Smartphone-Based Tree Diameter Measurement Using Single Snapshot

Wang Xiang[1], Song Zhang[1], and Songlin Fei[1]

[1]Affiliation not available

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Abstract

This paper presents an inventive and precise methodology for measuring tree diameters at specific heights, leveraging iPhones equipped with light detection and ranging (LiDAR) and red, green, and blue (RGB) sensors. Initially, a single snapshot of the tree is captured, incorporating depth and RGB images. Sparse LiDAR data is processed to generate a dense 3D point cloud for each RGB pixel, allowing accurate estimation of the tree trunk's orientation. This raw 3D point cloud is then standardized, ensuring consistency irrespective of the capture angle. A specific band of transformed 3D points around the target height is selected to estimate the initial diameter and the average distance from the tree to the smartphone camera. To enhance accuracy, a precomputed lookup table is utilized. Experimental results showcase the method's efficacy, achieving a measurement accuracy of approximately 1.12 cm in mean absolute error and 0.77 cm in root mean square error for 218 trees within a depth range of 0.2 m to 5 m, using an iPhone 13 Pro. This proposed diameter estimation technique proves invaluable for practical forest inventory applications, given its unmatched reliability and precision. Forestry experts and researchers can significantly benefit from this approach, revolutionizing the way tree measurements are conducted in the field. The integration of smartphone technology with advanced sensors marks a pivotal advancement in the realm of forest assessment, paving the way for more accurate and efficient ecological studies and resource management initiatives.

***Wang Xiang*[1]**, *Song Zhang*[1], *Songlin Fei*[2]

[1] *School of Mechanical Engineering, Purdue University, West Lafayette, USA*

[2] *Department of Forestry and Natural Resources, Purdue University, West Lafayette, USA*

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