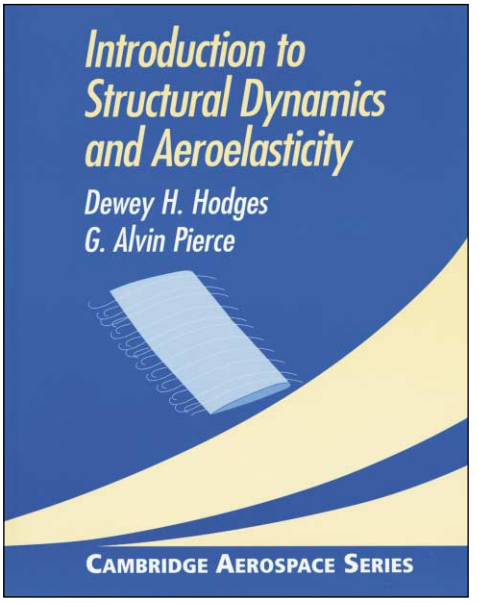
Aerospace series covers aeroelasticity

Introduction to Structural Dynamics and Aeroelasticity, Dewey H. Hodges and G. Alvin Pierce, Cambridge Aerospace Series, $82.50, hardcover, ISBN: 0521806984, 182 pp, Cambridge University Press.

Understanding aeroelastic and structural dynamics phenomena is essential for aerospace and mechanical engineers. There are valuable reference books in this subject by authors such as Dowell, Fung, Bisplinghoff, Ashley, Halfman and Scanlon, but there is a need for a more classic introductory textbook for educational purposes. This publication helps to fill the gap in aeronautical engineering education. The text meets the need for an up-to-date treatment of structural dynamics and aeroelasticity for advanced undergraduate aerospace engineering students. In conjunction with other references, it can also be used in a graduate level course.



The book offers a concise, well-written introduction to main topics in linear aeroelasticity and a few significant effects of nonlinearities. Following its introduction, three major chapters of the book deal with topics of structural dynamics, static aeroelasticity and aeroelastic flutter. At the end of each chapter, the authors provide several appropriate and much needed problem sets in aeroelasticity. The book ends with an appendix that provides a useful review of Lagrange's equations, along with a comprehensive subject index.

The first chapter gives a detailed explanation of the uniform string structural dynamics. Though the string may not have direct aeronautical application, it is a good example for explaining some basic structural dynamics concepts. The book also presents the development of the equations of motion for a uniform beam in bending and torsion. Approximate solution techniques for the equations are also presented.

In the static aeroelasticity section, three basic phenomena–divergence, aileron effectiveness/reversal and airload distribution–are explained. Aileron reversal is presented only for a two-dimensional airfoil section. Missing is a section in the aileron reversal of a three-dimensional wing model.

The fourth chapter of the book considers the general problem of lifting surface flutter. As engineering solutions for flutter, the book presents methods of flutter analysis such as the p method, the k method and the p-k method. The book then presents the application of the flutter analysis to the traditional two-degree-of-freedom wing section. In this chapter the reader is also exposed to Theodorsen's unsteady aerodynamics theory and the finite-state theory of Peters et al. Application of the assumed modes method to construct a flutter analysis of a flexible wing is demonstrated as well.

There are several topics that are not covered in the book, such as active flutter control, nonlinear aeroelasticity and state-of-the-art computational fluid dynamics and finite elements methods. These subjects play a significant role in modern aeroelasticity and should be introduced in a graduate-level course. Such topics, however, are beyond the scope of this book. The authors' goal is to provide an educational resource in structural dynamics and aeroelasticity for advanced undergraduate aerospace engineering students–and they accomplish the goal very well.

The book is well-written and has excellent illustrations. It is a solid introductory book for practising mechanical/aerospace engineers seeking a background in aeroelasticity.

Reviewed by Hekmat Alighanbari, PhD, P.Eng.
Council Chair,
Department of Aerospace Engineering,
Ryerson University