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Abstract

This work aims to model the consequences of different strategies used by tree branches to ensure a given posture. If tree branches were simple beams, they would collapse under their weight. Of course, branches have the ability to control their orientation, and thus compensate for the effect of gravity, which increases every year by the way of the primary and secondary growths that respectively increase the length and diameter of the organ. The two known strategies of the branch to straighten itself are the asymetry of maturation stress, including reaction wood formation, and eccentric growth. Both strategies are generally observed simultaneously in nature and influence the stress distribution developed in the branch each year. This so-called growth stress reflects the mechanical state of the branch. In this work, a growth stress model was developed at the cross-section level in order to quantify the biomechanical impact of each strategy. To provide realistic input to the model, branch profiles were modelled using the growth simulation software AMAP Sim. These modelling results provided different loading laws that evolved with space and time. For different types of branches, the impact of the two postural control strategies was then examined. In a final step, a profiling of the branch at different points of its final shape allowed to follow the evolution of the stress distribution along the branch. Figure 1 illustrates the approach. On the left, the main axis of a maritime pine branch *Pinus Pinae* is shown at different stages of development. On the right, the stress profile in a section at the branch insertion is proposed. In this case, the eccentricity is zero, so the branch must produce reaction wood (compression wood for a softwood) to maintain its posture. This is shown by the compressive stress in the lower section of the branch.

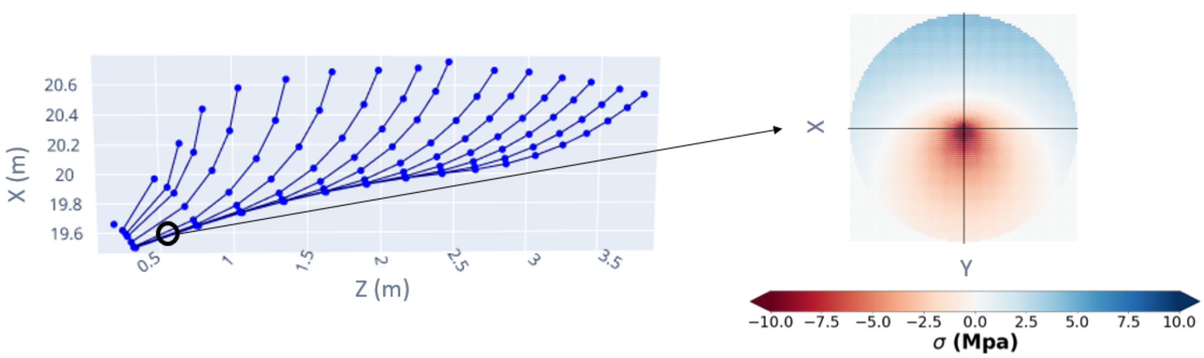

Figure 1: Left: Evolution of the shape of a maritime pine branch at different stages of its life. Right: Longitudinal growth stress distribution in the cross-section close to the insertion of the branch.