

Valorizing xylaria using computer vision-based wood identification: a case study on the INERA-Yangambi xylarium

Xylaria provide crucial reference materials for botanical studies, wood anatomical research, and forensic investigations. However, the accuracy of specimen identification within these collections is not always guaranteed, as specimens with dubious origins can enter collections, risking research integrity. Ascertaining the taxonomy is therefore crucial.

Although a full wood anatomical assessment could theoretically identify all specimens, this process would be impractically time-consuming, requiring years of intensive microtomy work. Artificial intelligence offers a faster, more economical solution. Computer vision-based wood identification uses wood images as diagnostic information to develop models that can distinguish timbers. This method enhances the reliability of xylaria, thereby increasing the trustworthiness of the research performed on them.

The objective of this study was to classify 58 Congolese wood genera through precise multiclass classification. The Xception architecture was leveraged on macroscopic cross-sectional RGB images, utilizing the SmartWoodID database derived from the Tervuren xylarium as training data. A total of 1700 specimens were divided into training (80%) and test (20%) datasets while maintaining species balance. Images were cropped into square patches with a side length of 5.42mm. Five-fold cross-validation was used for evaluation, and the most performant model was applied to the xylarium of the INERA-Yangambi research center.

Performance was assessed by calculating recall scores for all genera across folds for all patches, and for aggregated results per specimen. The predicted genus for each specimen was determined by majority vote on patch predictions and compared to the specimen's recorded genus. In total, 193 specimens of the INERA-Yangambi xylarium were classified. Among these, 57 specimens were misclassified at the genus level.

This research demonstrates that AI can significantly enhance the accuracy and reliability of xylaria, facilitating more dependable botanical and wood anatomical studies.