OPTIMIZATION AND CHARACTERIZATION OF A LINE-SCAN OCT FOR MEASURING HEMODYNAMICS OF CHICKEN EMBRYO'S DEVELOPING HEART WITH COMPARISON TO A POINT-SCAN OCT COUNTERPART

Shau Poh Chong,[1] Gordon Zhen Yu Ko,[1] and Nanguang Chen[1,*]
[1]Department of Biomedical Engineering, National University of Singapore,
4 Engineering Drive 3, Singapore 117583.
*biecng@nus.edu.sg

1. ABSTRACTS

Hemodynamics is a critical factor for healthy embryonic and fetal development, and when altered, could result in congenital heart defects (CHD), the most common birth defect in the newborns. Previous studies have shown that the fluid mechanical forces in the blood flow during early cardiac development could influence overall morphogenesis of cardiovascular system. Though near-infrared light (NIR) point-scan OCT [1] has been used to quantitatively assess the hemodynamics in the embryo, high speed visualization of the developing chicken embryo is still lacking. Here, we developed a line-scanning NIR OCT for high speed visualization of chicken embryo hemodynamics. The line-scanning approach also lowered the threshold of maximal exposure limit for the power delivered to the samples. The supercontinuum light source, with the output filtered to harness NIR wavelengths between 600 – 950 nm, will be used in the system. The noise performance of the supercontinuum light source will be characterized across different pulse repetition rates, camera exposure time, and wavelengths. A careful design of the spectrometer employing a low noise two-dimensional CMOS camera will be performed in order to optimize the maximal sensitivity and sensitivity rolloff. The effective performance of the line-scan OCT system will be compared to a point-scan OCT counterpart in term of maximal sensitivity, imaging speed, and contrast by imaging developing chicken embryo. The structural and functional information of dynamic cardiac tissue deformation and blood flow in ultrahigh spatiotemporal resolution will further enhance our understanding of the roles of hemodynamics and in embryonic development and in CHD.

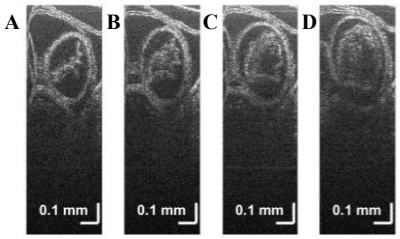

Figure 1 Cardiac cyclic changes (elliptical changes in the endocardium, A-D: end-systole, mid-systole, mid-diastole, end-diastole) in the cross-sectional shape of the heart tube imaged using a point-scan OCT.

[1] Z. Y. Ko, K. Mehta, M. Jamil, C. H. Yap, and N. Chen, "A method to study the hemodynamics of chicken embryo's aortic arches using optical coherence tomography," J Biophotonics **10**, 353-359 (2017).