represent the mainstream research in the area, while the references to the Russian literature are scarce and misleading.

As noted above, the book has various merits and is a useful and timely text in the area of finite volume methods for partial differential equations. It could be used as a textbook for an advanced course on finite volume methods or as a supplement to a course on discretization methods for differential equations.

## References

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**5[65-01, 65L05, 65L06, 65L10, 65L12, 65L99]**—*Computer methods for ordinary differential equations and differential-algebraic equations*, by Uri M. Ascher and Linda R. Petzold, SIAM, Philadelphia, PA, 1998, xvii+314 pp., 25 cm, softcover, $36.50

This book is intended to be a textbook introducing students of mathematics as well as of other fields like computer science, mechanical, electrical, and chemical engineering, physics, into the field of the numerical solution of ordinary differential equations (ODEs).

In addition to initial value problems (IVPs) and boundary value problems (BVPs) in regular ODEs, also specific, singular ODEs, namely, differential-algebraic equations (DAEs) are considered. While regular IVPs are discussed on about 140 pages, about 70 pages each are devoted to regular BVPs and DAEs.

Each attempt to write a concise textbook on such a broad and complex subject constitutes a hazardous business. It always means a tightrope walk trying to present facts as simple as possible and as complex as necessary. The selection of the topics and the necessary restriction of the material to be presented will be subjective in any case.

Many nice, partly quite extensive monographs are available on the numerical solution of regular IVPs, even on single methods, like the good, old Adams book [1] by Lawrence F. Shampine and Marilyn Gordon. Flicking through this book is of great benefit still today. More recent books already contain sections on DAEs. Corresponding extensive monographs are available on regular BVPs, too. Concerning the integration of those three aspects, IVPs, BVPs, and DAEs, in the necessary brevity but in adequate detail for an independent course, this new textbook by Uri M. Ascher and Linda R. Petzold is a welcome and useful novelty.

A predecessor worth mentioning is the now classical textbook of Josef Stoer and Roland Bulirsch [2] where the above three aspects are discussed within the framework of a general introduction to numerical analysis (IVPs and BVPs on 70 pages each, DAE on 5 pages).

In the preface the two author outline what they aim at with this book: "It is designed for people who want to gain a practical knowledge of the techniques used today. The course aims to achieve a thorough understanding of the issues and methods involved and of the reasons for the successes and failures of existing software. On one hand, we avoid an extensive, thorough, theorem-proof-type exposition: we try to get to current methods, issues, and software as quickly as possible. On the other hand, this is not a quick recipe book, as we feel that a deeper understanding than can usually be gained by a recipe course is required to enable students or researchers to use their knowledge to design their own solution approaches for any nonstandard problems they may encounter in future work." Although I do not at all dislike "theorem-proof-type expositions", I also like and use a textbook that is, so to say, written in prose, and that conveys knowledge in a relatively relaxed way. This book reminds me of another classical textbook by Gene H. Golub and James M. Ortega [3].

Uri M. Ascher and Linda R. Petzold, both of them teachers with experience and highly acknowledged experts, have structured this book didactically and formally in an excellent way. The great variety of applications considered in expositions as well as in examples motivate the reader for further investigation. Well thought-out and well understandable examples lead to individual questions and insights. This, too, reminds me of [3].

The whole layout turned out very well. It is quite convenient that the necessary fundamentals (Newtown's method, Taylor's theorem, matrix eigenvalues, etc.) are arranged as a short framed review within the text and not in a separate appendix.

In particular, students with diverse intentions will like the helpful guide-boxes, which also indicate whether certain paragraphs can possibly be skipped.

The book is divided into four parts and ten chapters. Part I is an introduction to all three problem areas. Part II (Chapters 2–5), Part III (Chapters 6–8), and Part IV (Chapters 9–10) refer to the mentioned areas, namely IVPs, BVPs, and DAEs. For experts, the headlines of the chapters clearly indicate what can be expected there. In Part II on IVPs we have On Problem Stability; Basic Concepts; One-step Methods; Multistep Methods. Part III on BVPs is subdivided into More Boundary Value Problems; Theory and Application; Shooting; Finite Difference Methods for BVPs. Part IV on DAEs contains More on DAEs; Numerical Methods for DAEs.

Each chapter concludes with informative sections on "Software, Notes and References" as well as a section presenting a whole host of exercises of different level, which are all very instructive and interesting.

As most books for beginners (e.g., [1]), the parts devoted to regular ODEs sensibly start from the most simple relations in the ODEs to be solved: a global Lipschitz condition is assumed for the vector field. More complex problems and the resulting difficulties are only sketched additionally. This sovereignty to restrict oneself to the essentials for beginners characterizes Parts II and III in a very pleasant way. In particular, this holds true for the stability discussion, although I am wondering here whether the authors have gone a bit too far in simplifying. I would prefer to make a primal distinction in notation, e.g., of the condition numbers of linearly bounded bijective mappings (as for BVPs for example) and of the qualitative, asymptotic properties of flows (like stability in the sense of Lyapunov for IVPs).

In my opinion the representation of the practical applicability of (multiple) shooting methods for regular ordinary BVPs is somewhat misleading. The much older representation in [2] seems to me to be more mature.

Writing a good textbook always requires, in addition to the authors' expert knowledge, that the development in the field concerned has been finished to a certain extent. A certain distance is necessary to be able to restrict oneself to the most essential things. In the case of the DAEs in Part IV, the stage of development essential for a really good textbook has not yet been reached, in my opinion, and the two authors are themselves too strongly involved in this development to keep the necessary distance. Hence, the nice character of a textbook gets lost in Part IV. This is rather a part of a monograph with a great amount of subproblems and approaches strung together. For example, in spite of the mentioned sound restriction to globally Lipschitz-continuous vector fields in the beginning, the authors do not introduce a global notion of index for DAEs then. Just for these already complicated equations, they start with a local notion of index, which is confusing not only for beginners.

As intended by the authors, this new textbook is a strongly advisable aid for introductory courses to the numerics of regular ODEs. In particular, I consider the IVP part to be so exceptionally successful that I will advise students to use it as first literature for studying on one's own. For the BVP part it requires a few additional comments to achieve a more balanced education.

The abundant source of instructive examples and exercises in all parts of this book will be extremely valuable for all teachers.

Altogether, a gain!

## References

[1] Lawrence F. Shampine and Marilyn Gordon, *Computer solution of ordinary differential equations. The initial value problem*, W. H. Freemann and Company, San Francisco, 1975.

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[3] Gene H. Golub and James M. Ortega, *Scientific computing and differential equations. An introduction to numerical methods*, Academic Press, Inc., 1981, 1992.

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**6[65L05, 34A50, 58F99]**—*Geometric integration: numerical solution of differential equations*, C. J. Budd and A. Iserles (Editors), Philosophical Transactions of the Royal Society, Mathematical, Physical and Engineering Sciences, The Royal Society, UK, April 1999, vol. 157, no. 1754, pp. 943–1133

The present issue of volume 357 of the *Philosophical Transactions of the Royal Society of London, Series A*, is entirely devoted to *geometric integration*. Under this heading, several recent developments in the numerical treatment of differential equations are collected. They have as a common theme the idea to preserve as far as possible structures (symmetries) of the exact flow in numerical discretization.