A Reader Study on a 14-head Microscope

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Content

In this work, we conducted two feature studies on detecting mitotic figures (MFs) with whole slide images (WSI) and a microscope.

Technology

Supervised image analysis algorithms are only as good as the ground-truth on which they are trained and tested. The most practical ground-truth is a pathologist's assessment with WSI. These are limited as the pathologist is unable to focus on nearby planes of a section (as can be done on a microscope). Another limitation arises from inter-pathologist variability. To overcome these limitations, we propose collecting ground truth from multiple pathologists using a microscope.

Design

We used a custom hardware and software evaluation environment for digital and analog pathology that allows us to automatically present the same regions of interest (ROIs) to a pathologist on a microscope or WSI. In Study 1 we collected MF counts and locations in 40 ROIs from 4 H&E slides of canine oral melanoma (five pathologists, institutional guidelines regarding animal experimentation were followed). The ROIs were 200 um x 200 um (800 x 800 pixels at 0.25 um/pixel; Aperio AT2). Study 2 was conducted on a 14-head microscope

(four original + six new pathologists, working independently). We collected MF counts and locations on the same 40 ROIs. In Study 2 we also asked the pathologists to quantify their confidence that a candidate was an MF.

Results

In Study 1, the pathologists identified 94 "candidate" mitotic figures, and they identified more with the microscope than with the WSI (See Table 1). We call them candidate MFs because only 18 of 94 were unanimously identified. In Study 2, the pathologists identified 170 candidates. More pathologists lead to more candidates. Lastly, we did not find noteworthy differences in the between-reader variability in count differences across the modalities studied (Table 1). More results will be presnted at the conference.

Conclusion

Detecting and quantifying mitoses is an important pathology task when evaluating tumors of various subtypes; it is also challenging and burdensome to pathologists, subject to significant pathologist variability. Future studies are underway, leveraging the results of these two studies, to train or test an automated mitosis detection algorithm.

Table 1: Preliminary Results

desc	Average Counts	Std of Average Counts	Std of Between-Reader Paired Count Differences
Study 1: Digital	1.22	0.23	1.29
Study 1: Microscope	1.48	0.27	1.12
Study 2: Multi-Head Microscope	1.54	0.25	1.07
Study 1: Microscope - Digital	0.26	0.12	1.20