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Introduction to the special issue on optics in elastography and cell mechanics

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The mechanical properties of tissues and cells have proven to be of great importance in biology and medicine, spawning major research efforts and commercial outcomes. The interplay between mechanical and biochemical cues and the mechanical properties of subcellular and cellular constituents has come to be appreciated as key to understanding many fundamental aspects of biology as well as the genesis and progression of disease. At the same time, at the other extreme, the mechanical properties of whole organs and their constituents have been shown to be effective markers of disease on the scale of the human body, as probed by ultrasound elastography and magnetic resonance elastography, both of which, after 20-year gestations, have reached commercial markets.

The role of optics in these companion fields of medical elastography and cell mechanics has been mixed. In cell mechanics, extensions of optical microscopy for the examination of single cells, such as traction force microscopy, have been important, as has atomic force microscopy, that uses optical interferometric detection of nanoindentation. In medical elastography, optics has been much less prominent. All of this has started to change over the last five years or so, as new techniques in optics emerge, and other techniques begin to mature.

At the cellular level, techniques that do not require contact, such as Brillouin microscopy, present new opportunity to explore cell mechanics non-invasively. Three articles in this Special Issue focus on novel developments in Brillouin microscopy. Cell mechanics is seeking to advance from examining single cells in two dimensions to exploring single cells, aggregates of cells, and small tissue volumes in three dimensions; optical coherence elastography represents an attractive method to achieve this, via a range of variants all applying optical coherence tomography to characterize displacement, without labelling, induced by an external load. Three articles in this Special Issue focus on optical coherence elastography.

This Special Issue, comprising nine articles in total, presents a remarkably broad range of methods and applications. A large variety of targets for elastography and related biomechanical imaging is presented, including cells, engineered tissues, small animal tissues, human cornea and non-biological lenses. Methods span the range of sizes from non-contact microscopy by particle-tracking or Brillouin microscopy, to compression (indentation) and shear wave optical coherence elastography, to ultrasound speckle tracking. Several papers target viscosity, an under-studied mechanical property, and several others target novel probes: endoscopes and indenters, and one paper targets combining modalities — in this case, Brillouin and Raman microscopy. Overall, they represent a remarkably diverse set of manuscripts touching on many of the topics of contemporary interest in this fast-growing field. We commend to you without hesitation these articles for your serious consideration.

Special Issue Editors

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References

1. S. Mattana, S. Caponi, F. Tamagnini, D. Fioretto, F. Palombo, "Viscoelasticity of amyloid plaques in transgenic mouse brain studied by Brillouin microspectroscopy and correlative Raman analysis," *J. Innov. Opt. Health Sci.* **10**, 1742001 (2017).
2. I. V. Kabakova, Y. C. Xiang, C. Paterson, P. Török, "Fiber-integrated Brillouin microspectroscopy: Towards Brillouin endoscopy," *J. Innov. Opt. Health Sci.* **10**, 1742002 (2017).
3. E. Edrei, M. Nikolic, G. Scarcelli, "Improving localization precision of Brillouin measurements using spectral autocorrelation analysis," *J. Innov. Opt. Health Sci.* **10**, 1742004 (2017).
4. L. Bartolini, F. Feroldi, J. J. A. Weda, J. F. De Boer, D. Iannuzzi, "Multimodal probe for optical coherence tomography epidetection and micron-scale indentation," *J. Innov. Opt. Health Sci.* **10**, 1742007 (2017).
5. V. Y. Zaitsev *et al.*, "Practical obstacles and their mitigation strategies in compressional optical coherence elastography of biological tissues," *J. Innov. Opt. Health Sci.* **10**, 1742006 (2017).
6. D. P. Jones, W. Hanna, G. M. Cramer, J. P. Celli, "*In situ* mapping of ECM rheology and microheterogeneity in embedded and overlaid 3D pancreatic tumor stroma co-cultures via passive particle tracking," *J. Innov. Opt. Health Sci.* **10**, 1742003 (2017).
7. K. Clayson, E. Pavlatos, Y. Ma, J. Liu, "3D characterization of corneal deformation using ultrasound speckle tracking," *J. Innov. Opt. Health Sci.* **10**, 1742005 (2017).
8. F. Zvietcovich, J. P. Rolland, K. J. Parker, "An approach to viscoelastic characterization of dispersive media by inversion of a general wave propagation model," *J. Innov. Opt. Health Sci.* **10**, 1742008 (2017).
9. M. A. Reilly, A. Cleaver, "Inverse elastographic method for analyzing the ocular lens compression test," *J. Innov. Opt. Health Sci.* **10**, 1742009 (2017).