

DeconvTest: An in silico microscopy framework to evaluate the accuracy of deconvolution

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01/09/2018

DeconvTest: An in silico microscopy framework to evaluate the accuracy of deconvolution

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1. Introduction

python-based simulation framework
parallel computation
compares performance of different deconvolution algorithms

2. Methods

Step 1: in silico microscopy

cells of different size and shape
Point spread functions (PSF) of different width and aspect ratio
simulation parameters specified via a settings file

Step 2: Deconvolution

ImageJ / Fiji deconvolution plugins run from python in a parallel manner:

- DeconvolutionLab2 [1]
- Regularized Inverse Filter (RIF)
- DeconvolutionLab2 [1]
- Richardson-Lucy Total Variance (RLTV)
- Iterative Deconvolver 3D (DAMAS3) [2]

Step 3: Validation

Jaccard index: $J = \frac{A \cap B}{A \cup B}$
Sensitivity: $S = \frac{A \cap B}{A}$
Precision: $P = \frac{A \cap B}{B}$

Overlap error: $E_o = \frac{A \cup B - A \cap B}{A}$
Ondetection error: $O_d = \frac{A \cup B - A}{A}$
Underdetection error: $U_d = \frac{A \cup B - B}{B}$

3. Results

Comparison of deconvolution approaches and their settings

Regularized Inverse Filter (RIF) | DAMAS3 | Algorithm comparison

Richardson-Lucy Total Variance (RLTV)

Comparison of different parameters of in silico microscopy

Regularized Inverse Filter | Richardson-Lucy Total Variance | DAMAS3

Computation time

Jaccard index

4. Outlook

- Open source package on GitHub
- Include other types of input cells and PSFs
- Include further deconvolution algorithms

References

[1] Tang, S.H. et al. DeconvolutionLab2: An open source software for deconvolution microscopy. *PLoS One* 10(12): e0145418 (2015).
[2] Figge, M.T. et al. DAMAS3: A framework for deconvolution and detection of fluorescence microscopy. *PLoS One* 13(10): e0200000 (2018).

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