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Synthesizing Training Data for Weakly Supervised Cell Segmentation using Spatially-Adaptive Modulation

Wednesday, October 26, 2022 2:45 PM (15 minutes)

Automatic segmentation and detection of cells is a fundamental task in many medical fields. The extraction of numbers, densities, types, and patterns of neuronal cells is an important instrument to study the structure of the human brain [1] and is a key task in the analysis of images of biological tissue. For example, a supervised cell instance segmentation method [2] was recently used to produce a dataset revealing detailed properties of cell distributions in different cytoarchitectonic regions [3]. Such supervised deep learning approaches, however, require high-quality training data, which prevents their immediate application to data e.g. from different species or modified staining protocols. In this work we combine Spatially-Adaptive Modulation [4] with Simulated+Unsupervised (S+U) learning [5] to drastically reduce annotation demand for the detection of neuronal cell bodies in 1-micron BigBrain data. A simple algorithmic approach provides basic simulated training data that is refined by a generative model to bridge the gap between simulated and real data, while preserving annotation correctness. We apply a self-regularization term to regulate the difference between simulated and refined images. The proposed method generates images with highly realistic appearance. The workflow significantly accelerates the process of providing cell segmentation models for new data domains, as it allows models to be pretrained on large quantities of generated images without manual annotations and can achieve performance close to that of fully supervised methods. The overall instance information in generated data is reliable in that it allows cell detection models trained on this data to form useful feature descriptions regarding the *objectness* of certain patterns. We view this method as a valuable pretraining procedure that may be combined with the concept of fine-tuning to yield well generalizing detection and segmentation models.

References:

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Primary author: Mr UPSCHULTE, Eric (Research Centre Jülich, Institute of Neuroscience and Medicine, Jülich, Germany)

Co-authors: Ms TOUSSAINT, Paule-J. (McGill University, Montreal Neurological Institute, Montreal, Canada); Mr RICHARDS, Blake (McGill University, Mila, Montreal, Canada); Mr HARMELING, Stefan (Technical University

Dortmund, Dep. of Computer Science, Dortmund, Germany); Mr EVANS, Alan (McGill University, Montreal Neurological Institute, Montreal, Canada); Ms AMUNTS, Katrin (Research Centre Jülich, Institute of Neuroscience and Medicine, Jülich, Germany); Mr DICKSCHEID, Timo (Research Centre Jülich, Institute of Neuroscience and Medicine, Jülich, Germany)

Presenter: Mr UPSCHULTE, Eric (Research Centre Jülich, Institute of Neuroscience and Medicine, Jülich, Germany)

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