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# Modelling Wood Quality, Supply and Value Chain Networks

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# INFLUENCE OF HEARTWOOD ON PULP PROPERTIES EXPLAINED BY MACHINE LEARNING TECHNIQUES

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The chemical and anatomical differences of sapwood and heartwood influence the performance of wood in different applications. The aim of this work is to develop a tool based on machine learning to predict some pulp properties e.g. pulp yield, Kappa number, brightness, fibre length and width, using the sapwood and heartwood proportion in the raw-material. Classification and regression trees (CART) and Multi-Layer Perceptron (MLP), a particular case of artificial neural networks, were the machine learning techniques applied to this problem.

For the construction of the predictive model, percentage of sapwood and heartwood, area and the stem eccentricity (in N-S and W-E directions) were measured on transversal stem sections of *Acacia melanoxylon* R. Br. belonging to 20 trees from four sites in Portugal. The samples were subsequently chipped and submitted to conventional Kraft pulping in a forced circulation digester under the following reaction conditions: 21.3% effective alkali (as NaOH), 30% sulfidity, 4/1 liquor/wood ratio, 90 min time to temperature, 90 min at 160°C. The relative position of the samples with respect to the total tree height was also considered as input variable.

The criterion used was the correlation coefficient both for CART and MLP models, by testing different configurations until the maximum correlation coefficient was achieved. The most accurate model found was CART for the prediction of pulp brightness (r= 0.85). The other parameters (pulp yield, Kappa number, and fibre length and width) could be predicted with fair results (r = 0.60 - 0.75) by both CART and MLP. Other mathematical techniques will also be tested.

The results clearly showed that the proportion of heartwood and sapwood is a relevant parameter for pulping and pulp properties, and should be taken as a quality trait when assessing a pulpwood resource.