

# Preface

This volume focuses on the recent advances in a domain that is situated at the interface of engineering and biomedical sciences and is an excellent example of the added value of integrative research: computational tissue engineering. After two decades of ‘traditional’ tissue engineering research with a strong focus on the biology of the tissue engineered construct and biomaterial development, the engineering side of the field is finally becoming exploited to its fullest potential. A common engineering approach when designing any kind of product or manufacturing process, from food to the chemical to the automotive industry, is to use in silico models of the product and/or the manufacturing process. These models, based on physical, mechanical, or (bio)chemical laws/equations and/or experimental data, are used in order to minimize the variability, optimize the overall process, and increase the quantity and quality of the final result. Accordingly, the chapters in the book fall under the following categories: computational tools for product design, computational tools for process design, and computational tools for the study of in vivo processes. The underlying tissue engineering applications will vary from blood vessels to trachea to cartilage and bone. For the chapters describing examples of the first two areas, the main focus is on (the optimization of) mechanical signals, mass transport, and fluid flow encountered by the cells in scaffolds and bioreactors as well as on the optimization of the cell population itself. In the chapters describing modeling contributions in the third area, the focus will shift toward the biology, the complex interactions between biology and the micro-environmental signals, and the ways in which modeling might be able to assist in investigating and mastering this complexity. The chapters cover issues related to (multiscale/multiphysics) model building, training and validation, but also discuss recent advances in scientific computing techniques that are needed to implement these models as well as new tools that can be used to experimentally validate the computational results.

The research groups which contributed to this book, from 10 different countries—mostly in USA/Canada and Europe—are all very well known internationally for their fundamental contributions to the field of computational tissue engineering, and the book as a whole therefore represents the state of the art of

research in computational tissue engineering. The book also nicely demonstrates how computational tissue engineering research not only benefits from but also contributes to advances in other fields such as biomedical sciences, applied mathematics and computer sciences, material sciences, nanotechnology and bio-informatics. Faculty and students with interest in these fields should find this book an excellent source of information indicating where computational tissue engineering research brought us so far, and what are some of the open questions that wait to be answered.

Finally, I would like to take this opportunity to pay my tributes to Christian Oddou (1938–2011) who passed away unexpectedly last year. Only shortly before his death we had been discussing his contribution to this book which would have been, without a doubt, a valuable one. His warmth, kindness, passion and enthusiasm for anything related to biomechanics and computational tissue engineering will surely be missed.

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