Doctoral Thesis Title: Modelling the Structural Growth of Forest Species Using Multitemporal LiDAR Data.

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Abstract: Wildfire prevention requires action on all potential factors that influence ignition risk, including those associated with overhead high-voltage power lines with bare conductors that run through forested areas. Preventing such fires requires estimating the growth rates of the forest species present in these ecosystems. Red Eléctrica, a company within the Redeia Group, has had access since 2020 to LiDAR data acquired during several airborne surveys conducted along circuits in Spain's electricity transmission network. The company aims to prevent uncontrolled vegetation growth and comply with regulations governing the maintenance of vegetation density and structure.

In this context, Bahreini and Hammad (2025) highlight that LiDAR enables the three-dimensional characterization of vegetation near power lines and provides valuable information for its management. Yu et al. (2005) demonstrated that repeated LiDAR surveys can be used to quantify the growth of individual trees, while Hoerbinger et al. (2020) showed that this capability can support preventive maintenance along railway corridors. Taken together, these studies demonstrate the feasibility of the proposed approach and support the integration of multitemporal structural change analysis with growth prediction in power-line corridors.

The aim of this doctoral thesis is to use these multitemporal LiDAR data together with time-series data on environmental and topographic variables to develop statistical models capable of predicting the growth of forest species around power lines. Machine-learning or deep-learning models will be fitted to explain the spatial patterns of this growth over time as a function of explanatory environmental and topographic variables. Vertical or horizontal forest growth rates will be estimated, and the model predictions will be quantitatively validated by assessing their accuracy and robustness.

Available Means: The LiDAR data will be made available by Red Eléctrica and Elewit under the specific collaboration agreement for the development of REDEIA–UPV R+D+i projects, under the technical annex entitled "Determination of Canopy Cover Fraction and Calculation of Structural Growth Rates of Forest Species Using Multitemporal LiDAR Data", in which both supervisors of this doctoral thesis are involved.

References:

Bahreini, F., & Hammad, A. (2025). Detection of vegetation proximity to power lines: Critical review and research roadmap. Forests, 16(11), 1658. doi:10.3390/f16111658

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