Fast Quantitative Retardance Imaging of biological samples using Quadri-Wave Interferometry

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We describe the use of polarized spatially coherent illumination to perform linear retardance imaging and measurements of semi-transparent biological samples using a quantitative phase imaging technique [1]. Quantitative phase imaging techniques [2-5] are used in microscopy for the imaging of semi-transparent samples and gives information about the optical path difference (OPD). The strength of those techniques is their non-invasive (the sample is not labelled) and fast approach. However, this high contrast is non-specific and cannot be linked to specific properties of the sample. To overcome this limitation, we propose to use polarized light in combination with QPI. Indeed, anisotropy has been used to reveal ordered fibrous structures in biological samples without any staining or labelling with polarized light microscopy [6-8]. Recent studies have shown polarimetry as a potential diagnostic tool for various dermatological diseases on thick tissue samples [9]. Particularly, specific collagen fibers spatial distribution has been demonstrated to be a signature for the optical diagnosis and prognosis of cancer in tissues [10]. In this paper, we perform quantitative linear birefringence measurements on tissues. The system combines a set of quantitative phase images with different excitation polarizations to create birefringence images where only anisotropic components appear. These give information about the local retardance and orientation of the tissue collagen network.We propose using a commercial QWLSI [11] (SID4Bio, Phasics SA, Palaiseau, France) directly plugged onto a lateral video port of an inverted microscope (TE2000-U, Nikon, Japan). We are able to take retardance images in less than 1 second which allows us to make high speed acquisitions to reconstruct tissues virtual slides with different modalities (i.e intensity, phase and retardance). Comparisons between healthy and tumoral 10 µm thick skin tissues will be presented.

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