VALIDATING IMAGE COMPRESSION FOR OPTICAL MICROSCOPY

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In the last years, advances in acquisition speed and signal detection, besides allowing for an impressive growth of imaging capabilities, have transformed optical microscopy into a big-data field bringing new challenges for data storage, transmission and processing. Image compression can allow for a durable and agile data management. However, efficient compression methods can provide unpredictable artifacts leading post-processing to unreliable quantitative results.

A suitable approach for microscopy is provided by a recently patented technology [1], relying on the accurate quantification of the information content of each micrograph pixel and in the adaptation of compression parameters such that this content is negligibly affected. The compressed files retain their intrinsic quantitative information with a size reduced by a factor of up to 10 (Figure 1).

We validated this image format against various techniques, such as phase-contrast (PC) and light-sheet (LS) microscopy, as well as optical coherence tomography (OCT), by showing that the outcomes of typical post-processing applications are not altered by compression, i.e. their statistical variability is lower than that stemming from the natural noise level of raw micrographs. We verified the preservation upon compression of resolution functions, such as PSF or MTF, as well as cell segmentation parameters (cells number, area, shape) calculated on different PC cellular micrographs. We analyzed the effect of compression on typical 3D image analysis operators used in supervised learning segmentation and confirmed the correct quantification of Alzheimer amyloid plaques in a mouse brain from reconstructed compressed OPT sections. We verified the raw equivalent quality of stitching performed on tiled compressed images from LS microscopy, and that the variation of results in 3D cell segmentation obtained with compressed data is smaller than the PSF of the system. The compression method validated in this work could represent a solution for managing and archiving massive datasets in optical microscopy.

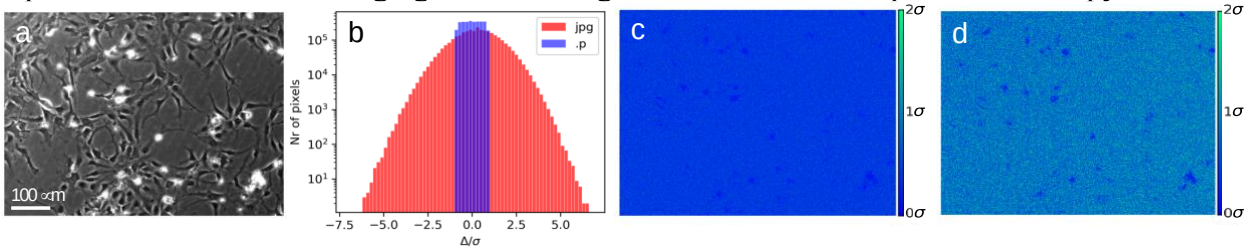

Figure 1: a) Raw PC micrograph of neural stem cells. b) Differences between the raw and the Dotphoton (.p) pixel values (Δ), normalised to the standard deviation of the raw ones (σ), for a .p and a .jpg image of same size. c-d) Color density plot of Δ /σ between raw and .p (c), as well as .jpg pixel values (d), showing the absence of artifacts in the .p file.

[1] A. Martin, H. Zbinden, and B. Sanguinetti, US Patent App. 10/063,891