Spectrum Estimation Methods for Optical Doppler Tomography

Multidimensional Digital Signal Processing Problem

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Optical Doppler Tomography (ODT) is a method to obtain high resolution, three-dimensional tomographic images of biological tissues. This method (Fig. 1) uses a modulated light source to raster scan a target tissue. Using a method such as the Short-Time Fourier Transform to obtain frequency information in the reflected light ($\Gamma_{ODT}(\tau)$), one can obtain images of the structure of the target tissue and of the velocity of fluids in the image.

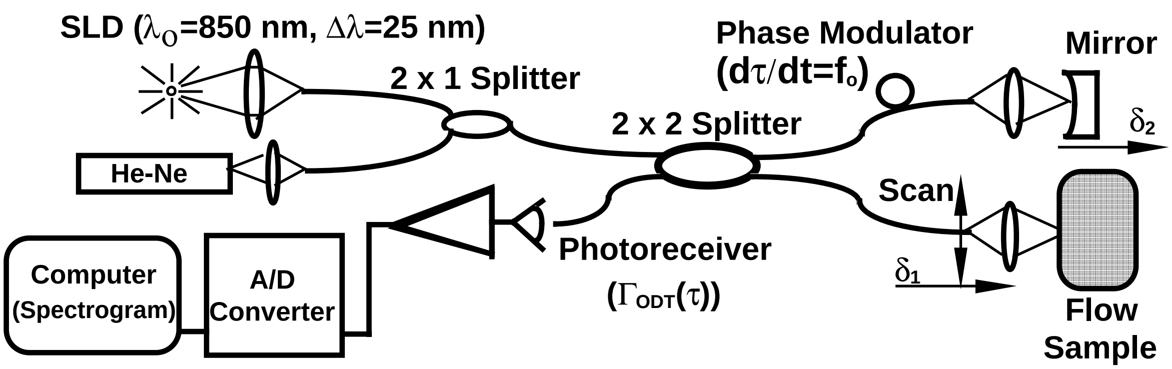

Figure 1: Prototype instrument to measure ODT interference fringe intensity ($\Gamma_{ODT}(\tau)$).

Further development of ODT will require substantially higher frame rates so that the method can be used in real-time clinical applications. One may be able to speed up the calculations for the velocity image by only calculating whether or not there is flow and the direction of the flow rather than calculating the magnitude of the flow. However, there is a theoretical maximum limit of the frame rate dictated by physiological constraints from the blood flow velocity in the tissue.

Using the interference fringe intensity ($\Gamma_{ODT}(\tau)$) as input data, I will identify and evaluate several spectrum estimation procedures in the context of the flow hypothesis testing problem described above; that is, how well they detect flow and the direction of flow. To accommodate testing of spectrogram estimation procedures, simulated data will be provided. Once an instrument is constructed in Dr. Milner's laboratory at the University of Texas at Austin, the spectrogram estimation procedure and hypothesis testing may be applied using real input data recorded from *in vivo* tissue samples.

References Cited

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