

Book Review

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Applied Mathematics in Aerospace Science and Engineering

Angelo Miele and Attilio Salvetti (Eds.), Volume 44, Mathematical Concepts and Methods in Science and Engineering, Plenum, New York and London, 1994, 510 pp., \$125.00, ISBN 0-306-44754-1

This book contains the proceedings of a weeklong meeting held in Erice, Sicily, Italy, Sept. 3–10, 1991. The title of the meeting was Applied Mathematics in the Aerospace Field, and the intent was to provide a perspective on the state of the art of and research trends in the application of mathematics to aerospace science and engineering. The book consists of 20 chapters written by 23 contributors. It comprises four distinct parts, each of which covers a different area of specialization: Part 1, Fluid Mechanics (six papers); Part 2, Flight Mechanics and Control (five papers); Part 3, Dynamics and Structures (five papers); and Part 4, Mathematical Techniques (four papers). The majority of the authors are from Europe, almost half from Italy and five from Germany. The remaining contributors are from the United States.

Topics covered in the Fluid Mechanics portion of the book include both practical issues of numerical solutions of compressible, viscous flows and theoretical/mathematical discussions involving analytic/numerical combined formulations and boundary integral formulations of potential and viscous aerodynamics. The Flight Mechanics and Control section includes a variety of papers discussing optimization of flight paths for hypersonic and gliding vehicles, as well as an excellent review of the use of singular perturbations in flight mechanics and a review of aeroassisted orbital transfers. (The latter paper predates the current application of these ideas to spacecraft at Venus and Mars.) The Dynamics and Structures section begins with a concise and useful review of Lyapunov stability theory applied to uncertain dynamical systems; it contains articles that provide a clear exposition of the basics of the dynamics of a flexible spacecraft, a theoretical discussion of solving dynamics problems in the discretized time domain, and detailed introductions to fatigue and fracture mechanics and mathematical representations of continuum mechanics. The Mathematical Techniques section concludes the collection with an interesting set of papers on the application of the dynamic programming problem to problems involving the optimization of large-scale designs. This final section also

includes papers that discuss the numerical quadrature of quasisingular integrals and the use of symbolic computation in mathematics, science, and engineering.

As is clear from this description, the scope of the book is broad and reflects what the conveners of the conference and editors of the book consider to be the state of the art. One finds detailed expositions on certain topics that are current in aerospace or that have played an important role in the recent development and evolution of the field. The most helpful papers in the book provide an overview of specific theories, along with relevant and motivating problems in that area; most of the detailed computations, subtleties, and applications of the theories are left to the bibliography. Not all of the papers follow this format, but those that do shed the most light on their subject and expose the fundamental nature of the idea or theory behind it. A good number of the papers fall into this favorable category, although exceptions are either too simplistic and incomplete or too detailed and better suited to a specialized audience than to the more general one to whom this book is apparently targeted.

This book should not be considered a complete survey of applied mathematics in aerospace science and engineering; neither is it a handbook for mathematical methods in aerospace science and engineering. Rather, it provides a limited series of applications of mathematical methods to topics in aerospace science and engineering. Although much ground is covered, the conference paper format of the book precludes a more exhaustive survey. Indeed, as with any conference proceedings, its scope is limited by the attendees.

I would recommend this book to a mature graduate student looking for a partial survey of what is going on, mathematically, in aerospace science and engineering. I would recommend some of the review papers to people interested in getting up to speed in an applicable subfield. It is a book more suitable as a library holding than as a ready reference.

Daniel J. Scheeres
Iowa State University