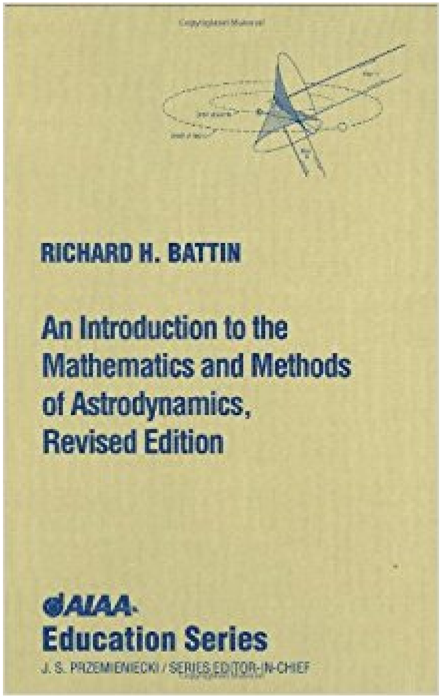
An Introduction To The Mathematics And Methods Of Astrodynamics, Revised Edition (Aiaa Education Series)



Synopsis

This comprehensive text documents the fundamental theoretical developments in astrodynamics and space navigation that led to Man’s ventures into space. It includes the essential elements of celestial mechanics, spacecraft trajectories, and space navigation, as well as the history of the underlying mathematical developments.

Book Information

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Customer Reviews

The book represents an excellent review and complete reference for astrodynamics. The organization is linear and the style is clean and synthetic

Although "Astrodynamics" is a discipline only about 50 years old - the name is attributed to the late Samuel Herrick - it has a distinguished history. For one thing, it is a branch of celestial mechanics, whose history can be traced all the way back to Ptolemy’s "Almagest." Along the way are found many venerable masterpieces, including Copernicus’s "De revolutionibus orbium coelestium," Kepler’s "Harmonices Mundi," Newton’s "Principia," and Laplace’s "Mecanique Celeste."Only time will tell exactly where Richard Battin’s book fits into this pantheon, but there is no question it is an outstanding book. Actually, the book may be considered to be three books: a) a history of Apollo navigation; b) an exposition of classical celestial mechanics/astrodynamics; and c) a book on applied mathematics covering hypergeometric functions, continued fractions, and elliptic functions.The material on Apollo navigation is fascinating, and perhaps nowhere else so easily accessible. Prior to reading Battin's "Astrodynamics [for short]" I was somewhat familiar with this topic (I started my career with Apollo), but I discovered much that was new and fascinating. For example, I knew that optical navigation was a backup to radio navigation on Apollo, but I did not fully appreciate why. It turns out that NASA was afraid the Soviet Union would try to disrupt radio navigation in an attempt to make Apollo fail. Optical navigation would then be the backup safety-net to complete the mission. Fortunately, these fears were not realized, and Apollo was a huge success.The material on celestial mechanics is very thorough and well done. Battin includes all the obligatory material, but includes much addition material such as quaternions, Lagrange's perturbation equations, F and G series, universal variables, and much more. He spends considerable space - some would say too much space (see below) -- to solving Kepler's equation by various means. He leaves much material to the proverbial "student exercises" -- and these are often hard!It is almost irresistible to compare this book with the similar book by Samuel Herrick, "Astrodynamics". Harrick's book is generally on a more elementary level. Also, Herrick avoids vector and matrix notation. This may make Herrick easier to read for beginners, but in general, it gives Herrick's book a much more "old fashioned" feel.My own favorite part of Battin's book is the "applied math" part - hypergeometric, continued fractions, etc. But why did the author decide to include this material? I suspect, if asked, he might say he included this material because of the importance of elliptic functions to an understanding of certain classical solution, and that continued fractions are best for evaluating elliptic functions. I heartily agree with the first, but have reservations about the second. It is true that elliptic functions enter into many classical solutions, and a deep understanding of these requires a fair knowledge of elliptic function. It is also true that continued fractions may provide an efficient means of evaluating elliptic functions. However, almost no one uses "home brew" code to evaluate functions anymore - one gets a commercial math package. So, my belief is, in the final analysis, Battin added this material because: a) he loves this subject; b) he fears that knowledge of continued fractions is slowly being lost; and c) he wants to reverse this trend. I for one am glad he included continued fractions, for I love the topic and it IS REALLY DIFFICULT to find first class material on it.Perhaps what would serve best is to take the applied math material and add additional chapters covering: a) the two-fixed-centers-of-force solution; b) selected n-body-problem material; c) almost periodic functions; and d) chaos theory; then turn this material into a separate book.Hmmm ... now there's an idea ... would anyone care to collaborate on such a project?

Wow. That sums up my thoughts on this book. There is stuff in here that I have never seen anywhere else, some of it discovered by his students! Battin is clearly an aficionado of mathematics, spaceflight and orbital mechanics, and the history of these. Sprinkled throughout the text are little historical anecdotes on the discovery of the various methods. Some of the material is apparently in here for the sheer beauty of it, rather than for any practical application. And beautiful it is - more than once, I found myself in a kind of awe - a joy of discovery that is a little hard to describe. The book itself is beautifully printed and bound - one of the finest books I own. As other reviewers have mentioned, some of the material is presented as problems, which Battin expects you to derive... I don't know if I'm ready for that yet. I loved the Apollo navigation details - something you don't find in popular accounts of the Apollo project.

The following comments refer to 1987 edition. Some of these comments were communicated to Professor Battin, who, very kindly, acknowledged them.The book by Richard H. Battin, Adjunct Professor of Aeronautics and Astronautics, Massachusetts Institute of Technology, USA, covers essential mathematical background needed to work with astrodynamical problems. Topics covered include hypergeometric functions, elliptic integrals, continued fractions, coÃƒÂ¶rdinate transformations as well as essentials of two-body-central-force motion.The author's way of discussing these topics with historical introduction and personal narrative makes the book interesting to read. There are minimal typographical errors, probably, because the book was, personally, typeset by the author. However, there are a few omissions and oversights. For example, on page 172 captions are given for Fig. 4.15 and Fig. 4.16, whereas the actual figures are missing (The author has rectified this omission in the 1999 edition). In addition:a) On page 7, it is stated: (DELTA)r[VECTOR] = v[VECTOR](SUB)g x s(SUB)g/v(SUB)gwheres(SUB)g = (INTEGRAL)v[VECTOR](SUB)g dtIn this equation, a scalar on the left-hand side is equated to a vector on the right-hand side. The equation should be modified as:s(SUB)g = MOD[(INTEGRAL)v[VECTOR](SUB)g dt]b) On pages 10-11 it is stated: "If you want to drive a vector to zero, it is sufficient to align the time rate of change of the vector with the vector itself." This is not true, in general, but only if time rate of change is negative.c) On page 13 the author tries to show that constant in the equation:[(DEL) x v(SUB)c]/(RHO) = constantvanishes by the following argument. "The demonstration concludes with an argument that the fluid is converging on the target point r(SUB)T so that the density in the vicinity r(SUB)T of is becoming infinite. Hence, the constant is zero." There are 2 problems in this line of argument: (i) The statement, "Hence, the constant is zero" is true, only if the numerator is finite. B = infinity, implies A/B = 0, only if A is not equal to infinity. Otherwise, one has to apply l'Hospital rule; (ii) even if the constant is supposed to be zero, this does not imply that the curl is everywhere zero. A/B = 0, where B = infinity does not imply that A = 0. In fact, a could have any finite value.d) On page 109 equation of motion in a frame of reference moving with acceleration -a(SUB)1 is written as:m(SUB)2[a(SUB)2 - a(SUB)1] = ...Since the frame is noninertial (accelerated) Newton's second law, F = ma, is not applicable in his frame.e) On page 223 it is stated: "When we compare Eqns. (5.57) and (5.58), it is clear that we must havesinE = SQRT[6(E - sinE)/sinE]."This is not the only choice for sinE, which reduces (5.58) to (5.57) in the limit E tends to 0. The word "must" is inappropriately used here.I would recommend this book very strongly to anyone seriosly interested in learning astrodynamics.

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