



The importance of optical optimization in whole slide imaging (WSI) and digital pathology imaging

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Abstract

Introduction: In the last 10 years, the WSI has seen impressive progress not only in image quality and scanning speed but also as variety systems available to pathologists. However, we have noticed that most systems have relatively simple optics axes and rely on software to optimize image quality and color balance. While much can be done in software, this study examines the importance of optics, in particular optical filters, in WSI.

Optical resolution is a function of the wavelength of light used and the numerical aperture of the lens system ($\text{Resolution} = (f) \text{ wavelength} / 2 \text{ NA}$). When illuminating light is not conditioned correctly with filters, there is a tendency for the wavelength to shift to longer values (more red) because of the characteristics of the lamps in common usage. Most microscopes (but remarkably few WSI devices) correct for this with ND filter for brightness and Blue filter (depends on the light source) for color correction.

Material and methods: Using H&E slides research microscopes (Axiophot, Carl Zeiss MicroImaging, Inc. NY. Eclipse 50i., Nikon Inc. NY) at 20x, an attached digital camera (SPOT RT741 Slider Color, Diagnosis Instruments., MI USA), and a filter set, we examined the effect of filters and software enhancement on digital image quality. The focus value (as evaluated by focus evaluation software developed in house and SPOT imaging Software v4.6) was used as a proxy for image quality.

Results: Resolution of tissue features was best with the use of both the Blue and ND filters (in addition to software enhancement). Images without filters but with software enhancement while superficially good, lacked some details of specimen morphology and where unclear compared with the images with filters.

Conclusions: The results indicate that the appropriate use of optical filters could measurably improve the appearance and resolution of WSI images.