Polarimetric THz Imaging of Human Brain Tissues Exhibiting Alzheimer's disease

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THz imaging has been presented as a prominent tool in bio-medical applications given the properties of the THz radiation. The presence of significant water absorption lines in the THz spectrum allows high-contrast images when the changes in the tissue hydration can be linked to a biochemical response (E. Pickwell and V.P. Wallace, "Biomedical applications of terahertz technology, *"Journal of Physics D: Applied Physics*, vol, 39, no. 17, pp R301-R310, Aug. 2006). Moreover, resonant vibrations of many critical bio-molecules in the THz region provide important spectroscopic information.

In this work, we study the interaction of polarized EM waves with human brain tissue samples by studying the broadside terahertz (THz) reflectivity of formalin-fixed paraffin-embedded (FFPE) samples for two linear polarizations. A new single-linear polarization THz imaging system with 3× improved resolution than commercially available tools is used to capture the spectral response of formalin-fixed paraffin-embedded (FFPE) samples. The two principle linearly polarized THz images obtained via our system are used to assess the properties of the nerve bundles in the hippocampus area. Spectral responses of control samples and diseased samples to THz polarized waves are compared to possibly identify small differences between control sample and diseased sample in an effort to potentially differentiate between healthy and diseased human brain samples.

The proposed approach is also compared with microscopic Luxol Fast Blue Staining (LFBS) method. Images obtained through pixel brightness analysis of LFBS samples was compared with the spectral image contrast of THz polarimetric images to demonstrate the potential of polarimetric image in differentiation between healthy and diseased human brain FFPE samples.