FLUORESCENCE WHOLE SLIDE IMAGING SYSTEM BASED ON COLOR-SEQUENTIAL LED-BASED LINE SCANNING

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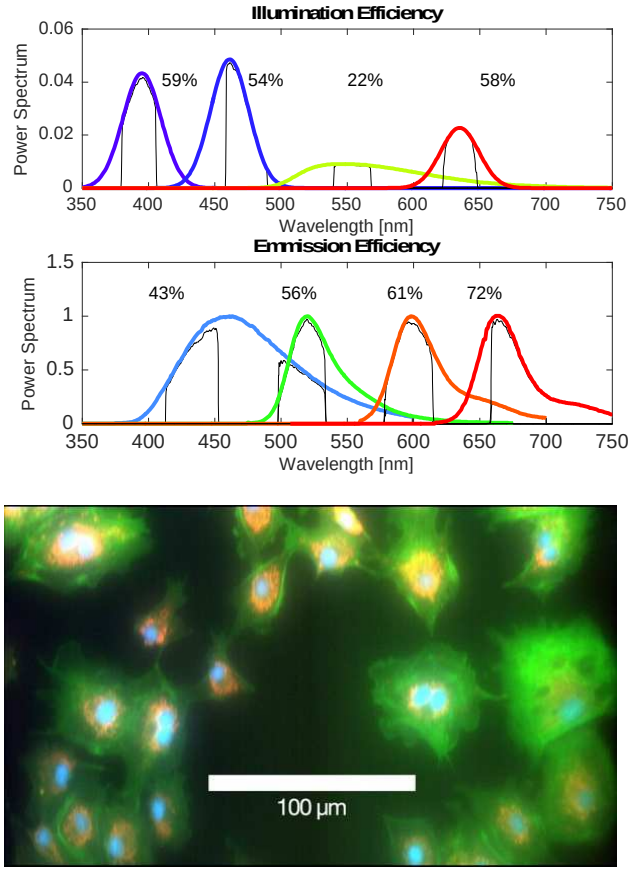
In the field of pathology there is an ongoing transition to the use of Whole Slide Imaging (WSI) systems which scan tissue slides at intermediate resolution (~0.25µm) and high throughput (15mm^2/min) to digital image files [1]. Most scanners currently on the market are only capable of brightfield imaging; while adding the ability of fluorescence imaging would open up a wide range of possibilities to the field. Our approach to fluorescence WSI systems is based on a (multi) line scanning technique [2] with color sequential illumination using multi-color LED epi-illumination. The use of multiband dichroics eliminates the need for any moving parts in the system, the use of LEDs as light source provides a cost-effective solution. The primary throughput limitation is then the minimum Signal-to-Noise-Ratio (SNR) given the level of shot noise for the available optical power in the illumination etendue. We present design details of a four-color LED based epi-illumination with a quad-band dichroic filter optimized for LED illumination for combining the four color channels. We provide an extended throughput analysis showing that the quad-band filter allows more than 50% of the LED's spectrum to be used. Further it is anticipated that in emission between 40% and 70% of the light can transmitted through the filter. Preliminary experimental results indicate a throughput on the order of k lines/sec.



Modeled illumination and emission efficiencies (top) and preliminary result. of color sequential line scan with 10ms exposure time per color per line.

[1] S. Al-Janabi, A. Huisman, and P. J. Van Diest, Histopathology Vol. 61, 1, 2012.
[2] S.M. Shakeri, B. Hulsken, L.J. van Vliet, and S. Stallinga, Optics Express Vol. 23, 1319, 2015.