
ABSTRACTS (MASTER THESIS)

Identification of two anatomically similar Cupressaceae species using two-dimensional MFA mapping

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Introduction

Wood identification is an important task for the better understanding of Japanese cultural background. One of the representative examples is the identification of *Chamaecyparis obtusa* and *Thujopsis* spp. because their usage has strongly depended on the ranks and localities of traditional buildings in spite of their similarities. Conventionally, they have been identified by the observation of cross-field pitting in earlywood appearing junctions between tracheids and rays. However, this methodology cannot give us a clear answer in many cases. Our research aims to invent a brand-new technique for the identification of *C. obtusa* and *Thujopsis* spp. via a quantitative criterion. Hence, we introduce MFA in a two-dimensional manner and extract wood species specific features from MFA using image recognition techniques.

Methods

Present and old wood specimens of *C. obtusa* and *Thujopsis* spp. were prepared (12 specimens each in present and 2 specimens each in old). Their cross sections in 10 μm thickness were cut using a sliding microtome and sealed by gum chloral. These sections were put on a revolving stage of a polarized optical microscope equipped with a sensitive color plate and 40x objective lens. Radial and tangential walls were roughly parallel to a slow and fast axis of the plate. For quantifying interference colors, hyperspectral images targeting a part of visible light regions (461-602 nm) were acquired by a CCD camera equipped with a liquid crystal tunable filter. Hyperspectral images were converted to two-dimensional retardation and MFA images using crystal optics equations. Finally, almost 500 images were obtained (10-20 images per one specimen). For utilizing two-dimensional information of MFA, a convolutional neural network (CNN) called VGG16 [1] was applied to the two-class (*C. obtusa* and *Thujopsis* spp.) classification problem. Accuracy decay by channel-wise erasing and Grad-CAM [2] were implemented for the sake of the interpretation of results obtained by CNN.

Results and discussions

Classification accuracy reached almost 90% in the both cases, present and old wood specimens. These results strongly suggest the applicability of MFA for extracting and describing wood anatomical features. Large accuracy decays were observed selectively in small and middle MFA regions (0° - 20°). In addition, Grad-CAM heatmaps highlighted only radial walls in *C. obtusa* and tangential walls in *Thujopsis* spp. as grounds for decision makings by CNN. These visualizations implied that MFA anisotropy in S_2 wall induced by pits creates wood species specific characteristics discriminating them.

Acknowledgements

This study was supported by Grants-in-Aid for Scientific Research (Grant Numbers 17F17402, 18H05485) from the Japan Society for the Promotion of Science, RISH Cooperative Research (2019ZAIKAN-06), and RISH Mission Research V.

References

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