

ESTIMATION OF PRECISION OF FLUORESCENCE REGISTRATION FOR MICROSCOPE IMAGE COMPRESSION

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Modern techniques, like high content, high throughput Screening (HCS), may involve collection of thousands of images per experiment in order to rapidly correlate several biological variables. To make this strategy successful one has to use an automated imaging system (microscope) as a quantitative device. Furthermore, efficient, yet information preserving image compression techniques are indispensable to manage the vast amounts of image data.

We use empirical data to model signal and noise in generic microscopic imaging. SNR (signal-to-noise ratio) is then applied as a quality measure to establish which image components may be discarded. We construct three observer-independent compression algorithms which use image quality characteristics. First, removal of noise is implemented in wavelet domain and followed by reversible coding with JPEG2000. The denoised images require less memory than their non-denoised counterparts when this wavelet-based encoder is used. Second, the presence of noise sets a practical limit to microscope optical resolution. SNR is used to estimate the decrease in the resolution caused by the noise. The number of image pixels is reduced accordingly so as to maintain optimal sampling. The down-sampled images may be coded using any reversible algorithm. Last, owing to the presence of noise in the images, not all intensity differences can be considered significant. Thus, the number of meaningful intensity levels is lower than the nominal dynamic range. The SNR characteristics is applied to calculate significant intensity levels and perform appropriate image segmentation. Resultant images, characterized by sparse intensity histograms, may be reversibly encoded using JPEG2000 or JPEG-LS. We used model images and microscopic test patterns (grating arrays) to demonstrate that the proposed image compression schemes does not alter the effective microscope modulation transfer function (MTF) when used in conjunction with lossless JPEG2000. Furthermore, we estimate the alterations introduced by compression to global intensity distributions of biological micrographs with a histogram distance metric (earth's mover distance, EMD). Furthermore we use texture parameters to estimate effect of compression on local intensity distributions. We conclude that proposed algorithms may preserve scientific information present in biological micrographs.