

Stem shape and volume of standing tree based on TLS point cloud inversion mixed-forest management

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Abstract

Objects:

Agroforestry is a sustainable land management mode to solve the current problems of resource depletion and land use contradiction through planting mixed-forest. Mixed-forestry management can directly change the forest stand structure by adjusting the management allocation per unit area, and it has the multi-level characteristics composed by various vegetation types to achieve the corresponding management objectives. With the support of active remote sensing technology, three-dimensional point cloud scanned by TLS (Terrestrial laser scanning) can be quantitatively monitored in agroforestry environment.

Method:

This research took the Chinese fir mixed-forest in Gaofeng Forest Farm of Guangxi Province, South China as the research object, including four planting species: *Cunninghamia lanceolata* (Lamb.) Hook., *Phoebe bournei* (Hemsl.) Yang, *Manglietiastrum sinicum*, *Sarcandra glabra* (Thunb.) Nakai., with three mixed management: LP(*Cunninghamia lanceolata* (Lamb.) Hook. - *Phoebe bournei* (Hemsl.) Yang), LM(*Cunninghamia lanceolata* (Lamb.) Hook. - *Manglietiastrum sinicum*), and LS (*Cunninghamia lanceolata* (Lamb.) Hook. - *Sarcandra glabra* (Thunb.) Nakai.) A series of the height-related characteristic parameters were extracted from the scanned points of each tree stems, including a proposed new parameter and the height cumulative percentage (Hz%).

Then the differences of growth, stem shape, yield and height cumulative percentage (Hz) inflection point of Chinese fir under three mixed-forest modes were compared, and the stem taper equation and yield table of different mixed-forest modes were established.

Results:

1) The upper diameter accuracy obtained by multi-station scanning is high, and the correlation coefficient with manually measured data is 0.9864. The modified five-parameter Schumacher equation is the best stem form equation in this study. With R^2 0.963, 0.896, 0.919 for each mixed-forest.

2) Mixed management with *Manglietiastrum sinicum* shows more conducive to the growth of Chinese fir. The average diameter at breast height (DBH), tree height (H) and volume (V) of LM were the largest within the three mixed-forest, which were 25.7714cm, 20.3257m and 0.5195m³. And the cumulative length and volume of large timber, mid-length timber and short timber in the LM plot shows largest output, which were 28.18m, 92.69m and 259.20m, 1.93m³, 2.60 m³ and 2.67 m³.

3) The point cloud characteristic parameters (height cumulative percentage Hz) can reflect

the differences of each mixed-forest modes. The Hz curve of LM is higher than others. The cumulative height percentage curves of LM and LP shows significantly different after H15. The diameter at the height corresponding to the mutation point of LM remains the largest.

Conclusion:

Under different mixed-forest management, the three elements for forest mensuration (DBH, tree height, stem form fact) of standing trees have corresponding differences, and the status of living standing trees can be reflected through the high-precision point cloud data of TLS.