

## Digital Phantoms as a Tool for Benchmarking and Testing in Cell Imaging

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### Abstract

This contribution tackles the problem of assessing the quality of cell image analysis results for benchmarking purposes. As the ground truth for cell image data (and measurements on them) is not available in most experiments, the outputs of different image analysis methods can hardly be verified or compared to each other. Images are often strongly affected by degradations (caused by cell preparation, optics and electronics) that cause high variation of the results computed using different algorithms.

Some papers solve this problem partially using estimates of ground truth by experts in the field (biologists or physicians). However, in many cases, such a ground truth estimate is very subjective and strongly varies between different experts.

In order to overcome these difficulties, we created a web-based toolbox [1] that can generate 3D digital phantoms of specific cellular components along with their corresponding images degraded by specific optics and electronics. The user can then apply image analysis methods to such simulated image data. The analysis results (such as segmentation or measurement results) can be compared with ground truth derived from digital phantoms of input objects (or measurements on them). In this way, image analysis methods can be compared to each other and their quality (based on the difference from ground truth) can be computed. Simulated benchmark data sets will be available soon for download.

[1] D. Svoboda; M. Kozubek, and S. Stejskal, "Generation of Digital Phantoms of Cell Nuclei and Simulation of Image Formation in 3D Image Cytometry," *Cytometry Part A*, 75A, 6, pp. 494-509, 2009.

### Keywords

Digital phantom, synthetic image, 3D cell imaging, fluorescence microscopy, benchmarking, web-based resources

