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TreeON: reconstructing 3D tree point clouds from orthophotos and heightmaps

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We present TreeON, a novel neural-based framework for reconstructing detailed 3D tree point clouds from sparse top-down geodata, using only a single orthophoto and its corresponding Digital Surface Model (DSM). Our method introduces a new training supervision strategy that combines both geometric supervision and a differentiable shadow and silhouette loss to learn point cloud representations of trees without requiring species labels, procedural rules, detailed terrestrial reconstruction data, or ground laser scan data. To address the lack of ground truth data, we generate a synthetic dataset of point clouds from procedurally modeled trees and train our network on it. Quantitative and qualitative experiments demonstrate better reconstruction quality and coverage compared to existing methods, as well as strong generalization to real-world data, leading to visually appealing and structurally plausible tree point cloud representations that can be integrated into interactive digital 3D maps. The codebase, synthetic dataset, and pretrained model are publicly available at https://angelikigram.github.io/treeON/.

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