JOURNAL OF GUIDANCE, CONTROL, AND DYNAMICS
Vol. 20, No. 4, July–August 1997

Book Review

Publishers are invited to send books for review to Dr. I: Michael Ross; Code: AA/Ro; Department of Aeronautics and Astronautics; Naval Postgraduate School; Monterey; CA 93943:

Dynamics of Flight: Stability and Control; **Third Edition**

Bernard Etkin and Lloyd Duff Reid; Wiley; New York; 1996; 382 pp:; $96:95;
ISBN 0-471-03418-5

Since the late 1950s; Bernard Etkin's texts have served as standard fare for students of flight mechanics: Discussions of static stability; stability and control derivatives; and dynamic flight modes were well constructed and complete; if sometimes terse: Notation; the bugaboo of undergraduate engineering students; was remarkably consistent and clear. Complaints of educators were few but notorious: too few examples and no practice problems:

The recent shift to the use of dimensional derivatives with equations of motion expressed in state-space format has perhaps prompted Etkin and his coauthor to produce an updated third edition of the now-classic text: The new book solves the few shortcomings of the earlier edition and provides a teaching tool more readily usable by the engineering educator. The working engineer requiring an introduction to the field will find the new edition slightly more approachable; yet the gist of the text remains as it was in the earlier edition: Except for solution techniques; basic open-loop flight mechanics has not changed since Perkins and Hage or McRuer; Ashkenas; and Graham penned their texts on the subject:

Sections on static stability and control in Chapters 1–3 remain almost completely unchanged: The addition of exercises at the ends of the chapters will be warmly received by students and instructors: The movement of all references from individual chapters to a section at the end of the text alleviates the past need to search randomly to find a listing for a desired text; but the continued inclusion of a piecemeal nomenclature; chapter by chapter; may get a mixed response from those preferring an all-encompassing list of variables at the beginning of the book: Longitudinal static stability is adequately presented in Chapter 2; Chapter 3 introduces longitudinal maneuvering stability; that gray area between statics and dynamics; and also directional and lateral static stability: Some students may have seen static stability in a course combined with aircraft performance taken prior to one in flight dynamics; and the first three chapters will serve to refresh them of the material and the nomenclature:

The derivations of the general equations of motion in Chapter 4 have been improved with a linear-algebra; rather than solely vector-analysis; approach: This time the equations have been left in dimensional form for direct application to linear-system software such as MATLAB®: Some may prefer the use of angle of attack and sideslip angle rather than the velocity components as choices of state variables; but the transition to a preferred format is straightforward once the state-space system has been presented: The development of the stability derivatives presented in Chapter 5 remains relatively unchanged: Minor wording changes in the text can be noted frequently; indicating that Etkin and Reid have made an effort to review the complete material; leaving well enough alone when the information is well presented and making broader improvements when warranted:

In Chapter 6 the authors present the dynamics of disturbed motion for both longitudinal and lateral-directional flight; as opposed to their previous practice of dividing the material into separate chapters: Because of the similarity of solving the uncoupled sets of linear time-invariant equations by the matrix approach; this works well: The eigenvalue/eigenvector solution is more clearly presented than was done previously: The distinction between static stability from solely a static point of view (referred to here as "stiffness") and static stability as the presence of a positive real root of the characteristic equation may confuse the student at first; but this confusion has existed in the past—it just has not been effectively brought to light in most texts: Such a discussion is an example of the small but helpful improvements made throughout the new edition: On the other hand; though valuable examples are presented for the Boeing 747; data are provided for only that one aircraft in the Appendices; limiting the sample database from which the student can choose for solving practice problems: Data are available from other sources—most commonly; ironically; from other flight dynamics texts:

The discussion of analytical tools is now an Appendix rather than an intermediate chapter, as was done previously: As the math background of the student is expected to be stronger than it was 15 years ago; this move makes good sense: Chapter 7 presents the airplane response to control inputs: The material includes a clearer presentation of responses to impulse and step commands as well as to sinusoidal inputs; with the elimination of the nondimensional time used previously: General first- and second-order responses are shown; placing the aircraft modes in perspective: The chapter has been greatly improved to be compatible with modern matrix solution techniques: Bode plots now include the responses from approximations to the flight modes as well as the full solutions; providing insight into their range of application and their limitations:

Chapter 8 on closed-loop systems serves as an introduction to that field; which the student will probably get elsewhere: However; the examples of pitch-attitude; speed; and altitude controllers and a yaw-damper design provide a reinforcement of the applications to aircraft flight mechanics usually missing from the broad texts commonly used as a first course in control theory:

In summary; the new edition of *Dynamics of Flight*; though in whole almost identical in material coverage to its earlier version; has been carefully reworked to enhance the readability of the text and to place the material in the modern context of state-space methods: Exercises included at each chapter's end now facilitate the student's ability to practice the material: Ironically; the quality of the figures suffers in the new edition; perhaps from cost-savings measures in new publication requirements: In any case; the new edition will most likely serve as the text of choice in the field of flight dynamics through the coming decade:

Richard M: Howard
U:S: Naval Postgraduate School