Deep-UV excitation fluorescence microscopy for detection of lymph node metastasis using a deep neural network

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Hematoxylin and eosin stain, namely H&E stain, has been utilized for pathological diagnosis as the gold-standard histological stain. There is no alternative as long as pathologists inspect stained slides. We developed a fluorescence microscope equipped with a deep-UV (λ = 285 nm) LED and an objective lens (10×/0.3NA), for detection of lymph node metastasis with the aid of a deep neural network (DNN). DNA and RNA were stained with DAPI and terbium ions respectively so that nuclei, nucleoli, and cytoplasm were visualized [1]. Fluorescence images of metastasis-positive/-negative lymph nodes of gastric cancer patients were used for patch-based training and validation with open-source DNN algorithms as well as for patch-based test of metastasis detection (Fig. 1). The metastasis detection accuracies of the models using the fluorescence images were 98%, that is comparable to the value by DNN models using correspondent H&E images [2]. We extended the method to wide-field-of-view (i.e., 1 mm × 1.2 mm) image analysis for clinical application in practice. The extended method detected the metastatic lesions as accurate as an experienced pathologist (Fig. 2). We will also discuss advantages of the presented approach in assisting pathologists to assess sentinel lymph node metastasis.
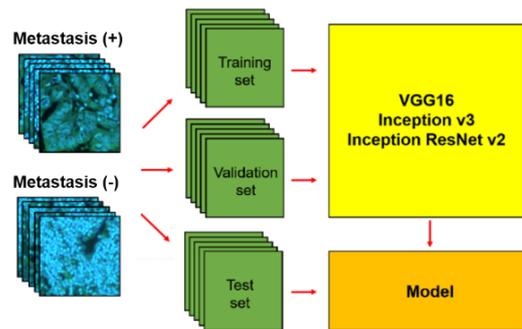

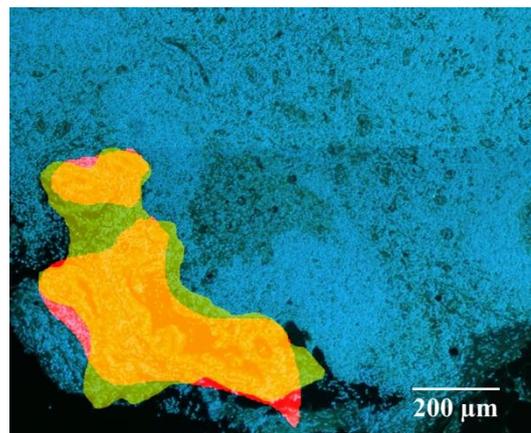Fig. 1. Workflow to establish DNN models for detecting lymph node metastasis by the fluorescence images.

Fig. 2. Metastatic lesion detection through the wide-field-of-view image analysis by the established DNN model (in red) and by an experienced pathologist (in yellow).

References

[1] Kumamoto Y., et al, *Sci. Rep.*, **9**, 10745 (2019).
[2] Matsumoto T., et al, *Sci. Rep.*, **9**, 16912 (2019).