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Density-Based Individual Tree Detection from Three-Dimensional Point Clouds

Carlo Camporeale, Melissa Latella, and Fabio Sola
DIATI - Department of Environmental, Land and Infrastructure Engineering, Politecnico di Torino, 10129 Torino, Italy
(carlo.camporeale@polito.it)

The use of three-dimensional point clouds in forestry is steadily increasing. Numerous algorithms to detect individual trees from point clouds and derive some fundamental inventory parameters have been proposed so far, but they usually provide higher accuracy in coniferous stands than in deciduous one. In the latter kind of stands, indeed, the tree identification is hampered by the geometrical round shape of the crowns, the interlacing branches of adjacent trees and the usual presence of understory vegetation.

In an attempt to overcome these limitations, we developed an algorithm that is innovatively based on the areal point density of the three-dimensional cloud and that provides the height and coordinates of all the trees within a region of interest.

In this work, we apply the algorithm to different situations, ranging from the regularly-arranged plantations to the very interlaced crowns of the naturally established stands, demonstrating how it is able to correctly detect most of the trees and recreate a map of their spatial distribution. We also test its capability to deal with relatively low point density and explore the possibility to use it to recreate time series of vegetation biomass. Finally, we discuss the algorithm's limitations and potentialities, particularly focusing on its coupling to other existing tools to deal with a wider range of applications in forestry and land management.