Full-field optical coherence microscopy (FF-OCM) is a recent optical technology based on low-coherence interference microscopy for semi-transparent sample imaging with ~1 µm spatial resolution [1, 2]. FF-OCM has been successfully applied to three-dimensional imaging of various biological tissues at cellular-level resolution [3]. The contrast of FF-OCM images results from the intensity of light backscattered by the sample microstructures. This contrast mechanism, based on refractive index changes, provides information on the internal architectural morphology of the sample.

Several extensions of FF-OCM have been developed including the ability to exploit the spectroscopic response of the imaged sample. The purpose of this complementary imaging modality is to enhance image contrast, permitting better differentiation of the sample structures through their spectroscopic properties and providing additional information on the sample composition.

Two different technological approaches to take advantage of the spectroscopic response of the sample are presented in this paper. A first approach involves detecting the whole interferometric signal and analyzing it using Fourier mathematics [4]. Another approach consists of imaging the sample in several distinct bands (2 or 3 are presented here).

High-resolution FF-OCM imaging is demonstrated in the 800 nm and 1200 nm wavelength regions simultaneously using a Silicon-based CCD camera and an Indium Gallium Arsenide (InGaAs) camera as area detectors and a halogen lamp as single illumination source [5]. The setup is optimized to support the two broad spectral bands in parallel.

Three-band FF-OCM is demonstrated to image successively at 635 nm, 870 nm and 1170 nm center wavelengths using a visible to short-wavelength infrared camera and a halogen lamp [6]. Reflective microscope objectives are employed to minimize chromatic aberrations. Constant 1.9-µm axial resolution (measured in air) is achieved in each of the three bands. A dynamic dispersion compensation system is set up to preserve the axial resolution when the imaging depth is varied. The images can be analyzed in the conventional RGB color channels representation to generate three dimensional images with enhanced contrast.


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Fig. 1: Dual-band FF-OCM images of African tadpole Xenopus laevis, ex vivo, representing a field of 250 µm (x) × 1200 µm (z) at 800 nm (a) and 1200 nm (b) center wavelengths. The imaging penetration depth is larger at longer wavelength at the price of a degradation of spatial resolution.

Fig. 2: Three-band FF-OCM sections of a light (left) and a dark (right) human hair. From top to bottom: in band 1 (centered at 635 nm), band 2 (centered at 870 nm), band 3 (centered at 1170 nm) and with RGB representation. The scale bar is 20 µm in the two directions (x and z).