
 ABSTRACTS (MASTER THESIS)

Computer vision application for quantitative analysis of anatomical features in Fagaceae woods

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Introduction

Fagaceae plants grow within Japan naturally and these species are excavated from some ruins. Therefore, it is conceivable that they had been used in dairy life since ancient time. Fagaceae plants have various anatomical features such as porosity; porous-wood, diffuse-wood and radial-wood, hence it is easy to classify by genus [1]. On the other hand, it is very difficult to identify species because anatomical characteristics are quite similar among genus or subgenus. In recent years, computer vision system is commonly used for face recognition and so on. Then wood recognition using this system has been studied for the purpose of identification of tree species of wooden cultural properties or safe trading of logs and timber. The purpose of my master study is to extract possible anatomical features among Fagaceae that may allow us identification or classification at species level by means of the computer vision, which are not able to obtain by our visual inspection.

Experiment

Wood samples of 18 Fagaceae species were selected from the xylarium collection at RISH, Kyoto University. The optical microscopic images were obtained using Olympus BX51 equipped with a digital camera. The database consists of 540 microscopic images, namely 30 images per 1 species. SIFT-LDA were calculated by Scale-invariant feature transform (SIFT) followed by linear discriminant analysis (LDA). SIFT-LDA feature vectors were analyzed by some statistical analyses such as cluster analysis and multiple regression analysis.

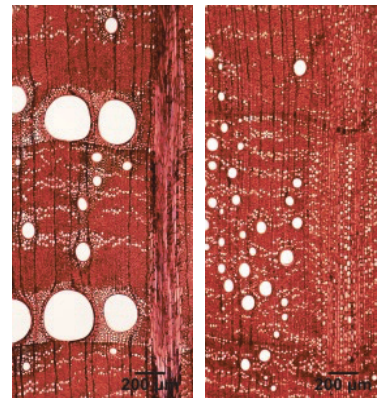


Fig. 1: Microscopic images of Fagaceae species.

Left: *Quercus acutissima*

Right: *Quercus phillyraeoides*

Results and discussion

High accuracy up to 99.44% by SVM discriminator using SIFT-LDA features calculated from 4.5 $\mu\text{m}/\text{pixel}$ images. In addition, k-means unsupervised clustering based on the dataset, a dendrogram of taxonomically accurate at the subgenus and section levels were obtained. In the dendrogram, *Quercus phillyraeoides* of radial-porous wood belongs to subgenus *Quercus* in which ring-porous species are dominant. It is because section Ilex containing *Quercus phillyraeoides* and section Cerris have similar arrangement of vessels and axial parenchyma cells in the latewood (Fig.1). Furthermore, the regression analysis using SIFT-LDA and estimated anatomical features suggested that frequency, porosity and aspect ratio of vessel elements are important factors for identifying species in Fagaceae.

References

[1] Shimaji Ken, "Anatomical studies on the phylogenetic interrelationship of the genera in the Fagaceae.", *Bull. Tokyo Univ. Forests*, 57, pp. 1-64, 1962.