GUIDED EXPLORATIONS OF THE MECHANICS OF SOLIDS AND STRUCTURES

Strategies for Solving Unfamiliar Problems

This book tackles the question: How can an engineer with a powerful finite element program but modest background knowledge of mechanics solve unfamiliar problems?

Engineering educators will find this book to be a new and exciting approach to helping students engage with complex ideas. Practicing engineers who use finite element methods to solve problems in solids and structures will extend the range of problems they can solve as well as accelerate their learning on new problems.

This book's special strengths include

- A thoroughly modern approach to learning and understanding mechanics problems
- Comprehensive coverage of a large collection of problems ranging from static to dynamic and from linear to nonlinear, applied to a variety of structures and components
- Accompanying software that is sophisticated and versatile and is available for free on the accompanying CD and from the book's Web site (www.cambridge.org/doyle)
- Ability to complement any standard finite element textbook or course in solid and structural mechanics
- The use of simple models to understand complex problems

James F. Doyle is a professor in the School of Aeronautics and Astronautics at Purdue University. His main area of research is in experimental mechanics with an emphasis on the development of a new methodology for analyzing impact and wave propagation in complicated structures. The goal is to be able to extract the complete description of the wave and the dynamic system from limited experimental data. Special emphasis is placed on solving inverse problems by integrating experimental methods with computational methods (primarily finite element–based methods). He is a dedicated teacher and pedagogical innovator. He is the winner of the Frocht Award for Teaching and the Hetenyi Award for Research, both from the Society for Experimental Mechanics. Professor Doyle is a Fellow of the Society for Experimental Mechanics. This is his fifth book, after *Propagation in Structures*, Second Edition; *Static and Dynamic Analysis of Structures*; *Nonlinear Analysis of Thin-Walled Structures*; and *Modern Experimental Stress Analysis*.

Cambridge Aerospace Series

Editors: Wei Shyy and Michael J. Rycroft

1. J. M. Rolfe and K. J. Staples (eds.): Flight Simulation
2. P. Berlin: The Geostationary Applications Satellite
3. M. J. T. Smith: Aircraft Noise
4. N. X. Vinh: Flight Mechanics of High-Performance Aircraft
5. W. A. Mair and D. L. Birdsall: Aircraft Performance
6. M. J. Abzug and E. E. Larrabee: Airplane Stability and Control
7. M. J. Sidi: Spacecraft Dynamics and Control
8. J. D. Anderson: A History of Aerodynamics
9. A. M. Cruise, J. A. Bowles, C. V. Goodall, and T. J. Patrick: Principles of Space Instrument Design
10. G. A. Khoury and J. D. Gillett (eds.): Airship Technology
11. J. Fielding: Introduction to Aircraft Design
12. J. G. Leishman: Principles of Helicopter Aerodynamics, 2nd Edition
13. J. Katz and A. Plotkin: Low Speed Aerodynamics, 2nd Edition
14. M. J. Abzug and E. E. Larrabee: Airplane Stability and Control: A History of the Technologies that Made Aviation Possible, 2nd Edition
15. D. H. Hodges and G. A. Pierce: Introduction to Structural Dynamics and Aeroelasticity
16. W. Fehse: Automatic Rendezvous and Docking of Spacecraft
17. R. D. Flack: Fundamentals of Jet Propulsion with Applications
18. E. A. Baskharone: Principles of Turbomachinery in Air-Breathing Engines
19. D. D. Knight: Numerical Methods for High-Speed Flows
20. C. Wagner, T. Hüttl, and P. Sagaut: Large-Eddy Simulation for Acoustics
21. D. Joseph, T. Funada, and J. Wang: Potential Flows of Viscous and Viscoelastic Fluids
22. W. Shyy, Y. Lian, H. Liu, J. Tang, and D. Viieru: Aerodynamics of Low Reynolds Number Flyers
23. J. H. Saleh: Analyses for Durability and System Design Lifetime
24. B. K. Donaldson: Analysis of Aircraft Structures, 2nd Edition
25. C. Segal: The Scramjet Engine: Processes and Characteristics
26. J. F. Doyle: Guided Explorations of the Mechanics of Solids and Structures

Guided Explorations of the Mechanics of Solids and Structures

STRATEGIES FOR SOLVING UNFAMILIAR PROBLEMS

James F. Doyle
Purdue University

CAMBRIDGE
UNIVERSITY PRESS

CAMBRIDGE UNIVERSITY PRESS
Cambridge, New York, Melbourne, Madrid, Cape Town, Singapore, São Paulo, Delhi

Cambridge University Press
32 Avenue of the Americas, New York, NY 10013-2473, USA

www.cambridge.org
Information on this title: www.cambridge.org/9780521896788

First published 2009

Printed in the United States of America

A catalog record for this publication is available from the British Library.

Library of Congress Cataloging in Publication data

Doyle, James F., 1951–
Guided explorations of the mechanics of solids and structures : strategies for solving unfamiliar problems / James F. Doyle.
p. cm. – (Cambridge aerospace series ; 26)
Includes bibliographical references and index.
ISBN 978-0-521-89678-8 (hardback)
1. Structural engineering – Problems, exercises, etc. 2. Structural engineering – Mathematics. 3. Engineering mathematics. 4. Finite element method.
5. Geometry, Solid. I. Title. II. Series.
TA640.4.D69 2009
624.1076 – dc22 2009002801

ISBN 978-0-521-89678-8 hardback

This book is dedicated to ALL
who have shared the ARC
at the LBC.

Contents

GUIDED EXPLORATIONS OF THE MECHANICS OF SOLIDS AND STRUCTURES