AUTOMATED DELINEATION OF TREE-RINGS IN X-RAY COMPUTED TOMOGRAPHY IMAGES OF WOOD

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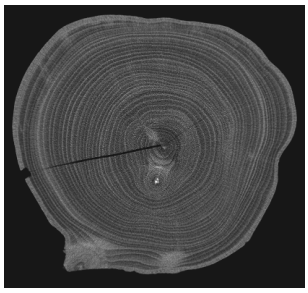
Characterizing the geometry of tree-rings is essential to understand and model the development of trees (wood quality assessment, tree growth study). CT-Scan allows acquiring accurate images of internal structures of logs. But robust image processing methods are required to identify precisely the tree-ring limits.

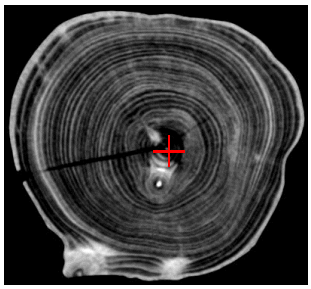
1- Image acquisition

The CT scanner of the Xylosciences platform



*A CT slice of a **fresh beech tree** log (512 x 512 pixels of 1.25 mm width)*

2- Automatic pith localization



*The pith center is localized by a **Hough transform**, well adapted to the detection of concentric circles.*

3- Image filtering

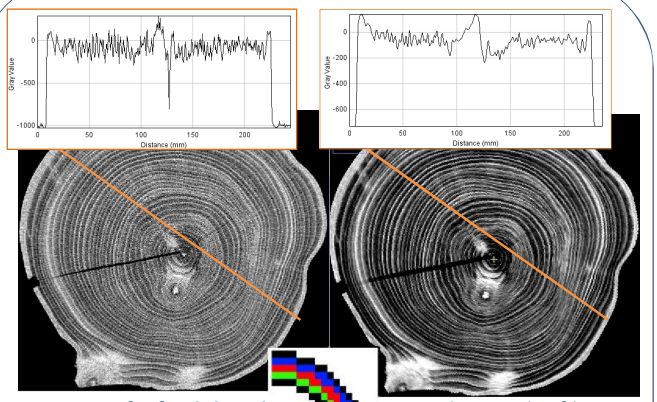
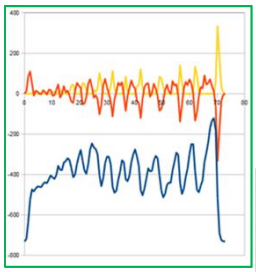


*Image of a **fresh beech wood***

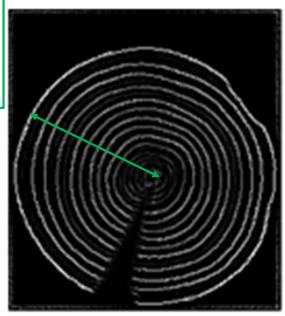
Discrete circle used by the circular filter

The circular filter enhances the tree-rings.

4- Tree-ring tagging

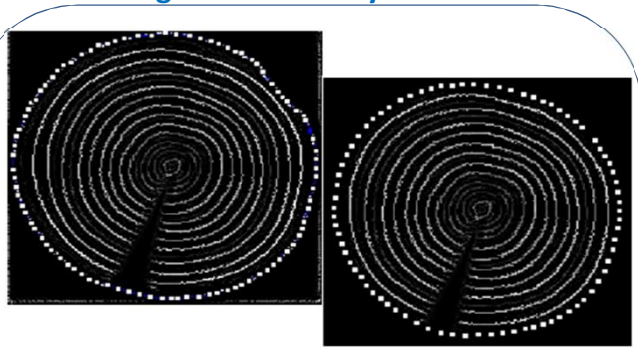


- *Intensity along a radius*
- *Derivative profile*
- *Tagging curve = probability of a transition between two rings along the radius.*



*Tagging image of a **dried spruce**: each tag indicates a potential ring transition and its value is displayed in grey level.*

5- Tree-ring delineation by active contours



*The active contour is initialized along the bark of the **spruce**. The tags of the bark are then erased, and the active contour converges towards the first external ring.*

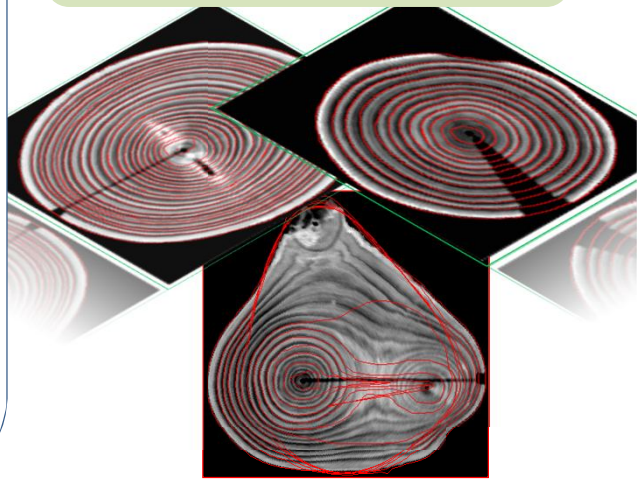
$$(1)\quad \mathbf{F_A} = \frac{1}{m}\sum_{j=1}^{m}\left(v(Q_j)e^{-4\frac{\|\mathbf{P_iQ_j}\|}{r}}\frac{\mathbf{P_iQ_j}}{\|\mathbf{P_iQ_j}\|}\right)$$

Where

- *v()* is the value of the tag
- *r* is the radius of the neighborhood
- *m* is the number of tags found in the neighborhood

Results

The tree-ring limits are overlaid onto the images of an ash tree (left) and a spruce (right). Notice the consistency of the shapes of the rings in spite of the nodes, the splits and the saw cut.



A limit of the method: case of two piths

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