Quantitative assessment of skin birefringent structures in scattered light confocal imaging using radially polarized light

Babu Varghese, Clemence Boudot, and Rieko Verhagen

Care and Health Applications group, Philips Research Europe, High Tech Campus 34, 5656 AE Eindhoven, The Netherlands.

Email: babu.varghese@philips.com

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Polarized light confocal microscopy is a reliable and robust technique to provide non-invasive real-time optical imaging of biological tissue at high resolution and contrast [1]. However, when tissues containing wavy birefringent structures are viewed with linearly polarized light, the polarization characteristics could be only partially obtained [2-3].

Here we for the first time report on the degree of depolarization of backscattered light from birefringent structures versus the orientations of the incident polarizations using radially polarized light in a cross-polarized confocal microscope. Using a spatially variable retardation plate composed of eight sectors of λ/2 wave plates, we have transformed a linearly polarized homogenous beam into radially polarized light [4] and we have measured a nearly-radial polarization distribution using an in-house polarimeter based on circular polarimetry.

The orientation related effects of linearly, circularly and radially polarized light on the degree of depolarization of backscattered light from birefringent structures were measured using ex-vivo measurements on human scalp hairs and in-vivo measurements on hair and skin in a modified cross-polarized confocal microscope in reflection mode with wavelength 830 nm. We demonstrate that the underestimation of the birefringence content resulting from the orientation related effects associated with the use of linearly polarized light for imaging tissues containing wavy birefringent structures could be minimized by using radially polarized light. We aim to further develop this method for imaging the birefringence in the biological samples with increased sensitivity by compensating for the depolarization effects in the optical path using a spatial light modulator and later with a fixed phase plate structure.

References: