

Preface

The application of methodological approaches and mathematical formalisms proper of Physics and Engineering to investigate and describe biological processes and design biological structures has led to the development of many disciplines in the context of computational biology and biotechnology. The most known applicative domain is tissue engineering and its branches, such as biomaterials and regenerative medicine, tissue regeneration and growth: models, simulations, experiments; cardiac mechanics; mechanics of articulations; biomedical implants and devices: mechanics and interactions with tissues; biofluid mechanics and circulatory system.

Other more recent domains of interest are in the field of biophysics, e.g., multiscale mechanics of biological membranes and films and filaments; multiscale mechanics of adhesion; biomolecular motors and force generation. Finally, it is worth to mention the application of physical methodologies and principles to the study of biological processes and micro- and nano-scale, e.g., physics of cell mechanics, cancer physics; physics of chemotaxis; protein conformation dynamics; DNA conformation dynamics; biophysics of polymer dynamics; physics of transport phenomena in cells and tissues.

For more than 20 years, numerous theories, methods, and software tools were proposed in almost all these fields. Nevertheless more modern hypotheses, models, and tools are currently emerging and resulting from the convergence of the methods and philosophical approaches of the different research areas and disciplines. All these emerging approaches share the purpose of disentangling the complexity of organisms, tissues, and cells and mimicking the function of living systems.

The contributions presented in this book are current research highlights of six challenging and representative applicative domains of physical, engineering, and computational approaches in medicine and biology, i.e., tissue engineering, modeling of molecular structures, cell mechanics and cell adhesion processes,

cancer physics, and physico-chemical processes of metabolic interactions. Each chapter presents a compendium or a review of the original results achieved by authors in the past years. Furthermore, the book also wants to pinpoint the questions that are still open and that could propel the future research.

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