Advanced image processing and analysis using ImageJ

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ImageJ is a widely-used public-domain image-processing software that was developed by Wayne Rasband from the NIH, USA. ImageJ has an open architecture that provides extensibility via Java plugins, recordable operations and macros; this greatly facilitates the dissemination of algorithms for biological image analysis. In this presentation, we describe some ImageJ plugins that were developed by the researchers of EPFL's Biomedical Imaging Group during the past five years. While these algorithms typically rely on sophisticated mathematical tools such as splines, wavelets, and steerable filters, special efforts have been made to make them accessible to non-expert users via a friendly interface. Specifically, we present efficient image analysis procedures for tracking fluorophores (SpotTracker), for segmenting cells (Snakuscule), for directional image analysis (SteerableJ) including filament detection, and for tracing neurites (NeuronJ). We describe a wavelet-based software (EDF) for extended depth of focus from of focal series of images (z-stack). We introduce a new 3D deconvolution package (Deconvolution lab) that implements most of the state-of-the-art algorithms in the field: Wiener filter, Richardson-Lucy, and various flavors of constrained least-squares deconvolution. We also cover the important topic of image registration and describe a collection of high-end algorithms for motion compensation (TurboReg, StackReg), building image mosaics (MosaicJ), and elastic registration (UnwarpJ).

This is joint work with Daniel Sage, Philippe Thévenaz, François Aguet, Cédric Vonesch, as well as many other members of the laboratory who have contributed to this effort over the years.