An Auxiliary Task for Learning Nuclei Segmentation in 3D Microscopy Images

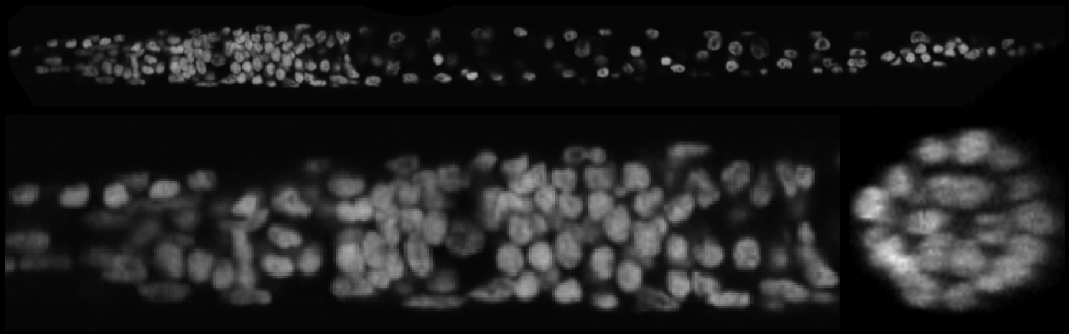
Peter Hirsch, Dagmar Kainmueller

MDC Berlin/BIH

MIDL 2020

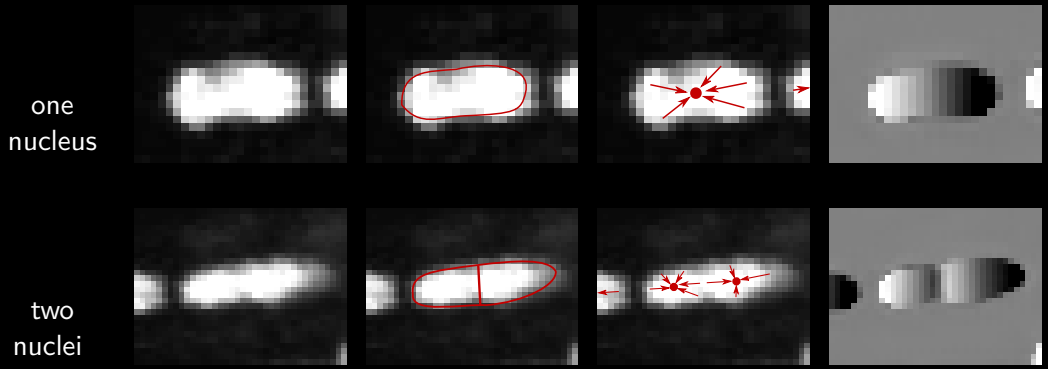
MDC MAX DELBRÜCK CENTER FOR MOLECULAR MEDICINE IN THE HELMHOLTZ ASSOCIATION

BIH Berlin Institute of Health Charité & MDC



C. elegans L1 larva, 3d, near-isotropic $0.116 \times 0.116 \times 0.122 \mu m^3$, average size of $140 \times 140 \times 1100$ pixel

We thank Long et. al [1] for providing the 3d nuclei data and segmentation.


one nucleus
two nuclei
(A) Exemplary nuclei
(B) Boundary label
(C) Center point vectors
(D) Prediction

- consistently get improvement with auxiliary task:
  - +1.5-4% in terms of $AP_{0.5}$
  - +1-2.5% in terms of $avAP$
- StarDist[2]: $avAP$: 0.628, $AP_{0.5}$: **0.765**
- our best model: $avAP$: **0.638**, $AP_{0.5}$: 0.750

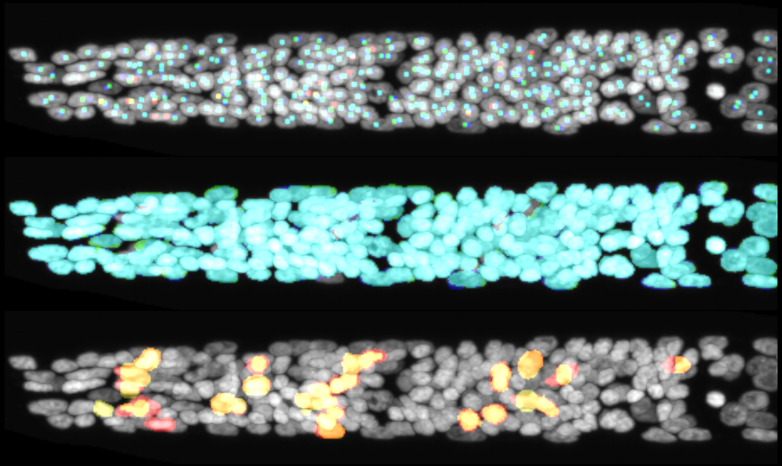
conclusion:

- performance on par with StarDist yet simpler
- easy to integrate into existing systems

Peter Hirsch

Kainmueller Lab
Dagmar Kainmueller

Preibisch Lab
Stephan Preibisch



example detection and segmentation: cyan: TP , yellow: FP, red: FN

MDC MAX DELBRÜCK CENTER FOR MOLECULAR MEDICINE IN THE HELMHOLTZ ASSOCIATION

BIH Berlin Institute of Health Charité & MDC

References

[1] F. Long, H. Peng, X. Liu, S. K. Kim, and E. Myers. A 3d digital atlas of c. elegans and its application to single-cell analyses. *Nature methods*, 6(9):667, 2009.

[2] M. Weigert, U. Schmidt, R. Haase, K. Sugawara, and G. Myers. Star-convex polyhedra for 3d object detection and segmentation in microscopy. *arXiv:1908.03636*, 2019.