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Acoustic behaviour of standing poplar trees: Influence of site in Spain, cultivar and measurement season

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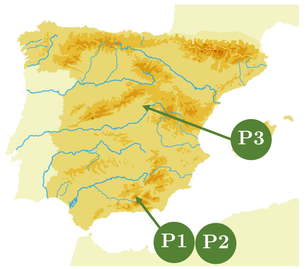
Abstract

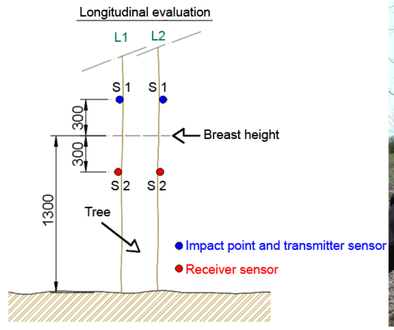
For the wood industry, being able to perform a quality grading of wood prior to harvesting is highly important and appealing, as it impacts on the purchasing price directly. The grade depends on physics variables such as density, fiber orientation, bending capacity and modulus of elasticity. One of the parameters that allows to evaluate the wood in standing trees is the elastic wave propagation velocity, acquiring recently more popularity since it allows a non-destructive evaluation. This work shows how the velocity is affected by the cultivar, the location of the crop and the measurement season, in the case of planted poplar tree. In order to accurately determine the arrival time of the waves, the Akaike method based on the entropy of the signals recorded the piezoelectric sensors is applied. Measurements were carried out in several plots located in North and South of Spain.

Plantation description



	Plantation 1	Plantation 2	Plantation 3
Location (DMS)	37°10'01.9"N 3°36'56.5"W	37°11'27.5"N 3°41'33.8"W	40°45'40.1"N 3°08'55.0"W
Altitude (m)	651	591	682
Climate	Mediterranean and Semi-arid	Mediterranean and Semi-arid	Continental Mediterranean
Poplar clone	I-214	Unal, Beaupre, I-214, and Raspalje	I-214
Age (years)	8	5	13
Plantation density (m^2)	5 x 5	5 x 5	5.5 x 5.5
Number of tested trees	18 (mix plot) + 36 (pure plot)	43, 43, 50, and 39	15
Measurement season	March 2018 & September 2018	September 2018	September 2018

ToF inspection setup

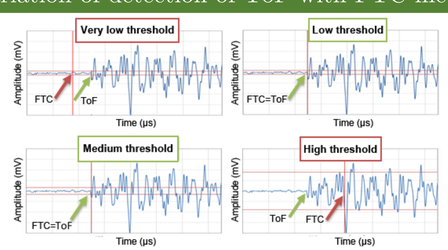


- 2 Fakoop SD-02 accelerometers
- Record of the signals: Picoscope® oscilloscope

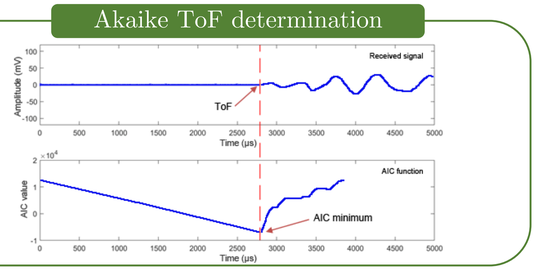
Akaike Information Criteria

- Time of arrival of the signal (ToF): highly influence on the propagation velocity (C_T)
- Traditional method: First Threshold Crossing (FTC)
- AIC: based on the entropy of the signal. Less sensitive to noise

Variation of detection of ToF with FTC method

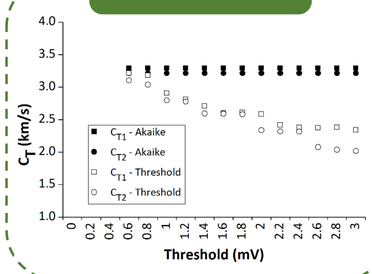


Akaike ToF determination

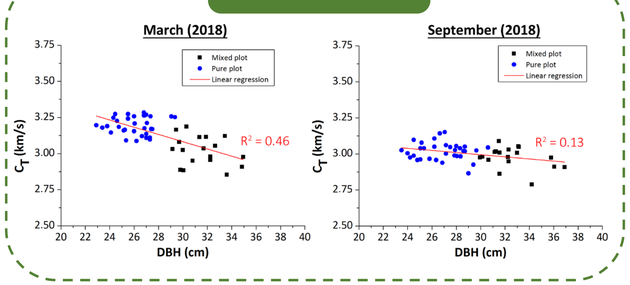


Results

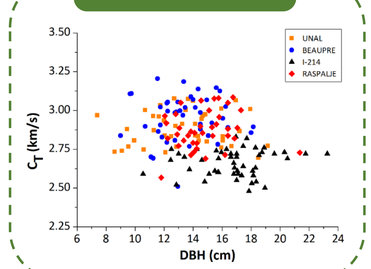
AIC vs FTC



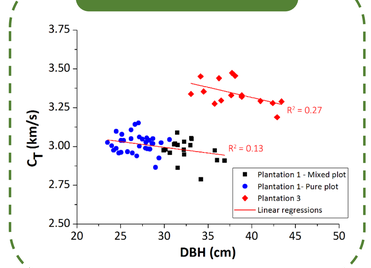
Influence of the season



Influence of the cultivar



Influence of the site



Conclusions

1) Akaike method provides a more reliable detection of ToF, being independent of the threshold and background noise

2) During winter (stopped sap) the velocity values were higher than in summer (sap alive), associated with the lower humidity of the wood

3) Mixed plots (poplar+walnut) provide to poplar trees more space: higher DBH and propagation velocity C_T

4) I-214 cultivar reached higher DBH values, but provided lower values of propagation velocity

COMPOP Chopo & Composites

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