DEFINING RELIABILITY COEFFICIENTS IN AN AUTOMATED METHOD OF IDENTIFICATION AND CHARACTERIZATION OF RADIAL FILES IN MICROSCOPIC IMAGES OF GYMNOSPERMS

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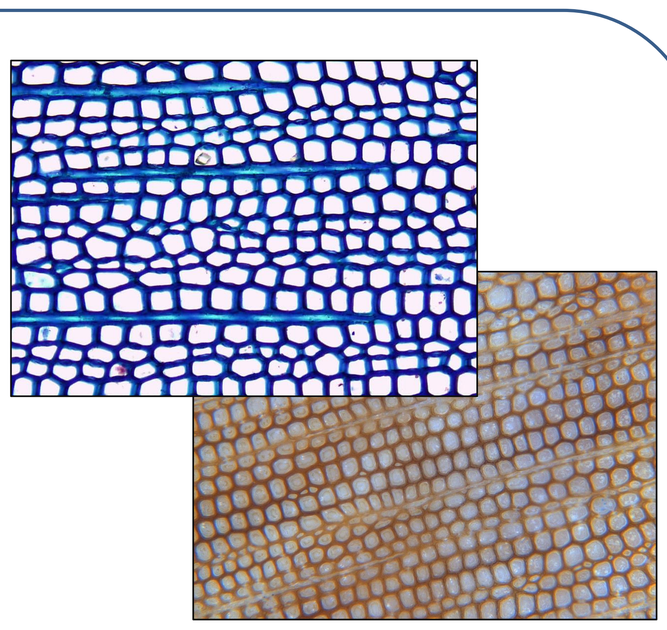
HIGHLIGHTS: Wood anatomical section analysis shows great interests in understanding the growth and development of plants[1]. We have proposed a novel method[2] to automatically identify and characterize radial files in wood microscopic images of gymnosperms. A key-point is to be able to assign an a priori reliability[3] coefficient to the results, in particular in the case of statistical processing in great-scale analysis. We describe in this paper the building principle of the reliability coefficients to evaluate the radial file identification process and the geometrical measurements of the cells and its components.

KEYWORDS: image processing, wood microscopic images, radial file identification, a priori reliability.

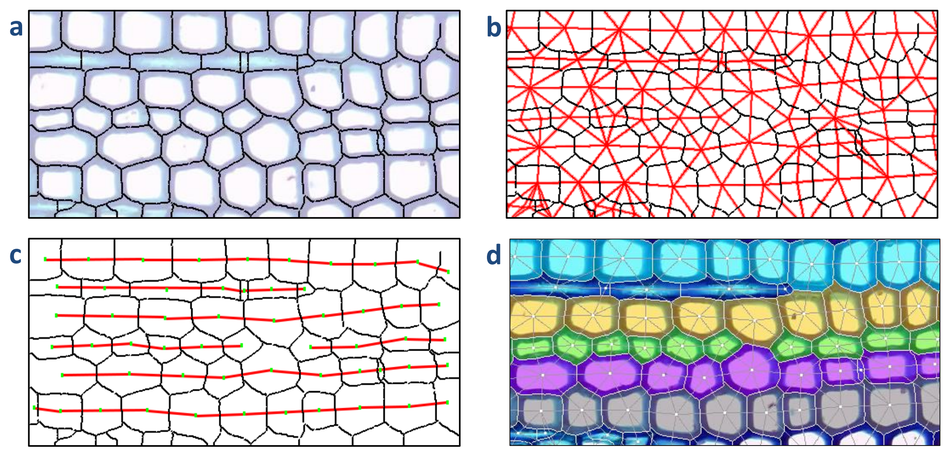
Image acquisition

Acquisition device

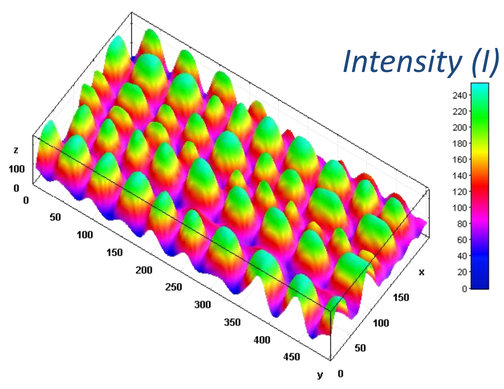


*Images of slice of **gymnosperms** (1600x2000 pixels) in 24bit colors*

Image processing workflow



Radial files(c) *are built from an* ***adjacency graph***(b) *of basins (β) defined from crest lines*(a) *of a* ***Watershed algorithm*** *filtering*



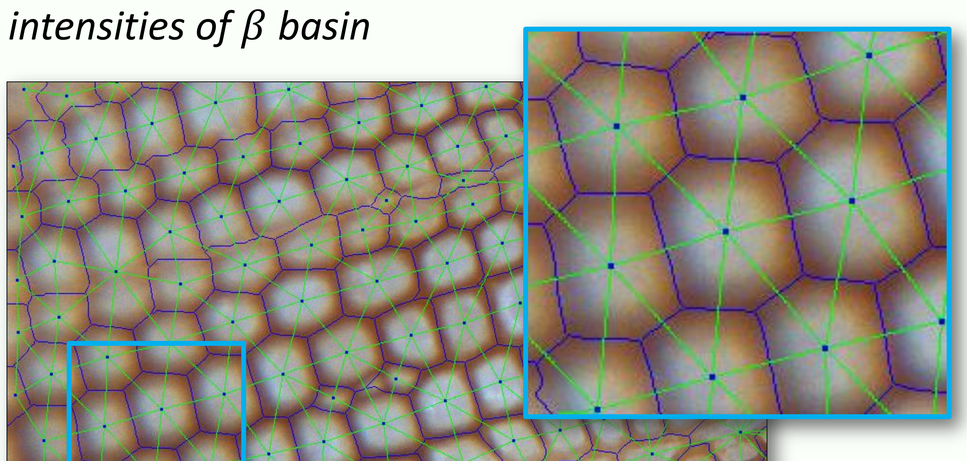
3D visualization *of topographic relief of image*

At the end of the workflow, all files are identified(d) *and a set of parameters are computed. But what about the cell identification and measure values reliability with respect to the blur introduced by acquisition conditions?*

Measure reliability : blur estimator

$$\mathcal{F}(\beta) = \frac{max(I_\beta) - min(I_\beta)}{\max(|\nabla I_\beta|)}$$

I_β *: intensities of* β *basin*



A local blur estimator. *The cell lumen area measure reliability depends on the local blur variation*

File reliability principle

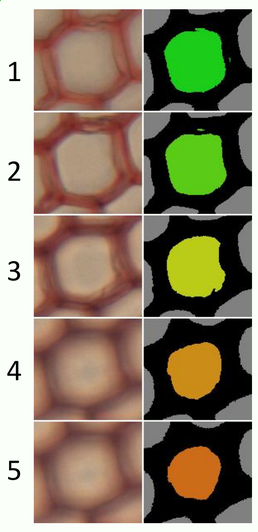
Radial file length *Complexity cost* *Cell height similarity*

$$R_f = \left(1 - max\left(\frac{L - L_f}{L}, 0\right)\right)\left(1 - \frac{N_{us}}{N_s}\right)\prod_{j=0}^{n-1}\left(1 - \frac{|H_j - H_{j+1}|}{H_j + H_{j+1}}\right)$$

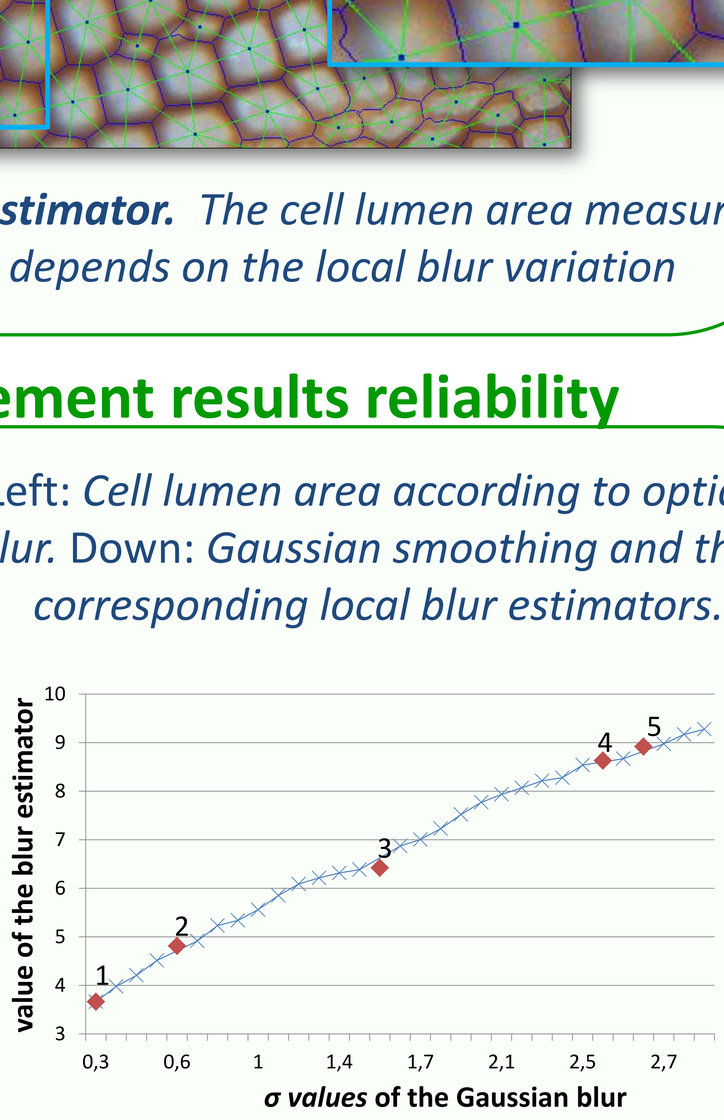
L: length of file; N: number of basin (un)stacking; H: height of file basins

The ideal radial file ***reliability*** *computation gives 1*

Measurement results reliability

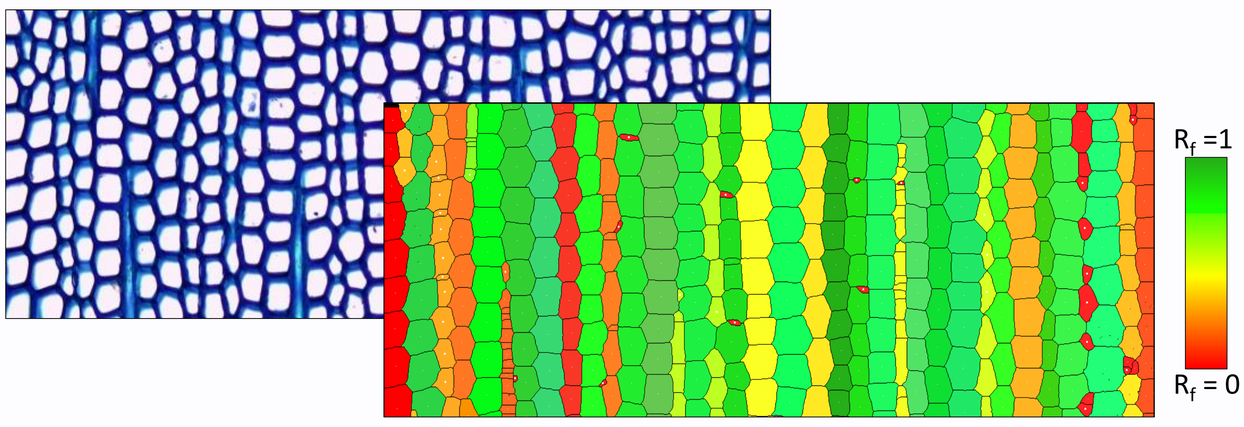


Left: *Cell lumen area according to optical blur.* Down: *Gaussian smoothing and their corresponding local blur estimators.*



1. *The blur estimator is highly correlated to σ*
2. *The optical blurred images fit very well with this curve leading to quantify precisely the optical blur*

File detection reliability result



Quantitative reliability estimation of the ***automatic labeling*** *of cell files: lower reliable files showing discontinuities or heterogeneities appear in warmer tones (from yellow to red).*

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