IMAGING OF BIOTISSUES WITH CIRCULARLY POLARIZED LIGHT FOR CANCER DETECTION

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Cancer is one of the leading causes of mortality in EU member states and around the globe, accounting for 24% of all deaths in Europe. The highest survival rate (up to 90% 5-year survival) could be achieved for the patients with the disease localized at the early stage when the cancer has not yet metastasized. However, during early cancer onset it is quite difficult for clinicians and pathologists to differentiate between tissues that could be neoplastic versus normal tissue that is unlikely to become neoplastic. Currently, the gold standard and most widely used methodology for precise cancer diagnosis is histological analysis that utilizes exhaustive microscopy investigation. However, despite best laboratory practices the rate of conclusive diagnosis by histological analysis for a range of cancers, including cervical, prostate, bladder, skin and oral cancer, is only 65-75%.

In this paper, we introduce a development of experimental optical system for noncontact diagnostics of biological tissues by using diffusively reflected circularly polarized light. In the experiment, the vertical polarized light from a laser diode (640nm, 40mW, Bio-Ray Laser, Coherent, USA) changed by a quarter wave plate into right circular polarized state is directed towards the tissue sample at 55° from the normal and focused onto the sample by a lens. Incident circularly polarized light undergoes multiple scattering during its propagation inside the biotissue before being collected by the detector. Polarization state of the diffusely backscattered polarized light collected at a certain distance from the focus point is then analyzed with a polarimeter (PAX5710VIS-T, Thorlabs, USA). The source detector separation as well as the angle of detection can be varied to influence the sampling volume. The multiple measurements have been performed with the developed experimental system utilizing scanning approach on a paraffin embedded sample of human lung metastasis of basal squamous cell carcinoma. The samples had a variety of structures including both healthy and cancerous tissue previously classified by the pathologist. To visualize and compare the polarization state of the detected radiation, the Poincaré sphere was used as suggested in [1]. The cancerous and healthy tissue samples have shown that their scattered polarization states are distinguishable from one another. It is noticeable that the polarization state of the diffusively backscattered light from the cancerous samples is located mostly on the upper regions of the northern hemisphere, while the healthy tissues correspond to lower latitudes. The proposed approach has great potential to be used as a new optical biopsy tool helping the pathologists in routine day-to-day diagnostic decisions.

[1] B. Kunnen, *et al*., J. Biophoton., 8(4), 317 (2015).