Book Review

Optimal Spacecraft Rotational Maneuvers

John L. Junkins & James D. Turner, Elsevier, Amsterdam, 1986, 516 pp., $109.25.

This is one of the few books available that has some treatment of the modeling and control of flexible spacecraft (S/C). It is a treatise, not a textbook (there are no problems for the reader to solve). There are worked examples but, in the most interesting cases, the input data are not given in a simple form, so that it is difficult for the interested reader to check them.

The book seems more expensive than necessary, but it is more comprehensive than the title indicates. Only three of the eleven chapters (154 pp.) are devoted to the subject of the book title. Four chapters (170 pp.) are about dynamic modeling of the rotational motions of rigid and flexible S/C. Two chapters (83 pp.) are about formulating and solving open-loop nonlinear optimal control problems, and one chapter (Chapter 10, 46 pp.) is about closed-loop linear-quadratic control design. In addition, there are five appendices (56 pp.) on mathematical topics.

Material not found in older books includes discussions of (a) dual spinners, (b) minimum-time magnetic torquing of spinning S/C, (c) attitude control with three momentum wheels, (d) hybrid coordinates, assumed modes, and finite element methods for modeling flexible S/C, (e) optimal large-angle single-axis maneuvers of flexible S/C, (f) use of quadratic penalties on the control-rate to produce "roll-off" to prevent spillover, for small-angle (linear) control of flexible spacecraft, and (g) use of Van Loan's method for computing convolution integrals containing matrix exponentials.

The book is more about the mathematics than the engineering of the subject, and, at least in places, lacks physical insight. For example, in Chapter 7 (on Numerical Solution of Two Point Boundary Value Problems), the authors fail to notice in Example 7.2 that the input data are such that the nonlinear terms are negligible and the supposedly complicated problem degenerates into three uncoupled simple integrators, making the problem trivial and numerical solution unnecessary.

In Chapter 7, one of the principal methods, invariant embedding using a Riccati matrix equation with auxiliary linear equations, is omitted, despite the fact that the Riccati equation is used in many other places in the book. Example Problem 7.1 is easily solved with this method.

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We apologize that this issue was mailed to you late. As you may know, AIAA recently relocated its headquarters staff from New York, N.Y. to Washington, D.C., and this has caused some unavoidable disruption of staff operations. We will be able to make up some of the lost time each month and should be back to our normal schedule, with larger issues, in just a few months. In the meanwhile, we appreciate your patience.