Depth sensitive Mueller Matrix imaging instrument

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Keywords: optics, polarization, spatial frequency, mueller matrix, imaging

Conventional Mueller Matrix Imaging (MMI) typically employs full-field illumination, capturing polarization data across extended sample areas [1]. However, this approach measures an integrated response that combines contributions from all photon paths, including those penetrating deeply into turbid media. In some situations, this presents a significant limitation, as biological specimens often exhibit heterogeneous optical properties with depth

An optical imaging approach that combines Spatial Frequency Domain Imaging (SFDI) [2] and MMI to enable depth-resolved characterization of polarization properties in turbid media is presented. By simultaneously exploiting the spatial selectivity of SFDI and the sensitivity of Mueller polarimetry to microstructural anisotropy, our method provides complementary contrast mechanisms that reflect both the layered structure and polarization-dependent behaviour of complex samples. Spatially modulated illumination at multiple frequencies is used to control the sampling depth, while full Mueller matrix measurements are performed at each frequency to capture the evolution of polarization as a function of depth. Experimental results in phantoms and biological tissue demonstrate the potential of this dual-mode technique to distinguish subsurface polarization features that would otherwise remain obscured in conventional imaging. This integrated approach opens new possibilities for applications requiring non-invasive, depth-sensitive analysis of anisotropic or scattering structures, such as biomedical diagnostics or material characterization.

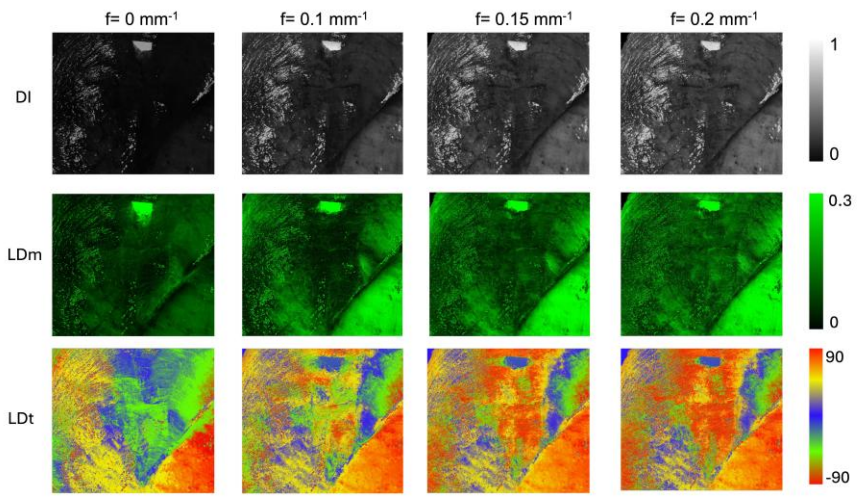

Fig 1: Polarimetric images (depolarization index (DI), linear diattenuation magnitude (LDm), and orientation (LDt)) for various spatial frequencies in the chicken breast sample.

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