Miniaturized nonlinear scanning microscope with spectral detection for in vivo tissue imaging

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We present a nonlinear miniaturized microscope which can be used for in vivo tissue imaging, built on a compact mobile platform. The imaging system is based on a miniaturized electromagnetically controlled fiber-scanner with a 3 mm outer diameter [1]. The scanner can work both in resonant and non-resonant mode. Figure 1 shows a photograph of the scanner. The scanner is coupled to the rest of the system using a double clad photonic crystal fiber to facilitate nonlinear microscopy. Both single-mode infrared excitation and broadband multimode visible emission can be guided by the fiber due to the dual clad geometry. The group velocity dispersion of the excitation light by the fiber is pre-compensated with a grating pair.

Emission is detected using a standard PMT or a custom built spectrograph with a sensitive EM (electron multiplication) CCD for fast (8 kHz spectral rate) spectral detection. The nonlinear excitation provides contrast without applying stains in living tissue. Signals are detected from, amongst others, auto-fluorescence of NADH, FAD, melanin, and second harmonic generation of collagen. In vivo results on mice are anticipated.

Figure 1: Photograph of the miniaturized scanner

[1] B.H.W. Hendriks, N. Mihajlovic e.a., JBO 16 026007 (Feb. 2011)