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Visible Wavelength Ultrafast Photonic Time-Stretch Optical Coherence Tomography

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Visible-light Optical Coherence Tomography (OCT) is an emerging imaging modality, providing new capabilities in both anatomical and functional imaging of biological tissue. Time-stretch dispersive Fourier transform or simply time-stretch is an all-optical processing method for real-time Fourier transformation of ultrafast optical signals. It allows for implementation of OCT at tens of MHz A-scan rates.

In this work we propose and demonstrate, for the first time, a photonic time-stretch OCT method which is cable of operating in visible wavelength. This is done by using a supercontinuum source and filtering the wavelengths outside the visible wavelength region. We also use an efficient dispersive medium which is capable of stretching the visible light short pulses with low loss.

Setup used for experiments is shown in Fig. 1(a). A 505/50 couple is used for interferometry and a 2D galvo mirror system is used for mechanical scanning. The spectral interference is starched using a fiber spool (FS) and then the signal is detected using a photoreceiver (PR) followed by an RF amplifier. Digitized signal was post processed in computer. As an example, sample under test was fast rotating fan shown in Fig. 1(b). 3D images taken using the proposed visible wavelength OCT method is shown in Fig. 1(c). OCT image show reflections from different depth layers wile fan is rotating. This OCT image contains 40 Mega voxels and was captured over 0.66 seconds with A-scan rate of 50 KHz.

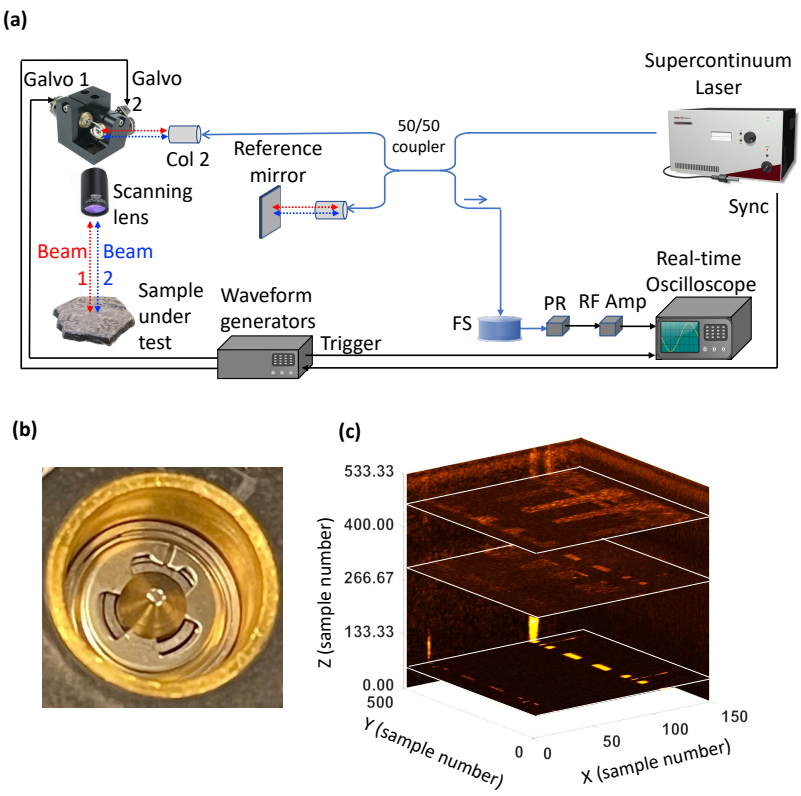

Figure 1. (a) Eperimental setup for visible wavelength time-stretch OCT system, (b) Sample under test, (C) OCT image captured using proposed method.