

AN ARTIFICIAL TREE/STAND MODEL COMBINED WITH DIFFERENT ILLUMINATION STRATEGIES FOR THE RETRIEVAL OF FOREST STAND STRUCTURAL PARAMETERS

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ABSTRACT:

A new method for the estimation of forest stand density (trees/ha), crown diameters (m) and crown closure (percentage covered) using artificially generated reference imagery is presented. The method presented makes extensively use of artificial forest stands using a tree model that allows for the specification of individual crown and stem shapes, leaf density and LAI. Crown projections are possibly-asymmetric, combined ellipses. The presence of holes in the tree crowns is governed by horizontal and vertical probability distribution functions. Artificial trees are inserted into artificial stands using positional, areal and volumetric constraints. The tree/stand model is implemented to work with two illumination strategies. A naïve illumination method using a freely available ray-tracer (POV-Ray) is compared with a state of the art radiative transfer model (DART) that is capable of simulating multispectral very high resolution imagery. The necessary species specific leaf reflectance is derived from a historical database pertaining to a large number of Flemish forest species. The database contains data recorded in several stages of the growing season, allowing for the simulation of forest stands in different seasons / months. Calibration and evaluation of the presented stand generation method is done by using inventory data recorded in summer 2005, together with IKONOS imagery. In order to test the artificially generated imagery for its applicability, a number of artificial images are generated, containing stands with varying density, cover, crown diameters and crown shapes. Afterwards, model inversion is applied by relating several scene derived statistics with stand density, crown diameter and crown closure. Scene statistics include local variance, the distances between directional local maxima and minima, and wavelet coefficients on different scales. The derived relationships are validated using real very high resolution multispectral imagery for which reference data is available. Where possible, the applicability of the derived statistics is put in perspective by comparing with previously derived stand structure estimation methods.