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Compact dual path-dual focus SS-OCT system for whole anterior segment and retinal imaging.

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Abstract

Purpose : To develop a swept source optical coherence tomography (SS-OCT) system that allows both retinal and whole anterior segment imaging and features a compact form factor.

Methods : A SS-OCT system has been built by using an Axsun Technologies laser with a central wavelength of 1050 nm, a 100 nm bandwidth and 50 kHz sweep rate. The sample arm optical interface was designed and optimized with optical design simulation software (Zemax). In the posterior segment imaging modality, the diffraction-limited optical design yields a lateral resolution of 10 µm and a field of view (FOV) of 6 x 6 mm. The anterior segment modality, designed to exhibit a longer depth of focus, shows a lateral resolution of 43 µm and 13 x 13 mm FOV. A flip mirror allows to rapidly switch from one interface to the other. An Alazar Technology digitizer alternates between an externally clocked acquisition optimized for retinal imaging and a long image depth range acquisition with a fixed-interval sampling rate of 0.8 GS/s for whole anterior segment imaging. The theoretical axial resolution is ca. 8 µm. A mirror switches synchronously with the flip mirror in the sample arm to adapt the reference arm length. An illumination ring of LEDs together with an iris camera and a display showing a fixation target aids the alignment of patients.

Results : A group of healthy human volunteers were imaged with the system. In the posterior segment modality a 7.4 mm image depth range was achieved in which less than

a 2 dB sensitivity drop-off was measured. The anterior segment modality exhibits a 6 dB sensitivity fall-off at 14 mm and the B-scans show angle-to-angle and corneal apex to posterior face of the lens, in which the lens capsule, the cortex and the nucleus can be distinguished.

Conclusions : A dual-path dual-focus SS-OCT system that enables consecutive acquisition of retinal images and whole anterior segment images was demonstrated. The preliminary measurements suggest that the versatility of the system can be of interest in the clinical practice, especially in those cases where visualization and quantitative measurements of the whole anterior segment are useful. In this line, the system is planned to be tested at an ophthalmologic hospital and compared with existing commercial instruments so that the agreement between them can be assessed.

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