

# Preface

This book provides a detailed discussion of the synergy between biology and engineering and the promise this convergence holds for advancing our understanding and practice of medicine. It is this complementary relationship between new discoveries in biology and the precise, quantitative, and predictable nature of engineering that underlies the significant advances described in each of chapters. When I was a young researcher, this type of multidisciplinary research was unprecedented. During the past decade I have been gratified to see it emerge and be validated as a powerful approach for addressing challenges in translational medicine.

The goal of this book is to highlight how invaluable engineering has become by describing an extensive range of fields. This book is organized into five parts, covering engineering of biological systems in the first two sections, followed by nanotechnology approaches and advances in instrumentation and concluding with the emerging field of theranostics. Although not written in the form of a college textbook, this book is well-suited for graduate students and researchers alike as the chapters contain both didactic materials and research findings.

It is impossible to describe all the areas where engineering has had an impact on medicine. The biology of living systems is extremely complex involving interactions over many spatial and temporal scales. For example, assessment of the structural and mechanical relationship of dynamic cell–cell interactions has been informed by quantitative metrics and engineering principles. Such interactions are vital to cellular processes and underpin the mechanism of disease such as cancer as evidenced by cell proliferation, cell adhesion, and extravasation of tumor cells in metastasis. These and other biological processes are discussed in this book from the perspective of engineering and the synergic impact with biology toward advances in medicine. The aim of each chapter is not to provide a complete survey, but to provide a commentary on the advances currently being made, to give the reader a sense of the opportunities and challenges in each field while providing extensive references to permit the interested reader to learn more about a particular subject or advance.

There are common challenges running through the book related to sensitivity, specificity, and efficacy that underlie the need for systematic and quantitative solutions. There are also disease-specific challenges that are highlighted, involving diagnosis, monitoring, and treatment. The targeted delivery of therapy has

emerged as one crucial area for engineering to have an impact. This book devotes several chapters on the various delivery systems and includes discussions of the increasing adoption of targeted versus systemic approaches. Topics include delivery system designs, cell entry, drug clearance, biodistribution, cellular absorption, etc.

As well as treating disease, engineering also holds the promise of renewing function. Regenerative medicine and tissue engineering are discussed through the book, highlighting another broad area where engineering approaches are leading to significant advances. For example, stem cell therapies are discussed based on research with quantitative metrics of the stem cell niche, innovatively engineered scaffolds, and the biology of pluripotent cells. The convergence of these disciplines has resulted in advances in the regeneration of nerves, blood vessels, and tissue repair.

This book is the culmination of a community of dedicated scientists whose contributions to this book are invaluable. Weibo Cai has worked tirelessly over the past year to coordinate, edit, and provide a framework for each of the chapters. I am indebted to him for his efforts in promoting engineering as an indispensable component of translational medicine.

NIBIB, USA

Belinda Seto

Engineering in Translational Medicine

Cai, W. (Ed.)

2014, XIX, 999 p. 267 illus., 130 illus. in color. In 2  
volumes, not available separately., Hardcover

ISBN: 978-1-4471-4371-0