CAS-CN

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Platform: Linux

Prerequisites: Python 3.7

CAS-CN: SUMMARY

Our method follows the tracking by detection paradigm and combines per-frame CNN prediction for cell segmentation with a Siamese network for cell tracking.

CAS-CN: PREPROCESSING

The preprocessing step consists in applying mean filtering histogram equalization.

CAS-CN: SEGMENTATION

First, the U-Net framework [1] is employed for the pixel-wise segmentation, with convolutions replaced by residual convolution blocks to improve the performance. A flipping test is also employed to obtain a better performance. Next, with the shared backbone, an additional 1×1 convolution is added in parallel to the mask prediction branch to predict the center regions of each cell. The reference cell centers are obtained by the erosion operator. Finally, a morphological watershed routine is applied to generate the cell masks.

CAS-CN: TRACKING

The tracking step is based on the cell segmentation masks. Individual frames are processed continuously to accomplish the judgment of cell collision and division. First, we compare the previous frame at *t-1* and the current frame at *t* to accomplish a cell-by-cell decision for cell collision. Multiple cells in *t-1* matching a cell in *t* means a crash, and re-segmentation is needed in the collision area. Next, we judge the division events that occur when multiple new cells are birthed at *t*, and record the lineage relationship of the cells accordingly. SiamFC [2] and SiamRPN[3], single object tracking algorithms based on the siamese network, are selected to establish the cell relationships between successive frames. The cell target is initialized in the very first frame, and its position is predicted in the subsequent frames by the deep tracker. Via calculating the prediction result and the intersection-over-union value of the cells in the next frame, we can determine the cells' subordination and obtain their lineages.

CAS-CN: POST-PROCESSING

No post-processing step was taken.

REFERENCES

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3. Li B, Yan J, Wu W, Zhu Z, Hu X. High performance visual tracking with Siamese region proposal network. In *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition*, 8971-8980 (2018).