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PREFACE

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PREFACE

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Many new computational and experimental techniques are currently being developed in the fields of biomechanics and biomaterials, and new applications are emerging, including multiscale theoretical modeling, nanoindentation and nanotribology, single cell mechanics and mechanotransduction, biomolecular mechanics and the synthesis and design of new biomimetic architectures. These recent advances have enhanced the development of engineered materials for nonbiological applications, providing new avenues for diagnosis and treatment of diseases.

In this special issue of *Journal of Mechanics of Materials and Structures*, we have assembled a number of recent studies in the field of mechanics of biomaterials at multiple length scales, ranging from a detailed hierarchical atomistic simulations of proteins to multiscale computational models for mechanics of encapsulated cells. Several review articles are also included which highlight the state of the art in biomechanics and biomaterials.

In “Spontaneous unwinding of a labile domain in a collagen triple helix”, Ravikumar et al. present a molecular dynamics simulation of the thermal unwinding behavior of collagen triple helix, showing a possibility for spontaneous local unwinding of collagen at physiological temperatures.

In “Particle collision and adhesion under the influence of near-fields”, Zohdi presents a relatively simple but predictive theory for relating the impact velocity needed for adherence of two microscopic particles. This study has direct implications for our understanding of the mechanisms of particle collision in many biomechanical applications.

In “Hierarchical chemo-nanomechanics of proteins: entropic elasticity, protein unfolding and molecular fracture”, Buehler develops a multiscale simulation approach to study large deformation and fracture of three protein structures. The results decipher some of the key aspects of mechanical behavior of chemically complex protein materials, including their unfolding behavior and fracture.

In “Micromechanical properties of chondrocytes and chondrons: relevance to articular cartilage tissue engineering”, Ofek and Athanasiou provide a comprehensive review of the studies on micromechanical properties of chondrocytes and chondrons. The implications of these studies in understanding the state of human health and disease, as well as their potential applications in developing engineered articular cartilage, are highlighted.

In “Assessment of the mechanical properties of the nucleus inside a spherical endothelial cell based on microtensile testing”, Deguchi et al. employ a microtensile experimental setup in addition to detailed finite element simulations to assess the mechanical properties of the nucleus of endothelial cells, providing a quantitative comparison of the mechanical properties of endothelial cells and intact nuclei.

In “Microscale hydrogels for medicine and biology: Synthesis, characteristics and applications”, Rivest et al. provide a broad review of the approaches used to synthesize and characterize miscroscale hydrogels as well as their applications in different biomedical fields, including tissue engineering, drug delivery and biosensors. Potential future applications of these materials are also highlighted.

In "A multilevel numerical model quantifying cell deformation in encapsulated alginate structures", Nair et al. provide a multiscale nonlinear finite element approach to study the mechanics of encapsulated cells. The microscale mechanics of individual cells are linked to the macrolevel mechanics of alginate cell constructs, providing insight into the interaction of tissue scaffold with living cells.

In "Modeling bone resorption using Mixture Theory with chemical reactions", Rouhi et al. present a biphasic mixture model for studying the cellular mechanisms of bone resorption, elucidating the main biochemomechanical factors contributing to the rate of bone resorption.

In "The mechanics of tip growth morphogenesis: what we have learned from rubber balloons", Bernal et al. demonstrate how a tubular rubber balloon offer a useful physical model for studying tip growth morphogenesis. A simple model of tip growth is proposed which provides insight into the underlying mechanisms of the morphogenesis of plants, fungal, and bacterial cells.

In "Continuum-based computational methods in cell and nuclear mechanics", Vaziri et al. provide an overview of the current continuum-based computational models in the field of cell and nuclear mechanics, while recent developments and current trends in multiscale computational models in the field are also highlighted.

In "Quantitative Evaluation of Mechanical Properties of Cell Membranes: An Exact Solution", Baesu et al. propose a simple but effective approach for measuring the mechanical properties of cell membranes. The proposed approach combines atomic force microscopy experimentation with a biomechanical model of the cell membrane to yield mechanical properties of the membrane.

These studies are broad examples of recent advances in some of the most important areas of biomechanics and biomaterials. Our hope is that the articles presented in this special issue will further enhance the increasing interest in these interdisciplinary areas of science, engineering, and medicine.

Finally, we wish to thank Professor Charles R. Steele, Editor-in-Chief of *Journal of Mechanics of Materials and Structures* and Marie-Louise Steele, Associate Editor, for giving us the great opportunity to organize this special issue, and we thank the contributing authors for their excellent papers and also the anonymous reviewers, who helped immensely in shaping this special issue in the current form.

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