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LAURACEAE TIMBER IDENTIFICATION USING VISION TRANSFORMER

Chieh-Hsiu, Teng 1 , Chin-Mei Lee 2 , Yan-Fu Kuo 1*

1 Department of Biomechatronics Engineering, National Taiwan University, Taipei, Taiwan.
2 Forest Products Utilization Division, Taiwan Forestry Research Institute, Ministry of Agriculture,

Taipei, Taiwan

* Corresponding Author: ykuo@ntu.edu.tw

ABSTRACT

The forest coverage in Taiwan exceeds 60%, yet over 99% of annual timber consumption relies on imports. This significant dependence, coupled with frequent incidents of wood misidentification and fraud, highlights the need for accurate and efficient wood species identification systems. Conventional approaches, such as microscopic analysis and sensory-based macroscopic inspection, are labor-intensive, subjective, and require domain expertise, making them unsuitable for large-scale or real-time applications. In this study, we propose an automated wood identification system based on deep learning, using cross-sectional images of Lauraceae timber. A total of 29,070 training and 6,857 validation images were collected using flatbed scanners at 1200 DPI. The images were hand-labeled and processed into patches to form a high-resolution dataset. A Vision Transformer model ViT_Base_Patch32_384 was trained on RGB input images and achieved an accuracy of 97.17% across ten Lauraceae species. Despite minor misclassifications among species with similar morphological features, the model demonstrates strong overall performance and robustness. This work confirms the effectiveness of transformer-based architectures for wood species classification and provides a scalable, accurate, and low-labor alternative to traditional identification methods, with broad applicability in forestry management, timber trade verification, and ecological conservation.

Keywords: Vision Transformer (ViT), Macroscopic Cross-Sectional Image, Wood Species Classification, Deep Learning, Lauraceae Timber

INTRODUCTION

Traditional identification methods, such as microscopic and macroscopic analysis, are time-consuming, subjective, and require expert knowledge, making them unsuitable for large-scale or real-time applications.

To address these limitations, this study explores an automated wood identification approach using a Vision Transformer model trained on high-resolution cross-sectional images of Lauraceae timber. By leveraging deep learning and image-based features, the proposed method aims to provide a scalable and objective solution to timber classification challenges.

MATERIALS AND METHODS

Cross-sectional timber samples were manually prepared by shaving the surface to ensure clarity for imaging. High-resolution images were acquired using an EPSON V370 flatbed scanner at 1200 DPI.

The scanned images were annotated using the Labeling tool and then segmented into smaller patches to construct a dataset suitable for deep learning. All images were processed in RGB format and resized to 384 × 384 pixels.

A Vision Transformer (ViT-Base) architecture with a patch size of 32 was adopted for classification. The dataset was divided into training and validation subsets with an 8:2 ratio.

RESULTS & DISCUSSION

ViT_Base_Patch32_384 model achieved a testing accuracy of 97.17% on a dataset comprising ten Lauraceae timber species. The model effectively captured anatomical features from high-resolution cross-sectional images.

Despite the high overall accuracy, misclassification occurred mainly among *Machilus kusanoi*, *Machilus zuihoensis*, and *Cinnamomum randaiense*. These species exhibit highly similar macroscopic structures, which remain difficult to distinguish even with color calibration. Furthermore, the dataset was unbalanced, with some species represented by significantly more image patches than others. This imbalance may have contributed to classification bias and reduced the model's generalizability across underrepresented species.

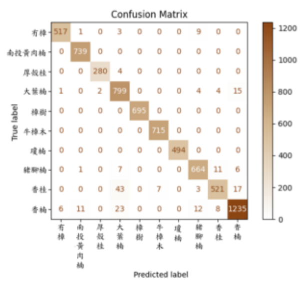

Fig. 2 Confusion matrix of model predictions across 10 Lauraceae species.

CONCLUSIONS

This study demonstrates the feasibility of using Vision Transformer models for automated classification of Lauraceae timber species based on high-resolution cross-sectional images. The proposed method achieved high accuracy and shows potential for supporting wood identification in forestry, trade, and conservation applications. However, classification challenges remain for visually similar species and imbalanced datasets. Addressing these issues through data augmentation, expanded species coverage, and model refinement will be key to improving real-world applicability.

REFERENCES

Barmpoutis, P., K. Dimitropoulos, I. Barboutis, N. Grammalidis, and P. Lefakis. 2018. Wood species recognition through multidimensional texture analysis. *Computers and Electronics in Agriculture* 144: 241–248.

Wu, F., R. Gazo, E. Haviarova, et al. 2021. Wood identification based on longitudinal section images by using deep learning. *Wood Science and Technology* 55: 553–563.

Yang, J., P. Huang, F. Dai, Y. Sun, L. Wang, and H. Bi. 2019. Application of deep learning in wood classification. In *2019 IEEE Int. Conf. on Computer Science and Educational Informatization (CSEI)*, 124–129. Kunming, China: IEEE.