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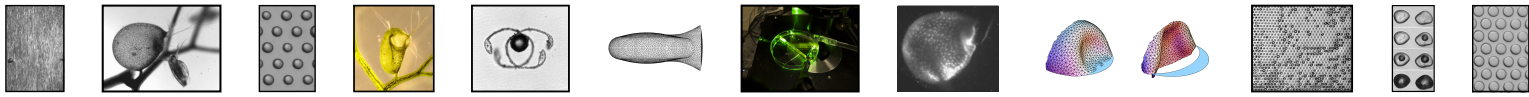
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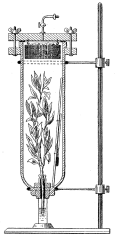


Combining optics and acoustics to characterise cavitation in trees

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Cohesion-Tension theory

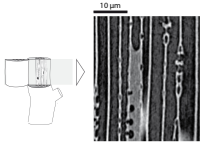


- evaporation from the leaves establishes a liquid column from the roots to the leaves
- the water column is under strong tension (several MPa)

Dixon & Joly (1895)

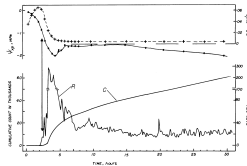
Sap in a metastable state

- Cavitation events in the xylem
- Embolism in the circulation



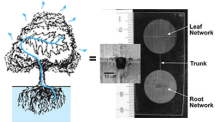
picture: Badel (2011)

A link between hydric stress and acoustic events



Tyree & Dixon (1983)

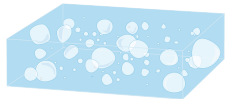
Modeling a tree with hydrogel microfabrication



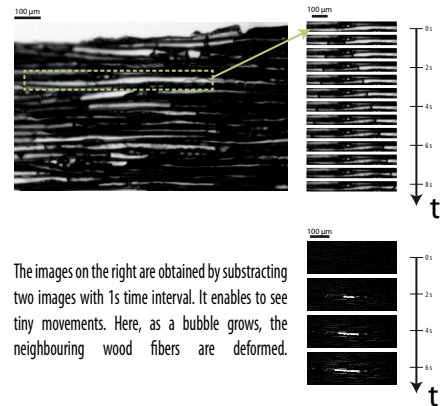
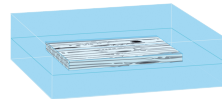
Wheeler & Stroock (2008)

Origin of the acoustic events?

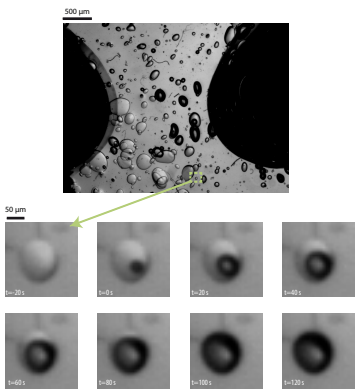
Voids in hydrogel



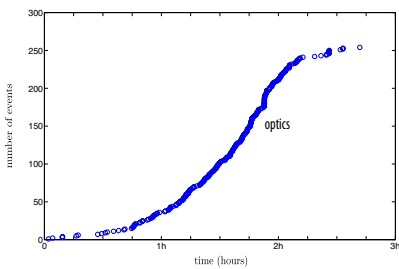
Wood in hydrogel



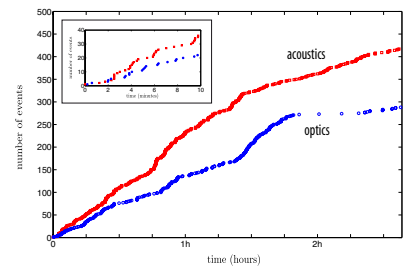
The images on the right are obtained by subtracting two images with 1s time interval. It enables to see tiny movements. Here, as a bubble grows, the neighbouring wood fibers are deformed.



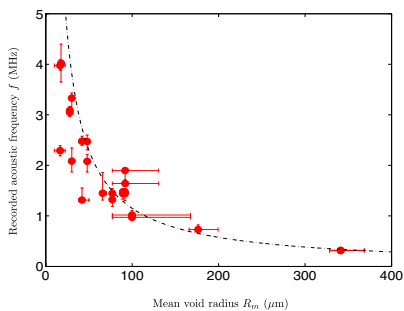
Cavitation events during hydrogel drying



Comparing acoustic and optic signals

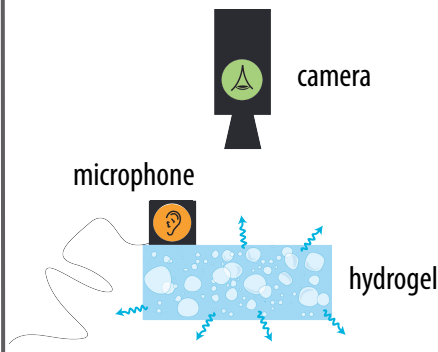


Influence of the void geometry on frequency



Experiment with a photodiode
 $fR_m = \mathcal{C} \approx 115 \text{ m/s}$
 Vincent (2012)

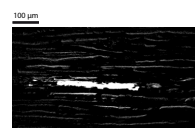
Experimental set up



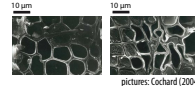
The hydrogel dries in ambient air. Water tension in the hydrogel increases from 0 MPa up to 20 MPa and cavitation events appear. We monitor the drying using simultaneously (i) a microphone in the ultrasound range and (ii) a camera.

Potential mechanisms for the acoustic events

1. wood cracks



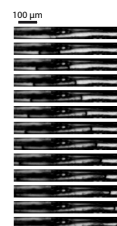
2. xylem collapse



pictures: Cochard (2004)

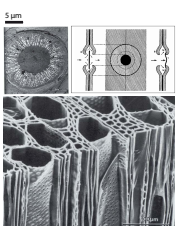
3. bubbles

3.a nucleation



3.b growth

4. pits movements



pictures: Tyree & Zimmermann (2001)

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