Carole Frindel: Scale analysis of multicomponent biomedical images with ImageJ software

Abstract

With the growing development of multimodality, image fusion is currently a very important process in medical science. This post-processing step corresponds to the spatial matching of images acquired by different imaging techniques. It involves several steps: image registration, image association and data visualization targeting efficient exploitation of the informational contents. The registration step aligns the images from the different imaging systems. The association step creates an expandable N-D data-structure. The visualization step consists in finding an appropriate space and visualization mode to analyze this N-D data-structure. In this work, we focus on the latter two steps. To address the related issues, we have developed, MultiMod, an ImageJ macro that selects from a directory N images from different imaging techniques, associates them and represents them in a 3-D, RGB-like, colorimetric space. The image association can be performed according to two different strategies. If N=3, the association is performed using a simple RGB encoding. If N>3 association is performed using the three first components of a principal component analysis to constitute a RGB image. In addition, we then consider a release of a variant of the imageJ plugin Color Inspector 3-D [1] that displays RGB images using 3-dimensional histograms and performs a multiscale colorimetric analysis [2,3]. We illustrate the interest of performing the visualization of multicomponent data-structures with a 3-D histogram, to capture, in a single glance, the dependance between modalities. We also demonstrate the existence of scale invariant, fractal-like organization through scales with biomedical images. We will illustrate the use of our original ImageJ macro and plugin as in Fig. 1 with various cerebral imaging examples in the extended version of the report.

Figure 1

[1] http://rsbweb.nih.gov/ij/plugins/color-inspector.html
[2] J. Chauveau, D. Rousseau, F. Chapeau-Blondeau; "Fractal capacity dimension of three-dimensional histogram from color images"; Multidimensional Systems and Signal Processing 21, 197-211 (2010)
[3] http://www.signal-image.net/

Keywords

Multimodal imaging, scale analysis, pair correlation integral, magnetic resonance imaging

Short CV

Carole Frindel is associate professor with Université de Lyon. Her research interests include image processing applied to biomedical imaging. She uses ImageJ for interaction with life science scientists

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