Multi-Positional Spectral Domain Optical Coherence Tomography (SD-OCT) using Wavelength Multiplexing

Taye Mekonnen[1], Agisilaos Kourmatzis[2] and Shaokoon Cheng[1]
[1]School of Engineering, Macquarie University, NSW 2109, Australia
[2]School of Aerospace, Mechanical and Mechatronic Engineering, University of Sydney, NSW 2006, Australia
taye.mekonnen@hdr.mq.edu.au

ABSTRACT

Optical Coherence Tomography (OCT) is a non-invasive cross-sectional imaging technique based on the principle of laser interferometry. Normally, the lateral field of view of a low-coherence interferometric OCT is limited to a single-spot of a sample; thus, available OCT techniques can take significant time to scan large objects. This paper presents a novel multi-channel spectral domain Optical Coherence Tomography (SD-OCT) method involving spectral-slicing of broadband low-coherence light to enable the simultaneous acquisition of images from multiple lateral positions of a target. A triple-channel SD-OCT system was devised using a broadband source of center wavelength 840nm and full width half maximum (FWHM) bandwidth of 50nm. Both sample and reference arm beams were split into three channels using two dichroic splitters of 50% cut-on wavelength at 825nm and 848nm. With a FWHM spectral distribution of 13.5nm, 19nm and 17.5nm in the three channels, the measured axial resolutions were 22.6µm, 14.5 µm and 17.2µm, respectively. The capability of the technique was demonstrated by concurrently acquiring tomographic images of a 3D-printed phantom. Despite the relative drop in the axial resolution and depth sensitivity, this new design promises a cost-effective and real-time multi-positional imaging technique suitable for various endoscopic and industrial applications.