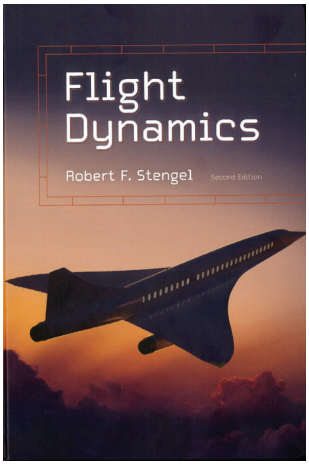

Flight Dynamics, 2nd edition. Robert F. Stengel. Princeton University Press, 41 William Street, Princeton, New Jersey 08540; and 99 Banbury Road, Oxford OX2 6JX. 2022.

Flight Dynamics (*2nd edn*) by R. F. Stengel is one of several appealing books[1–5] on the subject to be published internationally in the last decade. It showcases Stengel's decades of academic experience and familiarity with the subject. The release of the second edition of this book is testimony to the success and wide acceptance of the first edition.

The main addition to this edition is a chapter dealing with flight control, which takes up nearly a fifth of the book. The focus is on linear quadratic methods and the Kalman filter, mostly based on the author's research experience, briefly mentioning neural nets, nonlinear dynamic inversion (but no back-stepping), and adaptive methods. The rest of the book largely retains the structure and contents of the first edition, focusing mainly on the flight dynamics of fixed-wing aeroplanes. The presentation is quite traditional. About a third of the book contains introductory material, covering preliminaries on aerodynamics and propulsion, along with a primer on linear systems. There is also a section on aircraft performance. The meat of the book, about 40 per cent of the length, is devoted to deriving the 6-degree-of-freedom equations of motion for rigid aircraft, followed by the usual route of decoupling, longitudinal modes and their dynamics, and then likewise for the lateral-directional motions. A subsequent chapter discusses coupled lateral-directional dynamics. The appendix lists MATLAB codes for flight simulation and linear system analysis/control design that are available online. Additionally, a set of exercise problems is provided in an appendix.

Chapter 7 on 'Coupled longitudinal and lateral-directional motions' is the weak link in the book. The use of bifurcation methods for analysing aircraft flight dynamics has arguably been the most significant development in the field in recent decades, but the book does not do justice to this topic. Most of the chapter is spent on rapid roll manoeuvres, whereas the presentation of high-alpha flight phenomena, especially spin, appears outdated.

At nearly 900 pages, the book may be daunting to a novice in the field. As the author himself remarks, the contents of the book are too much for a one-semester course. He has helpfully suggested a sample syllabus which, along with accompanying online pedagogical material, may aid the instructor in drafting the contents and teaching a first course on flight dynamics. However, the material in '*Chapter 8: Flight Control Design*' may not be entirely appropriate in universities that offer a single undergraduate course covering flight dynamics and flight control. The instructor then must choose to use this book for only part of the semester or go with another text altogether.

As a mathematical presentation of the theory of aircraft flight dynamics, this is a comprehensive and well-crafted work. A positive aspect is a mention of 'residualization' on pages 297–298 in the context of using the static residual of the faster mode when deriving the literal approximation to the slower mode. Unfortunately, the author omits citing the original paper[6], where this concept was first used to derive the aircraft modal equations. Also, eventually, the author does not use the static residual when deriving the expressions for modal frequency and damping, as in 'Section 5.2: Reduced-order models of long-period modes', for example.

All in all, this book is a welcome addition to any library. It will be a valuable resource for both academics and personnel in the industry. The second edition has appeared 18 years after the first edition's release. Let us hope there will be a third edition sooner rather than later with many more exciting topics, such as thrust vector control, hypersonic flight, and stealth aircraft, to name a few.

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