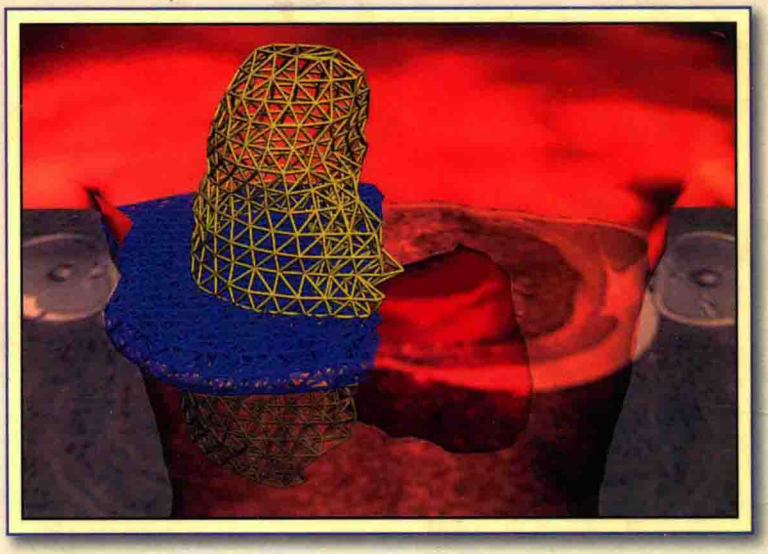

INTRODUCTION TO BIOMEDICAL ENGINEERING

JOHN ENDERLE

SUSAN BLANCHARD

JOSEPH BRONZINO

ACADEMIC PRESS

INTRODUCTION TO BIOMEDICAL ENGINEERING

John D. Enderle
University of Connecticut
Storrs, Connecticut

Susan M. Blanchard
North Carolina State University
Raleigh, North Carolina

Joseph D. Bronzino
Trinity College
Hartford, Connecticut

ACADEMIC PRESS

A Harcourt Science and Technology Company

San Diego London Boston New York Sydney Tokyo Toronto

Cover Image
A collage of the geometric model construction process. Starting from magnetic resonance images, a geometric model of the human thorax is constructed by segmenting the images, triangulating surfaces (such as the lung, shown in yellow), and tetrahedralizing the volume (shown in blue). A shaded view of a portion of the torso is shown in bronze, while a view of the ventricles of the heart are shown in red.

Photograph courtesy of Chris Johnson, Rob MacLeod, and Mike Matheson
University of Utah

This book is printed on acid free paper. ♾

ACADEMIC PRESS
A Harcourt Science and Technology Company
525 B Street, Suite 1900, San Diego, CA 92101-4495, USA
http://www.academicpress.com

ACADEMIC PRESS
24–28 Oval Road, London NW1 7DX, UK
http://www.hbuk.co.uk/ap/

Library of Congress Cataloging-in-Publication Data

Introduction to biomedical engineering/[editors] John D. Enderle, Susan M. Blanchard, Joseph D. Bronzino
p. cm. — (Academic Press series in biomedical engineering)
ISBN 0-12-238660-4
1. Biomedical engineering. I. Enderle, John D. II. Blanchard, Susan M.
III. Bronzino, Joseph D.
IV. Series.
R856.I47 1999
610´.28—dc21 98-38976
CIP

Printed in the United States of America
99 00 01 02 03 MB 9 8 7 6 5 4 3 2 1

INTRODUCTION TO BIOMEDICAL ENGINEERING

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The series editor, Joseph Bronzino, is one of the most renowned biomedical engineers in the world. Joseph Bronzino is the Vernon Roosa Professor of Applied Science at Trinity College in Hartford, Connecticut.

This is a volume in
BIOMEDICAL ENGINEERING

JOSEPH BRONZINO, SERIES EDITOR
TRINITY COLLEGE, HARTFORD CONNECTICUT

DEDICATION

This book is dedicated to our families.

PREFACE

The purpose of this textbook is to serve as an introduction to and overview of the field of biomedical engineering. During the past 50 years, as the discipline of biomedical engineering has evolved, it has become clear that it is a diverse, seemingly all-encompassing field that includes such areas as biomechanics, biomaterials, bioinstrumentation, medical imaging, rehabilitation engineering, biosensors, biotechnology, and tissue engineering. Although it is not possible to cover all the biomedical engineering domains in this textbook, we have made an effort to focus on most of the major fields of activity in which biomedical engineers are engaged.

The text is written primarily for engineering students who have completed differential equations and basic courses in statics, dynamics, and linear circuits. Students in the biological sciences, including those in the fields of medicine and nursing, can also read and understand this material if they have the appropriate mathematical background.

Although we do attempt to be rigorous with our discussions and proofs, our ultimate aim is to help students grasp the nature of biomedical engineering. Therefore, we have compromised when necessary and have occasionally used less rigorous mathematics in order to be more understandable. A liberal use of illustrative examples amplifies concepts and develops problem-solving skills. Throughout the text, MATLAB (a matrix equation solver) and SIMULINK (an extension to MATLAB for simulating dynamic systems) are used as computer tools to assist with problem solving.

Chapters are written to provide some historical perspective of the major developments in a specific biomedical engineering domain as well as the fundamental

principles that underlie biomedical engineering design, analysis, and modeling procedures in that domain. In addition, examples of some of the problems encountered, as well as the techniques used to solve them, are provided. Selected problems, ranging from simple to difficult, are presented at the end of each chapter in the same general order as covered in the text.

The material in this textbook has been designed for a one-semester, two-semester, or three-quarter sequence depending on the needs and interests of the instructor. Chapter 1 provides necessary background to understand the history and appreciate the field of biomedical engineering. Then, the text divides naturally into two parts, physiological systems and modeling (Chapters 2–10) and technology (Chapters 11–19). Serving as a capstone, Chapter 20 addresses the moral and ethical issues associated with the field of biomedical engineering.

John D. Enderle, Susan M. Blanchard,
Joseph D. Bronzino

ACKNOWLEDGMENTS

We would like to acknowledge Joel Claypool and Diane Grossman from Academic Press for their continued support and encouragement and to Kelly Ricci and Lana Traver from the PRD Group for their support.

We would also like to thank all those who have provided input to the development of the various chapters in this textbook.

CONTRIBUTORS

Numbers in parentheses indicate chapters of authors' contribution(s).

Susan M. Blanchard (2,5,6,13)
North Carolina State University
Raleigh, North Carolina

Joseph Bronzino (1,14,19,20)
Trinity College
Hartford, Connecticut

Stan Brown (11)
Food and Drug Administration
Gaithersburg, Maryland

Gerard Coté (17)
Texas A&M University
College Station, Texas

Roy B. Davis III (9)
Shriners Hospitals for Children
Greenville, South Carolina

John D. Enderle (3,7)
University of Connecticut
Storrs, Connecticut

R. J. Fisher (8)
University of Connecticut
Storrs, Connecticut

Carol Lucas (6)
University of North Carolina at Chapel Hill
Chapel Hill, North Carolina

Amanda Marley (5)
North Carolina State University
Raleigh, North Carolina

Yitzhak Mendelson (4)
Worcester Polytechnic Institute
Worcester, Massachusetts

Katherine Merritt (11)
Food and Drug Administration
Gaithersburg, Maryland

H. Troy Nagle (5)
North Carolina State University
Raleigh, North Carolina

Joseph Palladino (9)
Trinity College
Hartford, Connecticut

Bernhard Palsson (12)
University of California at San Diego
LaJolla, California

Sohi Rastegar (17)
Texas A&M University
College Station, Texas

Daniel Schneck (10)
Virginia Polytechnic Institute & State University
Blacksburg, Virginia

Kirk K. Shung (15)
Pennsylvania State University
University Park, Pennsylvania

Anne-Marie Stomp (13)
North Carolina State University
Raleigh, North Carolina

Andrew Szeto (18)
San Diego State University
San Diego, Carolina

LiHong Wang (17)
Texas A&M University
College Station, Texas

Steven Wright (16)
Texas A&M University
College Station, Texas

Melanie T. Young (6)
North Carolina State University
Raleigh, North Carolina

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