

Preface

Patient-specific modeling (PSM) is an emerging field in biomedical engineering. PSM is aimed at implementing the powerful modeling tools and techniques developed over the years by biomedical engineers and medical physicists for the benefit of patients. This is typically done by first creating a three-dimensional computational reconstruction of the anatomy of the tissues or a mathematical model of the organ of interest in the individual patient, based on imaging scans or other individualized parameters, and then by using the model for calculations that provide a diagnosis, prognosis or prediction of treatment outcomes. Hence, a particularly challenging aspect of PSM is that it requires integration of expertise from various technological and bioengineering subdisciplines, such as biosolid and biofluid mechanics, biomass transport, medical imaging, constitutive tissue modeling, numerical simulations and computer visualization to solve actual medical problems.

The PSM approach is currently being put into practice to assist in managing a wide range of different medical conditions, such as in orthopaedics, cardiology, neurology, oncology and ophthalmology. Critical issues in making PSM standard and routine are the ease of use and interpretation of data by medical staff, as well as successful validation of the predicted outcome measures, which are all significant barriers for PSM technologies to become clinically acceptable. Substantial research efforts are underway worldwide to resolve these issues, and it does appear that PSM technologies will eventually become an integral part of modern medicine, as PSM can be naturally combined with common imaging examinations such as MRI, CT or ultrasound scans. This book reviews the frontier of research and clinical applications of PSM, and provides a comprehensive and rigorous update as well as perspectives on future directions in this exciting field.

The frontier in PSM research is presented in this volume through contributions of internationally leading groups in this field, from the US, Australia, New Zealand, Israel and five different European countries. The book is useful for medical physicists, computer scientists, biomedical engineers and other engineers who are interested in the science and technology aspects of PSM, as well as for medical specialists such as radiologists, orthopaedists, cardiologists and others who wish to

be updated about the state of implementation. Academics, medical doctors and students alike can use this book to learn about the state-of-the-art and current achievements in PSM as well as on the challenges that will need to be addressed in the near future to ensure that the great promises that PSM brings are indeed put into clinical practice.

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