Biomechanical Properties of Murine Embryos Using Optical Coherence Tomography and Brilloiun Microscopy

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***Abstract*—A combination of optical coherence tomography (OCT) and Brillouin microscopy, termed Br-OCT, allows for the noninvasive study of biomechanical properties in the developing murine embryo. In this talk I will discuss our recent progress using Br-OCT to measure stiffness and track structural changes during embryonic development.**

Keywords—Optical Coherence Tomography, Brillouin Microscopy, Biomechanics

I. Introduction

This talk will focus on the combined use of optical coherence tomography (OCT) and Brillouin microscopy (Br-OCT) to determine the elasticity distribution in developing murine embryos. Mechanical forces play an important role in the development of tissues and organs. In this study, OCT was used to obtain high resolution three-dimensional structural images of early-stage embryos. Brillouin microscopy was then performed within eight hours to determine the Brillouin frequency shift in each part of the embryo. The Brillouin shift is related to the high-frequency longitudinal modulus and is proportional to the bulk elatic modulus. By determining the Brillouin frequency shift, we can determine the stiffness of the tissue in an area. The differences in Brillouin frequency shift detected in the various regions of the embryo correspond to differences in the stiffness of the tissue itself. The results of this study demonstrate that the combination of OCT and Brillouin microscopy can be used for the noninvasive and noncontact determination and tracking of biomechanical properties. By looking at embryos from various developmental stages, it is possible to map out the changes in biomechanical properties as the cells migrate and as the local tissue structure changes during embryonic development.

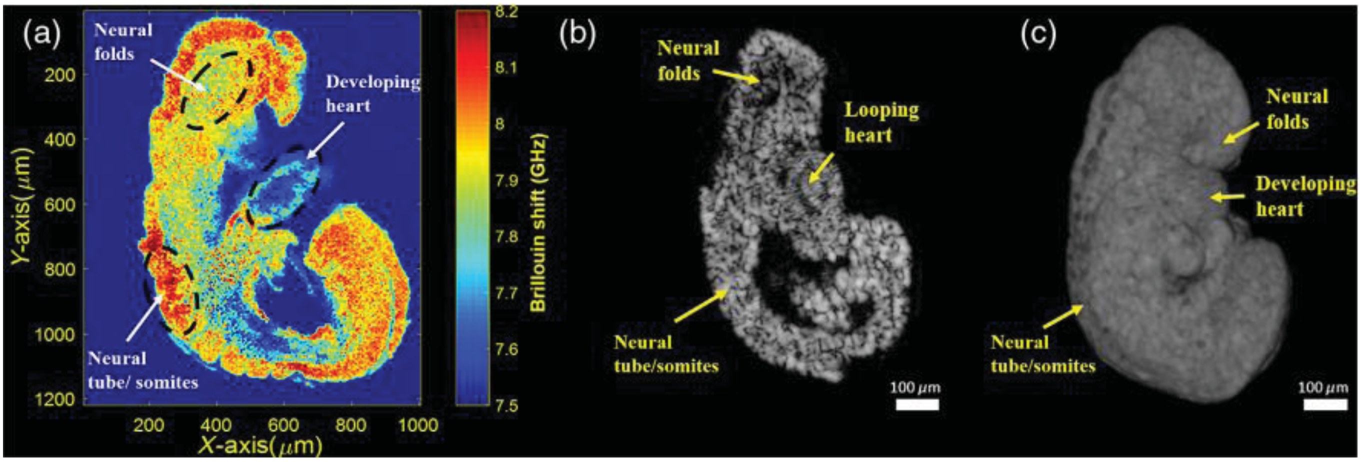

Fig. 1. An example of application of Br-OCT to assess the structural and mechanical properties in an E8.5 murine embryo. (a) 2-D elasticity map for a sagittal plane obtained via Brillouin microscopy. The difference in stiffness can be seen in the difference in Brillouin shift. This corresponds to a difference in longitudinal modulus and therefore in elasticity. (b) 2-D OCT image of a similar sagittal plane in the same embryo. This shows the structural features corresponding to (a). (c) 3-D OCT image. This image shows the external three-dimensional structure of the embryo corresponding to the features in (a).

Adapted from R. Raghunathan *et al.*, "Evaluating biomechanical properties of murine embryos using Brillouin microscopy and optical coherence tomography," *Journal of Biomedical Optics,* vol. 22, issue 8, 086013, 2017/08/22.

This work was supported, in part, by the U.S. National Institutes of Health (NIH) grants R01HL120140, R01HD086765