

A Modern Course in Aeroelasticity

Fifth Revised and Enlarged Edition

von
Earl H. Dowell

5. überarbeitete und erweiterte Auflage

Springer Verlag Berlin; Heidelberg 2014

Verlag C.H. Beck im Internet:
www.beck.de
ISBN 978 3 319 09452 6

Preface to the Fifth Edition

In this fifth edition, a new chapter is added, Chap. 14, Some Recent Advances in Nonlinear Aeroelasticity: Fluid-Structure Interaction in the Twenty First Century, with a discussion of some of the most recent research results that have been obtained in the last decade. Also a new author and distinguished colleague, Dr. Deman Tang, has joined us. And the opportunity has been taken to correct all the typographical errors that we and our readers have found.

With this edition, the first author is making available upon request video/audio recordings of his semester long lectures that cover Chaps. 1–4 as well as selected lectures on current research topics. It is planned to continually update these video/audio lectures and these updates will also be made available to those who purchase the new edition. Also available are lecture notes and additional homework problems and their solutions augmenting those already included in the text.

Earl H. Dowell

Preface to the Fourth Edition

In this edition, several new chapters have been added and others substantially revised and edited. Chapter 6 on Aeroelasticity in Civil Engineering originally authored by Robert Scanlan has been substantially revised by his close colleague, Emil Simiu. Chapter 9 on Modeling of Fluid-Structure Interaction by Earl Dowell and Kenneth Hall is entirely new and discusses modern methods for treating linear and nonlinear unsteady aerodynamics based upon computational fluid dynamics models and their solution. Chapter 11 by Earl Dowell, John Edwards and Thomas Strganac on Nonlinearity Aeroelasticity is also new and provides a review of recent results. Chapter 12 by Robert Clark and David Cox on Aeroelastic Control is also new and provides an authoritative account of recent developments. Finally Chapter 13 by Kenneth Hall on Modern Analysis for Complex and Nonlinear Unsteady Flows in Turbomachinery is also new and provides an insightful and unique account of this important topic. Many other chapters have been edited for greater clarity as well, and author and subject indices are also provided.

Dr. Deman Tang has provided invaluable contributions to the production of the text, and all of the authors would like to acknowledge his efforts with great appreciation.

Earl H. Dowell

Preface to the Third Edition

The authors would like to thank all those readers of the first and second editions who have written with comments and suggestion. In the third edition, the opportunity has been taken to revise and update Chapters 1 through 9. Also three new chapters have been added, i.e., Chapter 10, Experimental Aeroelasticity, Chapter 11, Nonlinear Aeroelasticity; and Chapter 12, Aeroelastic Control. Chapter 10 is a brief introduction to a vast subject; Chapter 11 is an overview of a frontier of research; and Chapter 12 is the first connected, authoritative account of the feedback control of aeroelastic systems. Chapter 12 meets a significant need in the literature. The authors of the first and second editions welcome two new authors, David Peters who has provided a valuable revision of Chapter 7 on rotorcraft, and Edward Crawley who has provided Chapter 10 on aeroelastic control. It is a privilege and a pleasure to have them as members of the team. The author of Chapter 10 would also like to acknowledge the great help he has received over the year from his distinguished colleague, Wilmer H. “Bill” Reed, III, in the study of experimental aeroelasticity. Mr. Reed kindly provided the figures for Chapter 10. The author of Chapter 12 would like to acknowledge the significant scholarly contribution of Charrissa Lin and Ken Kazarus in preparing the chapter on aeroelastic control. Finally the readers of the first and second editions will note that the authors and subject indices have been omitted from this edition. If any reader finds this an inconvenience, please contact the editor and we will reconsider the matter for the next edition.

Earl H. Dowell

Preface to the Second Edition

The authors would like to thank all those readers who have written with comments and errata for the first edition. Many of these have been incorporated into the second edition. They would like to thank Professor Holt Ashley of Stanford University who has been most helpful in identifying and correcting various errata.

Also the opportunity has been taken in the second edition to bring up-to-date several of the chapters as well as add a chapter on unsteady transonic aerodynamics and aeroelasticity. Chapters 2, 5, 6 and 8 have been substantially revised. These cover the topics of Static Aeroelasticity, Stall Flutter, Aeroelastic Problems of Civil Engineering Structures and Aeroelasticity in Turbomachines, respectively. Chapter 9, Unsteady Transonic Aerodynamics and Aeroelasticity, is new and covers this rapidly developing subject in more breadth and depth than the first edition. Again, the emphasis is on fundamental concepts rather than, for example, computer code development per se. Unfortunately due to the press of other commitments, it has not been possible to revise Chapter 7, Aeroelastic Problems of Rotorcraft. However, the Short Bibliography has been expanded for this subject as well as for others. It is hoped that the readers of the first edition and also new readers will find the second edition worthy of their study.

Earl H. Dowell

Preface to the First Edition

A reader who achieves a substantial command of the material contained in this book should be able to read with understanding most of the literature in the field. Possible exceptions may be certain special aspects of the subject such as the aeroelasticity of plates and shells or the use of electronic feedback control to modify aeroelastic behavior. The first author has considered the former topic in a separate volume. The latter topic is also deserving of a separate volume.

In the first portion of the book, the basic physical phenomena of divergence, control surface effectiveness, flutter and gust response of aeronautical vehicles are treated. As an indication of the expanding scope of the field, representative examples are also drawn from the nonaeronautical literature. To aid the student who is encountering these phenomena for the first time, each is introduced in the context of a simple physical model and then reconsidered systematically in more complicated models using more sophisticated mathematics.

Beyond the introductory portion of the book, there are several special features of the text. One is the treatment of unsteady aerodynamics. This crucial part of aeroelasticity is usually the most difficult for the experienced practitioner as well as the student. The discussion is developed from the fundamental theory underlying numerical lifting surface analysis. Not only the well-known results for subsonic and supersonic flow are covered; but also some of the recent developments for transonic flow, which hold promise of bringing effective solution techniques to this important regime.

Professor Sisto's chapter on Stall Flutter is an authoritative account of this important topic. A difficult and still incompletely understood phenomenon, stall flutter is discussed in terms of its fundamental aspects as well as its significance in applications. The reader will find this chapter particularly helpful as an introduction to this complex subject.

Another special feature is a series of chapters on three areas of advanced application of the fundamentals of aeroelasticity. The first of these is a discussion of Aeroelastic Problems of Civil Engineering Structures by Professor Scanlan. The next is a discussion on Aeroelasticity of Helicopters and V/STOL aircraft by Professor Curtiss. The final chapter in this series treats Aeroelasticity in

Turbomachines and is by Professor Sisto. This series of chapters is unique in the aeroelasticity literature, and the first author feels particularly fortunate to have the contributions of these eminent experts.

The emphasis in this book is on fundamentals because no single volume can hope to be comprehensive in terms of applications. However, the above three chapters should give the reader an appreciation for the relationship between theory and practice. One of the continual fascinations of aeroelasticity is this close interplay between fundamentals and applications. If one is to deal successfully with applications, a solid grounding in the fundamentals is essential.

For the beginning student, a first course in aeroelasticity could cover Chapters 1-3 and selected portions of 4. For a second course and the advanced student or research worker, the remaining chapters would be appropriate. In the latter portions of the book, more comprehensive literature citations are given to permit ready access to the current literature.

The reader familiar with the standard texts by Scanlan and Rosenbaum, Fung, Bisplinghoff, Ashley and Halfman and Bisplinghoff and Ashley will appreciate readily the debt the authors owe to them. Recent books by Petre¹ and Forsching² should also be mentioned though these are less accessible to an English speaking audience. It is hoped the reader will find this volume a worthy successor.

Earl H. Dowell

¹ Petre, A., Theory of Aeroelasticity. Vol. I Statics, Vol. II Dynamics. In Romanian Publishing House of the Academy of the Socialist Republic of Romania, Bucharest, 1966.

² Forsching, H.W., Fundamentals of Aeroelasticity. In German. Springer-Verlag, Berlin, 1974.

<http://www.springer.com/978-3-319-09452-6>

A Modern Course in Aeroelasticity

Fifth Revised and Enlarged Edition

Dowell, E.H.

2015, XXX, 700 p. 331 illus., 30 illus. in color., Hardcover

ISBN: 978-3-319-09452-6