Book Reviews

Radar and Laser Cross Section Engineering – Second edition

D.C. Jenn

American Institute of Aeronautics and Astronautics, 1801 Alexander Bell Drive, Reston, VA 20191-4344, USA. 2005. 505pp. Illustrated. $74.95 (AIAA members); $99.95 (non-members). ISBN 1-56347-702-5.

This is the second edition of a book first published in 1995 and the structure essentially follows that of the first edition. The new edition contains some updated material (in particular on composite and artificial materials) and additional examples and 'homework' problems for the student. The book is intended for graduates, preferably those who have studied electromagnetics at undergraduate level. However, it contains helpful early chapters and Appendices on basic concepts and electromagnetic theory that should do much to make the material accessible to the non-specialist.

A stated objective of the book is to give the reader a relatively comprehensive exposure to the major aspects of RCS without becoming too embroiled in the mathematics. This is a challenging task and on the whole the author has succeeded. The subject matter is certainly wide-ranging and contains much to interest both the novice and the more experienced practising engineer. Mathematics there is plenty of, but this is required for understanding. An inevitable consequence of striking a balance, necessary in a book of this size, between breadth of coverage and mathematical depth is that not all topics will be covered in sufficient detail to satisfy every reader.

A criticism of the book is that on occasion a statement is made that appears to be wrong, or is at least unsupported. For example, in Chapter Two it is asserted that the peak travelling wave RCS of a conducting strip is equal to its length squared. This figure is surprisingly large and a supporting reference would have been helpful.

The updating is also not without the occasional minor anachronism. For example, the physical theory of diffraction is described as not having received extensive attention outside of the Soviet Union until recently. This was a questionable statement in 1995 and is more so in 2005. Method of Moments techniques are stated as being restricted to bodies less than 20 wavelengths in size. There is no mention of recent advances in method of moments techniques (the fast multipole method) that have extended the size of problem that may be addressed by these methods.

On the whole, however, the merits of the book outweigh its faults and it is a satisfactory introductory text to RCS engineering. The bibliography is extensive and the problem examples appear to be well chosen.

Gerry Jepps

Applied Orbit Perturbation and Maintenance

C.-C. Chao

Co-published by The Aerospace Press, 2350 East El Segundo Boulevard, El Segundo, CA 90245-4691, USA and American Institute of Aeronautics and Astronautics, 1801 Alexander Bell Drive, Reston, VA 20191-4344, USA. 2005. 264pp. Illustrated. $54.95 (AIAA members), $79.95 (non-members). ISBN 1-884989-17-9.

Chia-Chun 'George' Chao is a highly respected figure in the celestial mechanics community, well known for providing practical solutions to challenging astrodynamics problems, and his new book *Applied Orbit Perturbation and Maintenance* underlines his important contribution to this field.

This publication by the recently retired JPL and Aerospace Corporation researcher provides an invaluable text for academic (both undergraduate and post-graduate) and industrial (designers and operators) readers, building on the fundamentals of Kepler's laws through equations of motion with perturbations (offering both analytical and numerical solutions), and expanding into the station-keeping strategies for geostationary and medium Earth orbit satellites. An important feature of this new text is the inclusion of consideration of the use of ion propulsion in addition to more classical and established systems.

Chao also considers the operational challenges of working within an increasingly crowded geostationary ring, incorporating issues such as collocation strategy and maintenance, and very importantly collision avoidance strategies. With the need to work within increasingly small regions of orbital space, the opportunities offered by GPS for station-keeping are also explored. George Chao was one of the early advocates of end of life disposal of satellites both at geostationary and low Earth altitudes and his text devotes a whole chapter to this important issue, including the emerging problem of medium Earth orbit stability and re-entry strategies.

Chao's impressive body of publications provides the backbone for this text and weaves in additional material as required, offering introduction, development, and insight into, many of the challenges that operators are beginning to face as we search for ways to develop near-Earth space in a responsible and sustainable manner.

Richard Crowther, FRAeS

Fundamentals of Multibody Dynamics: Theory and Applications

F. Amirouche

Birkhauser Verlag, Viaduktstrasse 42, CH-4051 Basel, Switzerland. 2006. 684pp. Illustrated. £98.50. ISBN 0-8176-4236-6.

Although the title refers only to multibody systems the text covers most of the basic theory associated with classical mechanics. The first two chapters cover traditional particle dynamics and rigid body kinematics. Chapter Three develops the kinematics of multibody systems using a well presented matrix approach, I was surprised not to see the Denavit Hartenberg method mentioned. The subject matter of the book clearly covers robotics and although there are many worked examples using robot elements the word robot does not appear in the contents list until Chapter Eleven. Chapters Four and Five deal mainly with applications to robotic type problems and concludes with a project applying the methods to a hydraulic excavator. The text then returns to fundamentals covering Hamilton-Lagrange and Gibbs-Appel equations and also mentions Kane's equations. Then follows a thorough discussion of constraints in Multibody systems ending with a section on human locomotion. Chapter Eight is concerned with numerical stability introducing the Baumgarte technique and discusses a modified Pseudo upper triangular decomposition (PUTD) method devised by the author and previously mentioned in Chapter Seven. Chapters Nine and Ten present a conventional treatment of vibration problems for elastic systems. The next chapter applies the expounded techniques to multiple flexible body systems and makes use of modal analysis to reduce the equations of motion. Chapter Twelve concentrates on the use of the BEM (boundary element method) and compares it with the FEM (finite element method) and the AMM (assumed mode method), again there is a detailed worked example.

Matrix notation is widely used and most chapters include several worked examples making it an important reference book for anyone involved in the numerical application of dynamics to any type of structure from robots to aircraft structures. Overall this is a very comprehensive and authoritative (though expensive) work on the modern methods of dealing with the practical problems involved in the dynamics of structures.

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