MULTIMODAL COMPUTATIONAL COLONOSCOPY

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Colonoscopy can reduce colorectal cancer mortality by identifying and removing precancerous lesions. However, these lesions can be missed due to poor contrast. To explore how lesion contrast can be improved with optimized illumination, we present a colonoscopy platform that allows the acquisition of in-vivo videos from a tunable variety of illumination properties, including wavelength, direction, and coherence. We modified a commercial video colonoscope (CF-HQ190L, Olympus Medical) to route a fraction of the illumination fiber bundle to externally-accessible ports. These ports are 1:1 mapped to the three illumination bundles at the distal tip of the colonoscope. This strategy enables the illumination to be toggled between the conventional illumination source and a tunable laser cart that varies illumination wavelength, directionality, and coherence properties. The laser illumination sequence is synchronized with the image sensor frame rate for the rapid collection of many imaging modes, including multispectral, photometric stereo, and laser speckle flow contrast imaging. The resulting system was approved for human use through a non-significant risk protocol. This presentation covers the optical and computational design of this colonoscope, validation of the multispectral, topographical, and flow contrast in benchtop models, and introduces first-in-human results showcasing the improvement in tissue contrast from multimodal imaging.

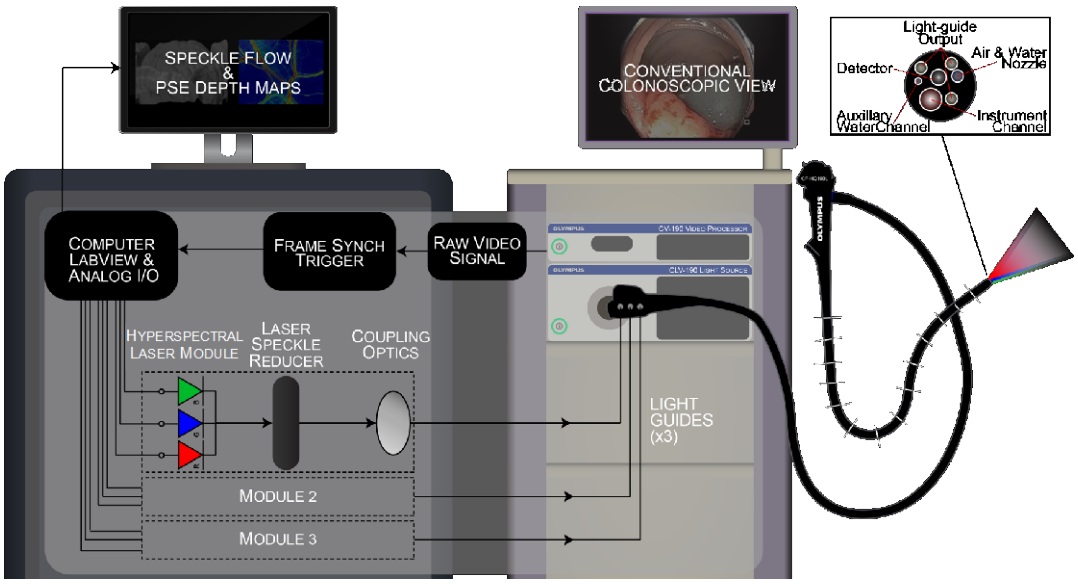

Figure 1: The computational multimodal colonoscope introduces custom laser illumination into a commercial colonoscope, allowing multispectral, photometric stereo endoscopy (PSE), and speckle flow contrast.