Fused-Based Segmentation Method for Tracking of Human Lung Epithelial Cells

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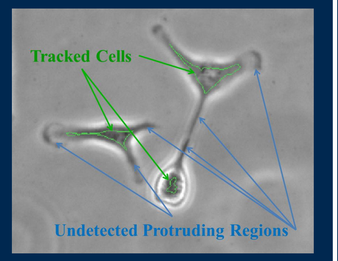
Motivation

- The investigation of morphological features of cells from time-lapse images is important for biology, such as cytotoxicity analysis.
- Traditional cell tracking techniques do not allow for analysis of morphological features due to undetected protruding regions.



Methodology

Cell Tracking

- We use the recently developed Global Data Association [1] to perform cell tracking.

Algorithm:

- Use preconditioned [2] images to detect cell positions.
- Organize cells into "tracklets" based on a probability function
- Create hypothesis for each tracklet that represent all possible outcomes for the tracklet (i.e. cell division, tracklet link, False Positive, etc.) and a associated probability for the hypothesis.
- The set of hypothesis are optimized to find the set that yields the largest total probability and the tracked cells are organized into paths.

Post-processing

- Post-processing consists of a segmentation method that can more accurately determine the cell border but has the inherent problem of not being able to separate large cell clusters.

Algorithm:

- Otsu Thresholding is used to determine border of cells or cell clusters.
- An association based on overlap is made between the tracked cells and the segmented cell boarders.
- Cell clusters are identified by having multiple associations from tracked cells. They are then separated using a Watershed Clustering method we have developed.
- The associations between tracked cells and cell borders are used to create new cell paths that more accurately reflect the size and shape of the cell.

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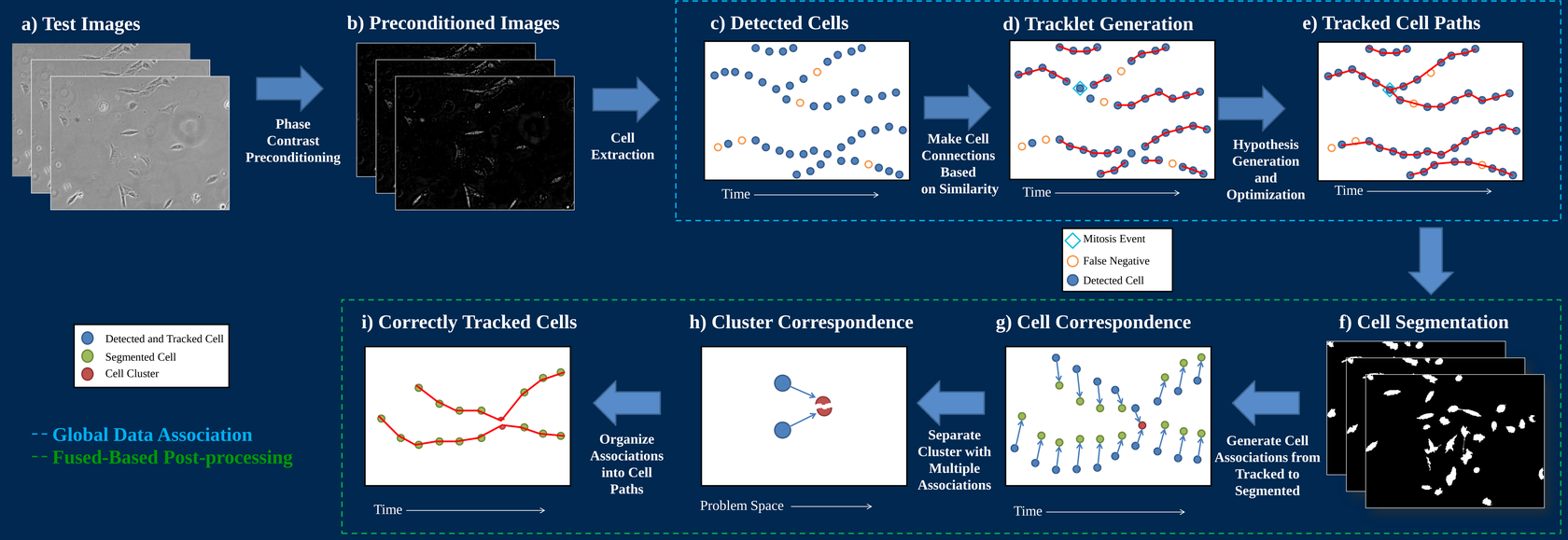
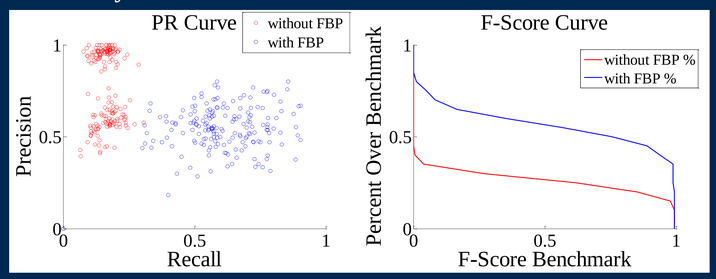
System Outline



Results

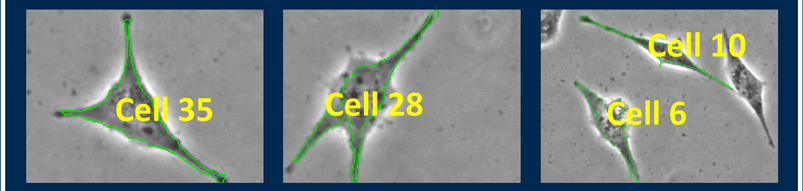
- A F-Score Curve generated by *F-Score = 2*(P*R)/(P+R)* is used to test segmentation accuracy. The results are shown below. The results show significant increase in segmentation accuracy



- We have proposed a methodological approach capable of performing cell tracking and the extraction of protruding cell regions for cell-based morphological analysis.

Future Research

- In future research we will focus on developing a system to automatically classify morphological features that can easily be integrated with our tracking and post-processing system.
- Due to some thresholds in our tracking algorithm not being fully optimized, cells were occasionally not tracked. This problem will be corrected in future work.



References

[1] R. Bise, Z. Yin, and T. Kanade, "Reliable Cell Tracking By Global Data Association", IEEE International Symposium on Biomedical Imaging, 2011.

[2] Z. Yin, Kang Li, T. Kanade, and M. Chen, "Understanding the Optics to Aid Microscopy Image Segmentation", International Conference on Medical Image Computing and Computer Assisted Intervention (MICCAI), 2010.

Acknowledgements

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