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Editorial Preface

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This Special Issue of *Experimental Mechanics* on *Experimental Advances in Mechanobiology* highlights some of the recent advances at the intersection of mechanics, biology and human health. It is now well-established that many homeostatic processes within the human body are strongly influenced, if not regulated, by mechanics, which about a decade ago led to the emergence of a new field of study coined *mechanobiology.* For example, cancer cell proliferation is often associated with local stiffening of the surrounding stromal tissue. Similarly, seminal work in the early 2000s showed how stem cells differentiate into distinct phenotypes ranging from neurons to bone cells simply by adapting to either a soft or stiff microenvironment. Traction force microscopy, a widely-used microscopy-based technique is yet another example that is based on classical continuum mechanics to reconstruct cellular traction profiles in a variety of biological investigations.

The eight articles in this Special Issue provide the reader with an overview of some of the emerging mechanics work currently conducted in cell biology, yet representing a mere glimpse of the significant role that mechanics plays in biological sciences at large. The Special Issue is divided into two sections, one focusing on the development of new experimental platforms for measuring interface, adhesion and surface traction properties of bacteria and cells, while the second section is dedicated on new advances on the characterization of gels, tissues and extracellular matrix of varying length-scale and architectural complexity. A brief summary of the work presented in each article is given below.

In *Two-Dimensional Culture Systems to Enable Mechanics-based Assays for Stem Cell-Derived Cardiomyocytes,* Notbohm et al. present a new experimental platform based on soft, micropatterned polydimethylsiloxane substrates for controlling and measuring cardiomyocyte microarchitecture and cell-matrix as well as cell-to-cell forces. Providing a similar, highly controlled microenvironment of varying stiffness for cells, Lee et al., developed a microfluidics-based platform in *Fabrication of Hydrogels with a Stiffness Gradient Using Limited Mixing in the Hele-Shaw Geometry* for generating tunable stiffness gradients in polyacrylamide, a commonly employed biological tissue mimic for cell studies. In *Mechanical Stimulation of Growth Plate Chondrocytes: Previous Approaches and Future Directions* Lee at al. provide a comprehensive review of our current understanding on how macroscopic stresses impact the local mechanics of growth plate chondrocytes within cartilage tissues, highlighting the need for more finely resolved experimental techniques at the micron scale. One attractive experimental avenue is the use of microfluidics in generating multiaxial loading states on individual cells. Finally, at a smaller scale, Boyd et al. in *Adhesion of Biofilms on Titanium Measured by Laser-induced Spallation* are providing a new innovative experimental platform for measuring the adhesion of gram-positive bacteria to titanium implant surfaces. Using laser-induced spallation the authors demonstrate the capability of this new technique to quantify bacterial adhesion to a titanium surface, an area of significant clinical concerns in particular for the employment of implant devices and catheters.

The second group of papers focuses on novel approaches to mechanically characterize the innate tissue and cell-level response. Muench et al. in *Numerical and Experimental Study of the Spatial Stress Distribution on the Cornea Surface During a Non-Contact Tonometry Examination* present a combined numerical and experimental study detailing an approach for characterizing the stress-strain response of the human eye via an idealized glass surrogate undergoing a routine non-contact tonometry exam. Moving from eye to muscle, Zhai and Chen present detailed findings on the constitutive response of porcine muscle tissue under compression at moderate strain rates (1–100 1/s) in *Compressive Mechanical Response of Porcine Muscle at Intermediate Strain Rates.* As most bodily tissues pose a general non-isotropic, inhomogeneous constitutive response, synergistic experimental, theoretical and numerical approaches are needed to address these

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complex materials. Furthermore, providing full-field kinematic and structural information is a necessary and significant step in understanding the hierarchical complexity of biological systems, and in particular, the extracellular component of the tissue, i.e., the extracellular matrix. Here, Acuna et al. in *In-situ Measurement of Native Extracellular Matrix Strain* tackle the challenging topic of acquiring full-field, volumetric data in a preserved, decellularized murine forelimb model, which is a particular showcase of nature's complex matrix structure. Using known compressive loads, fluorescent staining and digital volume correlation, Acuna et al. provide a new methodology for handling such complex material systems. Finally, to provide deeper insight into structurally-born material nonlinearities of fibrous extracellular matrices, and in particular collagen, Proestaki et al. provide a new methodology for mapping the local mechanical properties at the length scale of single cells in *Modulus of Fibrous Collagen at the Length Scale of a Cell.*

In closing, we believe that these papers provide an exciting view into the rich and complex world of mechanobiology, and the many opportunities that this area of the life sciences bears for experimental mechanics. We hope that you will enjoy reading about the challenges and intricacies associated with each of these experimental techniques and characterization approaches to help elucidate an important scientific area to human health, biology, and medicine.