Cell Nuclei Tracking

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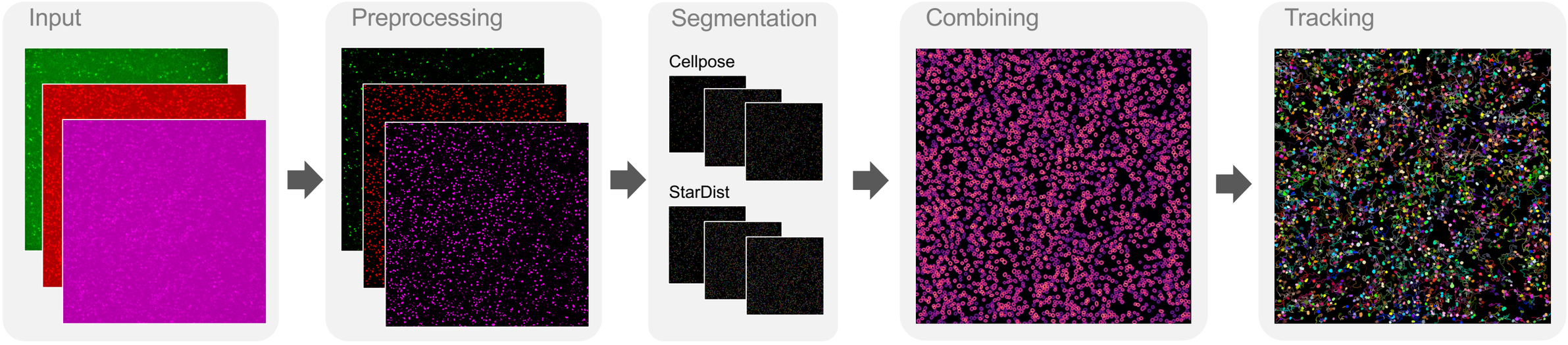


Method

Preprocessing

All channels are normalized and background is removed.

Segmentation

Channels are segmented individually with StarDist [3] and Cellpose [4], two Unet based DL methods.

Tracking

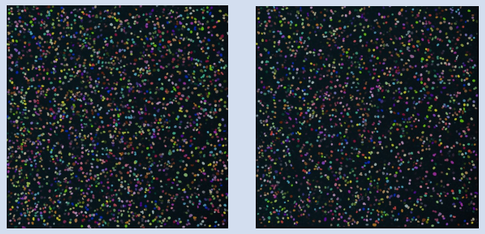
Ultrack [1] is used for tracking. Tracks and segments are computed using a watershed hierarchy of segmentation hypotheses. Disjoint segments are selected by maximizing the overlap between adjacent frames.

Postprocessing

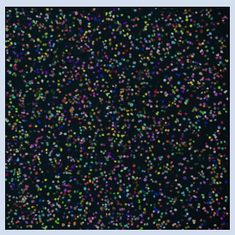
Tracks are cut between frames where the relative color composition of a cell changes too rapidly. Short tracks are removed.

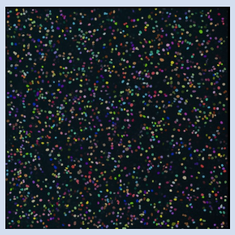
Results

There is a tradeoff between accuracy and processing speed. Depending on requirements and hardware/time constraints, Cellpose segmentation can be omitted and channels can be aggregated before segmentation.


StarDist+Cellpose over all channels

SD+CP over channel aggregate


SD over all channels


SD over channel aggregate

Discussion

A full pipeline for cell tracking was developed. Multiple configurations for accelerated processing are available and the results can be filtered based on plausibility assumptions. In addition to the tracks, segmentation masks are provided, allowing for easy and accurate cell feature extraction.

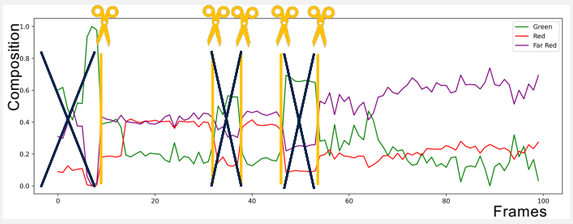
References

[1] J. Bragantini, M. Lange, and L. Royer, Large-Scale Multi-Hypotheses Cell Tracking Using Ultrametric Contours Maps. 2023.

[2] Stringer, C., Wang, T., Michaelos, M., & Pachitariu, M. (2021). Cellpose: a generalist algorithm for cellular segmentation. Nature methods, 18(1), 100-106.

[3] U. Schmidt, M. Weigert, C. Broaddus, and G. Myers, “Cell Detection with Star-Convex Polygons,” in Medical Image Computing and Computer Assisted Intervention - MICCAI 2018 - 21st International Conference, Granada, Spain, September 16-20, 2018, Proceedings, Part II, 2018, pp. 265–273. doi: 10.1007/978-3-030-00934-2_30.

Postprocessing



Visualization