**Performance Evaluation of a Lightweight and Low-Cost LiDAR Sensor for Mobile Scanning in Forest Plots**

Fangming W. 1, Jinchen W. 2, Lu X. 3 , Xuan M. 4 and Dan Z. 5\*

1 Engineer, Aerospace Information Research Institute, Chinese Academy of Sciences, China

2 Graduate Student, Aerospace Information Research Institute, Chinese Academy of Sciences, China

3 Graduate Student, College of Forestry, Beijing Forestry University

4 Graduate Student, Aerospace Information Research Institute, Chinese Academy of Sciences, China

5 Associate Professor, Aerospace Information Research Institute, Chinese Academy of Sciences, China

[\*zhaodan@aircas.ac.cn](mailto:*zhaodan@aircas.ac.cn)

***ABSTRACT***

Accurate and rapid assessment of forest structure is essential for ecological research, forest management, and environmental monitoring. Terrestrial light detection and ranging (LiDAR) scanning offers a promising approach to rapidly acquire detailed forest plot data. However, its considerable weight and high cost have largely prevented its use in large-scale forest plot surveys. We developed a helmet-mounted mobile LiDAR system (MLS) which incorporated a lightweight, low-cost LiDAR sensor costing approximately $750 USD. The accuracy and efficiency of the system were then evaluated in two forest plots, one coniferous and one decidous. A comprehensive comparison was also made between the developed MLS and a handheld MLS equipped with a high-end laser scanner. The developed MLS effectively captured forest structure and terrain surface information in two forest plots. The estimated individual tree height (TH) and diameter at breast height (DBH) were highly correlated with field measurements (DBH: R2 = 0.99, root mean square error (RMSE) = 0.026 m; TH: R2 = 0.90, RMSE = 1.706 m). The DBH error was smaller for coniferous plots than for decidous plots, but tree height was opposite. Overall, the efficiency and accuracy performance of the developed MLS is comparable to that of the high-end MLS in both plots. Despite its short detection distance and narrow vertical field of view, it is believed that the lightweight and low-cost system developed in this study can alleviate the problems of long field operation time and expensive equipment in most forest inventory applications.

**Keywords:** lightweight LiDAR, mobile scanning, low cost, forest inventory