Optimizing operational parameters in a full-waveform LiDAR processing tool for forestry

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Abstract

Full-waveform LiDAR provides more complete information than discrete LiDAR about vertical structure of forest stands, but processing techniques are not yet properly developed, dissuading foresters and practitioners from the use of this type of data for the generation of metrics to estimate fuel, inventory and structure related variables. The occasional commercial processing tools do not cope with the problem of selection of the adequate methodological parameters to improve the performance of the derived metrics, key for the generation of efficient forest variable prediction models. One of the most common procedures to simplify the original information contained in the raw LiDAR pulses or waves consists in the voxelization of the three-dimensional space, converting the initial distribution of wave values into discrete cells or voxels that are easier to manage for further analysis and processing. The vertical dimension of these voxels is directly derived from the temporal sample spacing, a parameter of the system. However, the selection of the appropriate minimum voxel size in X and Y is more related to the density of the LiDAR data and the characteristics of the forest stand. Changes in wave density due to LiDAR acquisition overlap or the voxel value assignation criteria are other parameters that require consideration. Previous studies (Crespo-Peremarch et al., 2016; Ruiz et al., 2016) revealed the influence of these operational parameters on the efficiency of prediction models for forest structural variables based on full-waveform LiDAR at stand level.

We present a full-waveform LiDAR processing tool to process the raw data and to compute metrics at stand/object level performing tasks such as: data import and indexation from LAS 1.3 files, data clipping, voxelization and creation of pseudo-vertical waves (Hermosilla et al., 2014), and generation of metrics. This tool allows the user for the selection of a representative data subset of the area of study and performs the analysis of the main methodological parameters to be considered before voxelization: the variation of the number of values/voxel and empty voxels as (1) voxel size is modified, and (2) as pulse density varies. Based on this automated analysis of methodological factors particularized on each study area, the minimum voxel-size and assignation method can be defined by the user, facilitating the application of these data for forest inventories and studies related to stand structure characterization. We also present a complete analysis of these factors using a dataset from the Panther Creek area, OR, suggesting some future improvements based on the results.

References

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