

EGU2020-10915

<https://doi.org/10.5194/egusphere-egu2020-10915>

EGU General Assembly 2020

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Structural features extracted from voxelised full-waveform LiDAR using the open source software DASOS for detecting dead standing trees

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DASOS is an open source software developed by the authors of this abstract to support the usage of full-waveform (FW) LiDAR data. Traditionally LiDAR record only a few peak point returns, while FW LiDAR systems digitizes the entire backscattered signal returned to the instrument into discrete waveforms. Each waveform consists of a set of waveform samples equally spaced. Extraction of peak points from waveforms reduces data and they can be embedded into existing workflows. Nevertheless, this approach discretizes the data. In recent studies, voxelization of FW LiDAR data has been increased. The open source software DASOS uses voxelization for the interpretation the FW LiDAR data and has four main functionalities: (1) extraction of 2D metrics, e.g. height, density, (2) reconstruction of 3D polygonal meshes from the data (3) alignment with hyperspectral imagery for generating aligned metrics with the FW LiDAR data and colored polygonal meshes, (4) extraction of local features using 3D windows, e.g. standard deviation of heights within the 3D window.

Here, we do not only present the functionalities of DASOS but also how the extraction of complex structural features from local areas, 3D windows, could be used for improving forest inventories. In Southern Australia, dead trees plays a substantial role in managing biodiversity since they are more likely to contain hollows and consequently shelter native, protected species. The study area is a native River Red Gum (*Eucalyptus camaldulensis*) forest. Eucalypt trees are difficult to delineate due to their irregular shapes and multiple trunk split. Using field data, positive (dead standing trees) and negative (live trees) samples were defined and for each sample multiple features were extracted using 3D windows from DASOS. With 3D object detection, it was shown that it is possible to detect them without tree delineation. The studies was further improved with the introduction of multi-scale 3D windows for categorizing trees according to their height and doing a three pass detection, one for each size category. By cross validating the results, it was shown that the multi-scale 3D-window approach further improved detection of dead standing Eucalypt trees. The extraction of structural features using DASOS and the methodology implemented could be applied to further forest related applications.

The project 'FOREST' (OPPORTUNITY/0916/0005) is co-financed by the European Regional

Development Fund and the Republic of Cyprus through the Research Innovation Foundation.