numerous contributions to the area. The result is both an accessible introduction into the topic and a work of reference. At some points however, the flow of the book seems a bit slow, even for the non-specialist, whereas at points where a more detailed exposition would have been welcome, it lacks such details. This may have resulted from the wish of the authors to keep the interest of as large audience as possible.

Jan Brandts