

Fiber Orientation Mapping with OCT Imaging

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Introduction: Current optical tissue imaging techniques used in biomedical and medicinal applications include ultrasound imaging, microscopy, and optical coherence tomography (OCT). OCT provides three-dimensional imaging with approximately 10-micron resolution. The primary objective of this research was to explore the viability of utilizing white light camera imaging techniques to measure collagen fiber organization. Collagen is a protein in the body that contributes to the growth of fibroids. Fibroids are benign tumors of the uterus that cause pain and increased bleeding and can impact fertility. Uterine fibroids are very common, however many are diagnosed or treated after years of experiencing symptoms. There are additional challenges when determining whether this abnormality is cancerous or a benign fibroid due to the imaging limitations of the current use of white light endoscopic cameras.

Methods: Human uterus samples were obtained under an IRB-approved protocol from Columbia University Medical Center after surgery. Samples were imaged with second harmonic generation and optical coherence tomography. Using the white light imaging (WLI) corresponding to the OCT field of view, images were taken of the uterus samples and compared to the same images taken using SHG. This was done for two small, seedling fibroids. The comparison was made with fiber orientation maps.



Fig. 1 WLI Sample with Box

Results: With the collected uterine samples, using both the OCT and microscopy (fig. 2) imaging modalities, both methods provided imaging to similar regions of the fibroid within each sample at their default resolutions. Following the imaging and post-image processing, each imaging modality provided varying fiber orientation map qualities as seen below (fig. 2)

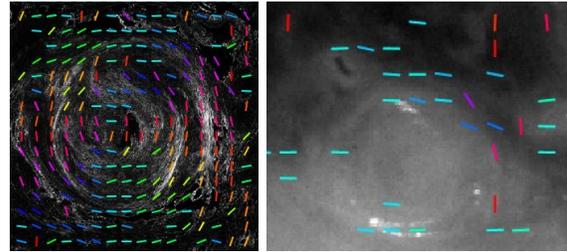


Fig. 2 Microscopy (left) and WLI (right) camera images Using the calculated fiber orientation maps, we can essentially compare the quality of the imaged fibroids. The below histogram (fig. 3) summarizes these comparisons.

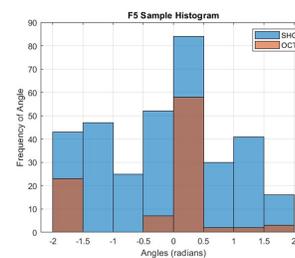


Fig. 3 Imaging Histogram Comparison

By design, the microscopy imaging technique has higher resolution capabilities; therefore, it is used as a reference for the quality of the OCT image viability.

Conclusion: The results of this research display that using white light imaging may not be a great way for showing collagen fibers. Fortunately, this research is extremely pre-mature, so further pre and post-processing should be done from here out to ensure better results when compared to that of the SHG images.

References:

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