

Estimation of Timber Volume in Tropical Rainforest using Airborne LiDAR

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Abstract: Airborne Laser Detection and Ranging (LiDAR) has been used extensively for timber volume estimation especially in temperate region. Application of such technology in tropical region specifically in developing countries faces several challenges due to low penetration of laser pulses over tree canopy and relatively low density of point clouds due to the cost constraint. This paper presents a thorough investigation on the capability of ALS data in estimating density of vegetation over Ayer Keroh recreational forest, Melaka, Malaysia. The study area covers about 2 hectare and consists of more than 30 tree species, which dominated by Merawan Siput Jantan (*Hopea odorata*). The airborne LiDAR data was obtained using the Optech ALTM 3100 in 2009 with a posting density of about 0.69 point per meter squared. The estimation of forest timber volume involves five main processing stages, i.e. 1) delineation of individual trees, 2) estimation of individual tree diameter at breast height (DBH) based on allometric equation, 3) estimation of crown diameter, 4) estimation of tree height and 5) estimation of timber volume. Individual tree crown segmentation is based on the inverse watershed (IW) segmentation routine and local maximum (LM) filtering in TreeVaw. Tree height and crown diameter of individual trees are calculated by using canopy height model (CHM) and crown segments. These parameters will be used as input in the allometric equation that is specially developed over tropical region to estimate tree DBH. Based on the estimated DBH, tree height and crown diameter, the timber volume will be calculated at a certain unit area by using a multiplicative method. The final timber volume map is validated using field collected data. In this study, the results are presented as a map of average of timber volume for every one acre in the study area. Correlation between field collected tree height, DBH, crown diameter and timber volume with values extracted based on the ML individual tree delineation are 0.59, 0.72, 0.72 and 0.79 respectively. On the other hand for IW segmentation, the correlation values for tree height, DBH, crown diameter and timber volume are lower than the ML approach with 0.26, 0.03, 0.16 and 0.05 respectively. The root mean square (RMSE) value for timber volume estimation by using IW segmentation capable of producing timber volume map with the accuracy about 111.31m³/acre. Whereas for LM filtering capable of estimating timber volume with RMSE of 73.62m³/acre.

Keyword: Timber volume, airborne LiDAR, allometric, tropical rainforest.