



INTRODUCTION TO BIOMEDICAL ENGINEERING

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ACADEMIC PRESS

INTRODUCTION TO BIOMEDICAL ENGINEERING

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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

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ACADEMIC PRESS

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The focus of this series will be twofold. First, the series will produce a series of core text/references for biomedical engineering undergraduate and graduate courses. With biomedical engineers coming from a variety of engineering and biomedical backgrounds, it will be necessary to create a new cross-disciplinary teaching and self-study books. Secondly, the series will also develop handbooks for each of the major subject areas of biomedical engineering.

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

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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

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- 1.5 Professional Status of Biomedical Engineering
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 - 1.6.1 American Society for Clinical and Biomedical Engineering
 - 1.6.2 The Engineering in Medicine and Biology Society (EMBS)
 - 1.6.3 Engineering and Technology for Medicine and Healthcare (ETMHC) Society
- Exercises
- Suggested Reading

At the conclusion of this chapter, readers will be able to:

- a. Identify the major role that engineers in medicine have played in the development of the modern health care system
- b. Define what is meant by biomedical engineering and the roles biomedical engineers play in the health care delivery system
- c. Explain the professional engineers and professionals

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