Statistical Orbit Determination

B.D. Tapley *et al*

Elsevier Academic Press, 84 Theobold's Road, London WC1X 8RR, UK 2004. 547pp. Illustrated. £49.99. ISBN 0-12-683630-2.

Byron Tapley developed the software that was the only source of real-time trajectory information available to Mission Control in Houston to monitor the final moments of the Apollo Moon landings. Based on the then relatively new Kalman filter or sequential estimation principles, Tapley's software allowed the relatively slow computers of the day to estimate the orbit of the Moon lander from Earth-bound tracking data in time for Houston to actually influence the landing.

A textbook by Professor Tapley on the subject of orbit determination therefore builds on unique experience in the subject. With his co-authors, themselves well known contributors to the field of satellite geodesy, Tapley gives a clear introduction to the problems of formulating the orbit determination problem, the data needed to address it, and the mathematical approach to solving it. The text distinguishes two approaches to orbit determination: the sequential estimation approach that can deliver real-time results as it did for Apollo, and the batch estimation approach that accumulates data for a period of time before producing an orbit estimate for that period.

The book's treatment of the sequential estimation method is particularly clear and useful, with much attention given to avoiding the rounding error and computational time challenges associated with the method. Perhaps surprisingly given Tapley's association with the landing phase of Apollo, the book ignores the powered flight phase of satellite missions, other than to propose the use of process noise to compensate for unmodelled phenomena – absent too from the otherwise excellent references supplied throughout the book.

After a sound introduction, the treatment of batch processing is not a reliable source of information for the advanced reader. The book focuses on much the same issues as for sequential processing and omits several practical aspects of the subject, such as the use of hard limits to avoid physical phenomena being given impossible values, or variations on the matrix inversion method that allow incremental addition of parameters to the state vector.

A textbook then that builds on the experience of its authors – and therein lies both its strengths and its weaknesses.

Pat Norris, MRAeS

Elements of Gas Turbine Propulsion

J.D. Mattingly

American Institute of Aeronautics and Astronautics, 1801 Alexander Bell Drive, Reston, VA 20191, USA. 2005. 960pp. Illustrated. $79.95 (AIAA members), $109.95 (non-members). ISBN 1-56347-778-5.

This book on gas turbine propulsion is anchored firstly in the interrelation between aircraft performance and the aero-thermodynamic behaviour of the gas turbine. The fundamentals are clearly presented and supplemented by numerous examples, illustrations and exercises. The comprehensive treatment of ideal cycles is followed by a chapter on component performance, parametric real engine performance and then a full discussion on engine performance analysis. While full chapters on the major components, namely turbo machinery, combustion systems, inlets and nozzles are included, they are mainly useful in the context of understanding gas turbine design.

This is a comprehensive and attractive text for appropriate undergraduate courses and of value to many postgraduate students. The extensive use of examples, questions and the simple computer programmes provided will be welcomed.

There are a number of other well regarded texts on gas turbines. For the UK reader, the focus on US engine examples may prove to be of special interest. Likewise, the extensive foreword presents details of early German and US developments, in a form not usually presented in the UK.

Prof Riti Singh, CEng, FRAeS

Introduction to Computational Fluid Dynamics

A.W. Date

Cambridge University Press, The Edinburgh Building, Shaftesbury Road, Cambridge, CB2 2RU, UK 2005. 377pp. Illustrated. £40.00. ISBN 0-521-85326-5.

The title of this book is slightly mislead ing, as it actually presents an introduction to computational methods specifically for heat transfer problems. It is presented in a fairly logical sequence of nine Chapters, each one ending with some problems/examples. There are also several appendices containing example source codes.

The book begins with a very nice introductory Chapter, presenting some of the basic concepts: transport equations and discussion of the Navier-Stokes equations, PDEs and ODEs, and numerical discretisation. Chapters Two and Three then use heat conduction and conduction-convection to introduce further concepts of discretisation and solution methods for one dimension, and the book becomes more detailed from here.

Boundary layer simulation in two dimensions is considered next, including a nice introduction to models used in turbulent simulation. Detailed investigations of various viscous simulations are presented, including for reacting flows. This is followed by 2D convection using Cartesian grids, presenting staggered and non-staggered grid approaches, and then 2D convection for complex domains. Very brief introductions are presented to structured and unstructured meshing options, followed by more details of an unstructured solution procedure. Chapter Seven is particularly specialised, considering phase change, and presenting methods for pure and impure substances.

The last two Chapters are slightly more applied. A brief introduction to numerical grid generation is presented, split into algebraic and differential structured, and unstructured approaches. Finally, convergence acceleration techniques are considered, but only methods of linear system solution are presented.

Overall, the book introduces many of the fundamental concepts related to heat transfer problems very nicely, but suffers slightly from not really covering some of the numerical methods concepts properly. For example, it is surprising that the type of the equation, i.e. elliptic, hyperbolic, parabolic, is not discussed, neither is truncation error and the link to numerical diffusion, and there are no detailed stability analyses. Hence, as an introduction to numerical methods or general CFD this book could not be recommended as, apart from the excellent introductory Chapter, it is too specialised. However, ignoring the title, that is clearly not the aim of the book, and as an introduction to computational methods specific to heat transfer problems, it certainly could be recommended. It would make a useful addition to the library of anybody involved in this area, and would offer a nice introduction to the subject for a postgraduate student.

Something like *Numerical Solution of Partial Differential Equations*, by Morton and Mayers, would be a good complementary text for those requiring more numerical methods background.

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