

Fiber Based Illumination for Miniature Endoscopy

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ABSTRACT

We have successfully established a novel ultra-compact endoscopic imaging system, which uses a miniature CMOS sensor (O.D. ~1.4mm) and a multimode fiber ($\phi \sim 400\mu\text{m}$) for light delivery. Critically, the illumination is realized by coupling the output of a supercontinuum or RGB laser into a multimode fiber. As a result, the overall diameter (~2.5 mm) of the endoscope is smaller than the currently used models in endoscopy.

To uniformly illuminate the target within the field of view of the CMOS sensor, a miniature diffuser [1] is prepared and attached to the tip of the light guide fiber to broaden the illumination cone from 10° to more than 70° , which is sufficient to cover the field of view (FOV) of generally used endoscopes [2]. Additionally, bandpass filters are used to reduce the laser power and adjust the spectrum to optimize the illumination conditions. The illuminance, optical power, and image quality of the supercontinuum are also characterized and benchmarked with standard medical white LED.

The illumination parameters of supercontinuum can reach CRI~72% with CCT=5200K from CRI~97% with CCT = 3100K, when driving level is set at 95% of the maximum value. Note that white LEDs have CRI~76% with CCT=6500K. Many *in vivo* images are also obtained with the ultra-slim endoscope, showing supercontinuum as a viable light source for future endoscopy.

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