Abstract

Mr. Hafeez Ullah
(Ph.D. Scholar, DPAM, PIEAS)

The objective of this work was to investigate optical diffuse reflectance (ODR) and optical coherence tomography (OCT) being an emerging technology in optical diagnostics. Both methodologies were implemented for measurements of optical properties and glucose levels respectively in biological tissues.

The reduced scattering, absorption and total attenuation coefficients for rat‟s liver have been determined by using Mie-scattering theory, diffusion approximation equation and linear fitting to the normalized intensity. These optical parameters for normal and thermally coagulated chicken liver in the near infra red region were obtained by using Kubelka Munk Model (KMM) in correlation with diffuse reflectance. The results show a significant increase in these parameters after coagulation. Monte Carlo simulation for these results validates the experimental measurements.

These optical parameters provide a base for extension of the work towards glucose monitoring in blood present in the blood vessels underneath skin. A subclass of OCT called swept source, SS-OCT was used in measurements of glucose levels in liquid phantoms and blood by analyzing temporal dynamics of scattered light. Brownian motion of the scatterers (polystyrene microspheres in phantoms and red blood cells in blood) is affected due to presence of glucose as measured by SS-OCT. The temporal analysis of Brownian motion statistics yielded the translational diffusion coefficient and viscosity of non-flowing and flowing fluids that were observed in good agreement with literature. The increase in glucose concentrations deformed red blood cells and caused rouleaux formations that were confirmed by imaging with inverted microscopes. The OCT method was successfully implemented for *in vivo* case scenario to obtain the translational diffusion coefficient in blood vessels. In case of *in vivo* application, speckle variance (SV)-OCT was used to obtain three dimensional high resolution cross-sectional imaging of blood vessels. This may be used to observe the blood viscosity modulation based changes in blood vasculatures. OCT probes for percutaneous coronary microstructures imaging have been discussed to be used for SV-OCT or Doppler OCT. This phantom and blood OCT study demonstrates the technique‟s ability to detect and quantify glucose presence in non-flowing and flowing liquid suspensions, and potential for *in-vivo* applications.