Transfer learning for cell detection in bone marrow smears

Farina Kock[1], Martina Pontones[2], Tabita Ghete[2], Markus Metzler[2], Henning Höfener[1]

1) Fraunhofer MEVIS, Institute for Digital Medicine, Germany
2) Department of Pediatrics and Adolescent Medicine, University Hospital Erlangen, Germany

Introduction

With increasing availability of medical datasets from multiple sources, the use of transfer learning can enhance the performance of deep neural networks. In this study, we compare different strategies to include external data sources into the training to boost the performance of a network with respect to our internal dataset while maintaining generalizability.

Material and methods

We use an external dataset of 512 regions of interest (ROIs) and a smaller internal dataset of 172 ROIs, both for cell detection in bone marrow smears. We train CenterNet and Faster R-CNN (FRCNN) on these datasets in different ways, namely a) each of the two datasets individually, b) both datasets combined (with and without balancing), and c) pre-training on the external dataset and fine-tuning on the internal dataset (with and without frozen backbone).

Results

When evaluated on the internal test set, both architectures show low F1-scores for a) when trained on external data only (CenterNet: 0.73, FRCNN: 0.79) and high scores on internal data only (CenterNet: 0.94, FRCNN: 0.9). However, external test quality is low in the latter case. We can further observe that training strategy b) is outperformed by strategy c) without frozen backbone (CenterNet: 0.92, FRCNN: 0.9). Furthermore, average distance between predicted and reference cells is lower for FRCNN (2.27 vs. 13.34).

Conclusion

While CenterNet provides better F1-scores, FRCNN predicts cell positions much more accurately. To increase cell detection quality in bone marrow smears while maintaining generalizability, pre-training on the larger external dataset and fine-tuning with the internal dataset appears to be the best strategy.

Keywords: Transfer Learning, Cell Detection, Bone Marrow Smear, Deep Learning

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Ghete Tabita 1

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