HIERARCHICAL RECURRENT SEGMENTATION WITH RESIDUAL REFINEMENT FOR HISTOPATHOLOGICAL IMAGE SEGMENTATION

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Paper under double-blind review

ABSTRACT

Accurate cell instance segmentation in histopathology is difficult because cells exhibit substantial appearance variation, irregular morphology, and frequent overlap or contact. We propose HRSM, an adaptive hierarchical recurrent model for flow-based cell instance segmentation. The model alternates between local refinement, which improves boundary localization and separation of touching cells, and global refinement, which leverages image-level context to correct ambiguous instance assignments. We further introduce an Adaptive Stopping Mechanism (ASM) that selects the required number of recurrent updates for each input, reducing unnecessary computation while preserving prediction quality. Experiments on the UCSB Breast Cancer Cell Dataset and MoNuSAC test dataset demonstrate competitive segmentation performance. The proposed approach outperforms the CellposeSAM baseline in terms of Intersection over Union (IoU) and Average Precision (AP), while reducing the average number of refinement steps. Ablation studies show that both hierarchical refinement and adaptive stopping contribute to the observed gains. Our results demonstrate that input-adaptive local-global iterative inference can improve the accuracy–efficiency trade-off in cell instance segmentation.

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