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種別(和文)	論文要旨
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（博士課程）
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論 文 要 旨

THESIS SUMMARY

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要旨（英文 800 語程度）
Thesis Summary（approx.800 English Words ）

Cancer is a major health problems around the world. Pathology is a microscopic study of tissue structure to examine disease. Pathologists diagnose disease by visual interpretation. However, the diagnosis result may not consistency and it also depend on pathologist experience. Moreover, computer aided diagnosis system may assist pathologist to analyze efficiently. The objective of this study is to implement a computational method to describe nuclear characteristics of pathology images and classify cancer in hepatocellular carcinoma and thyroid tumor. Cancer diagnosis is analyzed based on nuclear properties. Except traditional color image, this study investigate multispectral images and 3D images to analyze cancer. The system mainly contains two parts. First, nuclei segmentation is performed based on pixel-based classification. Lastly, Bag-of-visual-word model and random forest classifier are investigated in classification step. This thesis contains two main studies.

First study focused on classify HCC in multispectral images. The nuclei structure has a significant interpretation for cancer analysis in histopathological microscopic images. We analyzed hepatocellular carcinoma in 100x magnification from nuclear chromatin patterns. The multispectral imaging is a new potential technique for histopathology. It may provide an alternative to pathologists to see additional information. This study utilize multispectral images which have spatial and spectral information for nuclear analysis. The proposed framework is based on texture analysis of nuclei. The system aim to analyze the significant of multispectral bands for discriminating cancer and non-cancer nuclei. The textural features were extracted using Gabor descriptors. We present nuclei textural feature with 30 Gabor patterns at different scales and orientations. Bag-of-visual-word model with random forest classifier is employed to classify normal and cancer cells. Moreover, we remove irrelevant Gabor parameters using optimization algorithm, which achieve high recognition performance significantly. The experimental results shows that the use of optimized Gabor parameters improved classification accuracy of all multispectral bands comparing with using full set of Gabor parameters. For individual multispectral band analysis, most of multispectral bands have similar classification accuracy. Specifically, the 1^{st}, 2^{nd}, 4^{th}, 5^{th} and 8^{th}– 12^{th} bands achieve 99 % of classification accuracies approximately. However, 3^{rd}, 6^{th}, 7^{th} and 13^{th} bands and 15^{th}–16^{th} bands obtain 98.60 % and 97 %, respectively. In summary, the textures of nuclei obtained from wavelength 418-467 nm., 481-513 nm. and 548-641 nm. are adequate to classify normal and HCC in high-magnification. Our approach shows that multispectral images provide meaningful feature in terms of classifying normal and HCC nuclei. It was also proved that nuclei texture is sufficient to classify normal and HCC.

Second study performed on classification of favor benign and borderline types in follicular thyroid adenoma (FTA) of volumetric data. The subclassification of follicular neoplasm (FN) plays an important role for clinical management in Japan. The diagnosis system of indeterminate thyroid nodule is intended to stratify a health risk status of patient. However, it is difficult to separate the favor benign from borderline types, and the classification process normally requires an experienced pathologist. We present a new methodology to detect nuclei in 3D image stack based on unsupervised learning. We applied pixel-based classification technique to segment nuclei in each slice by utilizing k-mean clustering and random forest classifier. Consequently, 3D nucleus model is created by combining regions among slices according to their similarities. Our proposed method can work with complex background, different levels of image noises, and inconsistent of color-intensities. Furthermore, 3D shape model is investigated to analyze sub-categories of FN between favor benign and borderline in FTA. The classification approach based on 3D nuclei model are performed for classification. We investigated the use of GLCM and Gabor descriptors to extract volumetric texture features of chromatin patterns inside nuclei. Subsequently, the random forest classifier and majority voting strategy were performed to characterize favor benign and borderline. Moreover, experimental results showed that the use of volumetric feature descriptors including 3D GLCM method 2 and 3D Gabor method 2 achieved 95.45 % of classification performance. However, the 3D GLCM method 1 and 3D Gabor method 1 descriptors gave 90.91 % of classification accuracy. The classification rate of 2D GLCM and 2D Gabor were 86.36 % and 81.82 %, respectively. Even though, 3D GLCM method 2 and 3D Gabor method 2 descriptors achieved same classification accuracy. However, the computational time of 3D Gabor method 2 is three times faster than 3D GLCM method 2. Consequently, the proposed method probably helps a pathologist as a pre-screening tool.