Segmentation of Individual Cells in Phase Contrast Microscopy Images

Jindřich Soukup\textsuperscript{1,2,3}, Michal Lašan\textsuperscript{1}, Filip Šroubek\textsuperscript{2}

\textsuperscript{1}Charles University in Prague, Faculty of Mathematics and Physics
\textsuperscript{2}UTIA, ASCR
\textsuperscript{3}University of South Bohemia

\textsuperscript{1}Ke Karlovu 3, 121 16, Prague 2
\textsuperscript{2}Pod Vodárenskou věží 4, Prague 8, 182 08
\textsuperscript{3}Zámek 136, 373 33 Nové Hrady

\textbf{Motivation}

Phase contrast microscope images

- strong halo effects
- sometimes poorly focused
- impurities in solution - black dots outside the cells
- nonuniform shapes of cells
- dead cells
- texture-like background

\textbf{Toxicity/biocompatibility assessment - testing in vitro}

\textbf{Our aims}

- Automated processing of time-lapse image series
- Segmentation of moving objects (cells) from background
- Robustness to degradation present in phase contrast microscope images
- Characterize behavior of the cells

\textbf{Method}

- Original image
- Blurring
- Otsu thresholding
- Skeletonization - modified algorithm
- Adding the information about background
- Connecting loose ends using Dijkstra algorithm

- Halo effect is near borders of the cells ...
- we take the brighter part of the image ...
- and assume that border between cells goes in the middle of white fragments ...
- ... some parts of the border are missing ...
- ... and we also know, where is the background.
- Segmentation cells/background done by [1]

\textbf{Results}

- Precision, Recall, F1 (= Dice coeff)
- $P = TP/(TP+FP)$, $R = TP/(TP+FN)$
- $F1 = 2PR/(P+R)$
- HeLa (human carcinoma cells), L929 (mouse fibroplast), E6 (vero cells)
- Matlab + java implementation, 30 sec/image (4 MPixel)
- Results: (mean over all of the images) $P = 0.65$, $R = 0.73$, $F1 = 0.68$

\textbf{Implementation, gui, editor}

- Matlab/Java implementation
- Standalone application with GUI
- Speed: 30 s for 4 MPixel image (Dual Core 2.30 GHz)
- Batch processing

\textbf{Literature}


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