Lidar-Detectable Feature Variation in Northern Hardwood Species

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Abstract

This study explores cross-species variations in structural metrics derived from individual tree lidar scans and analyzes the structural characteristics of trees at both the individual and plot levels. Understanding the species composition of forests is vital for assessing ecosystem health and biodiversity. For this reason, much research has been dedicated to distinguishing between species through remotely sensed datasets; however, the goal of remote species identification remains unrealized. Progress has been hindered by two key challenges: 1) the lack of precisely georeferenced ground validation data, and 2) insufficient consideration of 3D environmental factors such as terrain, understory layers, and the structural entanglement of natural forests. In this study, we address these challenges by compiling a ground validation dataset comprised of precisely high-density laser scans at 60 forest inventory plot locations. Within this dataset, each of the 1200 trees is segmented and paired with a manually verified species label. Using this comprehensive dataset, we first isolate individual trees and investigate cross-species variations in lidar feature metrics. Subsequently, we examine how these structural features vary within the context of the micro-environment of their respective plots. Our analysis also explores how factors such as terrain and neighboring species impact structural feature variance. Our findings suggest that detectable structural features hold significant potential in accurately assessing biodiversity and determining the species composition within forests.

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