Book Review

Spacecraft Dynamics, Thomas R. Kane, Peter W. Likins, and David A. Levinson, McGraw-Hill Book Company, New York, 1983, 436 pp., list price $49.50.

Spacecraft Dynamics has arrived on the scene to join several other new engineering texts. It does complement the various other books available in the area of space mechanics, more specifically in the area of attitude dynamics of spacecraft. It can be recommended for the serious worker and graduate student in this field, because it brings together many ideas that have otherwise only been available in journal articles. The authors are well-known in this field through their teachings, publications, and presentations at specialists meetings. Their particular style and notation are manifest in the textbook.

The title, *Spacecraft Dynamics*, is somewhat misleading. In fact, the textbook deals almost exclusively with attitude dynamics and methods for treating problems associated with this technical topic. No material related to orbital mechanics or aspects of mission analysis has been included.

The book is obviously intended for graduate-level students and professionals. Subjects such as inertial properties, and knowledge of the basic elements of dynamics are assumed of the reader. The book has four chapters, each of which is of considerable length and content. The first one gives an extensive treatise on kinematics, starting with simple rotation and working on through direction cosines, Euler angles, successive rotations, angular velocity notation, various reference frames, and angular acceleration. Chapter 2 deals with forces acting on spacecraft, but is confined only to gravitational forces. Although these play a pre-eminent role in spacecraft dynamics, there are a number of other forces which are important when simulating spacecraft attitude motions. Chapters 3 and 4 deal directly with specific problem types. Chapter 3 deals with relatively simple spacecraft in which the authors rely on the angular momentum principle for the formulation of the dynamic equations of motion. In Chapter 4, they are concerned with more complex spacecraft and proceed to develop and use another method for formulating the equations of motion. This method is advertised to be well-suited for problems involving multi-degrees of freedom in spacecraft.

In addition to several examples in the text, there is a section containing four sets of problems, each set being associated with one of the four chapters. Answers are given for these problems in almost every case.

The authors recommend that this book be used for a two-course graduate curriculum. Although the use of computers in the solution of spacecraft attitude dynamics problems is extremely common in the industry, the problems appearing in this book are set up so that a computer will not be necessary in order to gain insight into the subject matter.

The authors take careful note to point out that the book is intended to be a self-contained text; therefore, they have omitted all references to the extensive literature on spacecraft dynamics. Unfortunately, this makes it difficult for the reader to get other points of view about the subject matter. Presenting all of this material in just four chapters makes it very tedious for the reader to maintain a consistent level of interest. Nevertheless, the many researchers and engineers working with flexible body problems will find this book very useful as a reference. Graduate students working in this area of technology will also find this a good source of information regarding techniques for modeling the complex motions of a spacecraft.

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