Maitreyee Roy, J Clin Exp Ophthalmol 2016, 7:8 (Suppl)
http://dx.doi.org/10.4172/2155-9570.C1.045

Geometric phase liquid crystal phase shifter: A novel technique for rapid full-field optical coherence tomography

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Optical Coherence Tomography (OCT) is a well-established technique for biological imaging, mainly used in the field of ophthalmology for routine corneal and retinal clinical examinations. The conventional OCT system produces longitudinal images by performing an axial scan and builds a two-dimensional *xz* or *yz* images. A variant of OCT called full-field optical coherence tomography (FF-OCT) is an emerging non-invasive, label-free, interferometric technique that has the inherent ability of providing rapid *en face (xy)* images of the object by using a detector array (CCD or CMOS), thus avoiding the necessity for using the instrumentationally complex, lateral point scanning scheme. In most FF-OCT systems, *en face* OCT images are constructed by using a conventional phase-shifting technique that involves shifting of the reference beam phase with a piezoelectric translator. However, with the use of a broadband source in FF-OCT, the phase shifts of different spectral components are not the same, resulting in systematic errors for reconstruction of tomographic images. To solve the problem, an achromatic phase shifter based on the geometric phase principle has been proposed which can be realized by cyclic change of the polarization state of the light beam through rotating a wave plate or polarizer using a stepper motor. However due to the slow response of stepper motor, real-time biomedical imaging is not attainable. We present a prototype FF-OCT system based on geometric phase that incorporates fast switchable ferroelectric liquid-crystal technology. It has a fast response time and can accurately map and produce 3D images of complex biological samples.

Biography

Maitreyee Roy is a Senior Lecturer and a Deputy Director of Optics & Radiometry Laboratory at the School of Optometry and Vision Science, University of New South Wales, Australia. She was awarded her PhD in Physical Optics from School of Physics at the University of Sydney. She is an accomplished Optical Physicist with broad experience in government and academic institutions with strong R&D background particularly in optical metrology, 3D optical imaging and nano-particle metrology. One of her major contributions was to demonstrate the fundamental principle of geometric phase in optics and its achromatic nature, which has opened up new insights in to broadband interferometry with application ranging from biological systems, electronics to astronomy.

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