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Contribution - <Weakly Supervised Tissue Segmentation in Colorectal Histopathology Images>

<DS algorithms with a view towards Machine Learning and Artificial Intelligence>

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Abstract

Precise tissue segmentation of histopathology images is often a crucial step in computational pathology pipelines. However, visual scoring by pathologists is very sensitive and depends on their experience and perception. Therefore, there is a need of novel automatic digital histopathology imaging systems to improve the accuracy and reproducibility of pathologist's interpretations by eliminating inter- and intra-observer variability. Here, we propose a new approach to conquer this task, namely group affinity weakly supervised segmentation (GAWS) with the following pipeline. First, we create an output image by extracting the visual feature of each pixel using convolutional neural network (CNN) and assigning it into different clusters. Then, we create a target image by refining this output image with the constraints on prior tissue, color, and spatial distribution of pixels. Finally, a backpropagation process with a segmentation loss is considered to evaluate the error signals between output and target images and update the network parameters. We validate our method with area tumor quantification using a colorectal cancer (CRC) clinical dataset with 163 Hematoxylin and Eosin (H&E) whole slide images (WSI) from 97 patients. Inter-observer agreement between pathologists and algorithm was excellent (ICC=0.917). Our approach shows more accuracy compared with the ICC score of two state-of-the-art weakly supervised and unsupervised segmentation methods TWS (0.882) and MorphGAC + CRF (0.851). Our results show that the GAWS results in a high average accuracy and excellent reliability when applied to histopathology images and may be a promising method for inclusion into clinical practice. This approach takes the advantage of weakly supervised learning without any pre-trained network to have a better tumor quantification tool that could improve the pathologist's workflow.