

Procedures for evaluating occurrence of tension wood in relation to the industrial processing of poplar and willow wood

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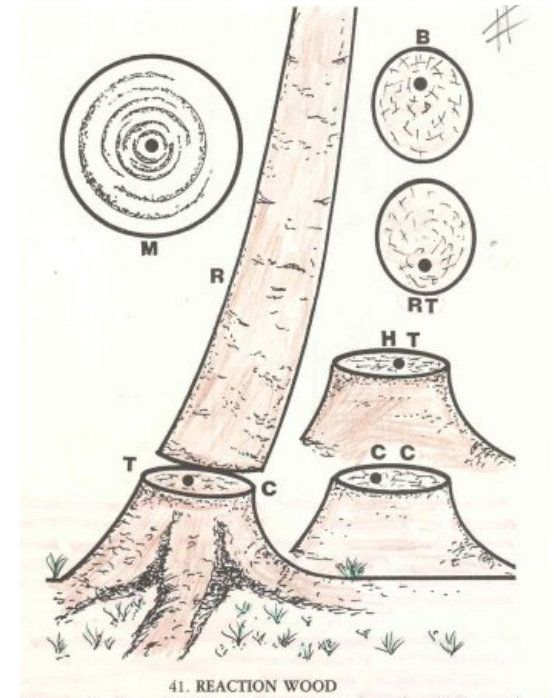
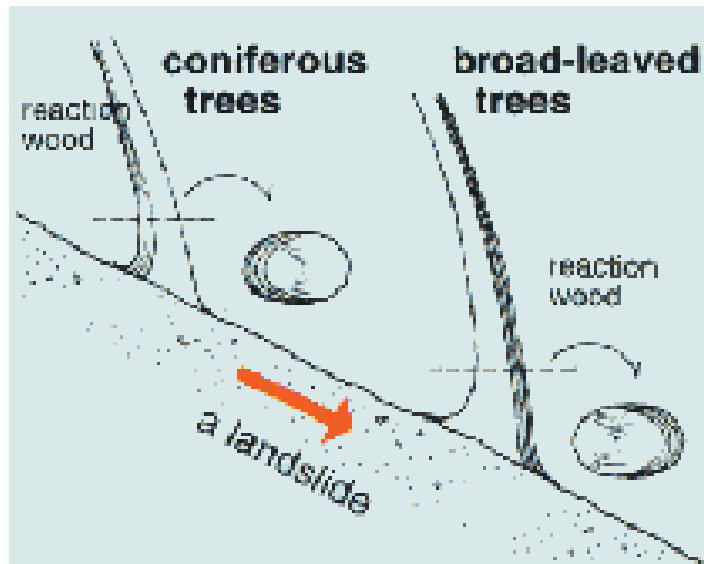


OUTLINE

- Introduction
 - Tension wood : occurrence
 - Tension wood : mathematical expression
- Aim
- Methodology – Discussion
 - Classic approach
 - Distributions analysis
 - Introduction of “Tension wood diffusion-coefficient (TWDC)”
- Future challenges and conclusions

INTRODUCTION

- Pioneer character of poplar and willow
 - Fast growing
 - More biomechanical flexibility
 - ALWAYS presence of significant amounts of tension wood



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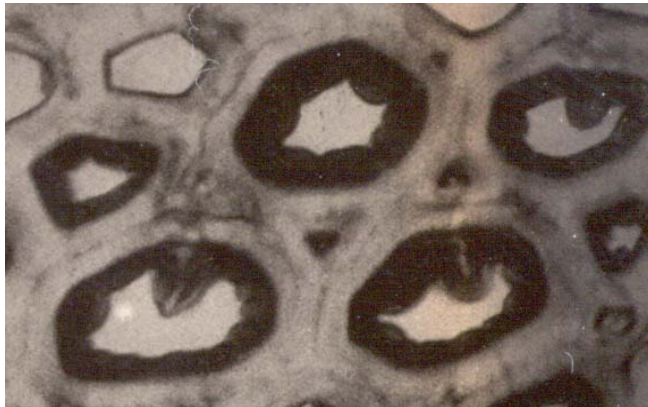
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INTRODUCTION

- Clones are ranked by tension wood occurrence
 - Different structure (S2 layer)
 - Different Wood properties (sawing, drying, finishing,...)
- Tension wood is expressed as:
 - Surface percentage
 - Volume percentage



INTRODUCTION

(a) Heartwood proportion

	Beaupré	Hazendans	Hoogvorst	Duncan ranking
Height 1.2 m	41.3	47.4	38.2	aba
6.5 m	20.0	37.5	26.3	aba
11.5 m	8.9	19.7	16.8	baa
Volume weighted average	30.8	41.5	31.5	aba
Standard deviation	5.1	7.3	6.3	–
Minimum	4.6	14.1	12.4	–
Maximum	48.6	54.6	51.3	–

(b) Tension wood proportions

	Beaupré	Hazendans	Hoogvorst	Duncan ranking
Height 1.2 m	16.5	19.1	19.7	aaa
6.5 m	9.8	8.9	8.6	aaa
11.5 m	8.5	7.3	7.2	aaa
Volume weighted average	11.6	11.7	11.8	aaa
Standard deviation	4.3	6.4	6.8	–
Minimum	4.2	5.5	3.6	–
Maximum	25.4	26.8	28.7	–

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AIM

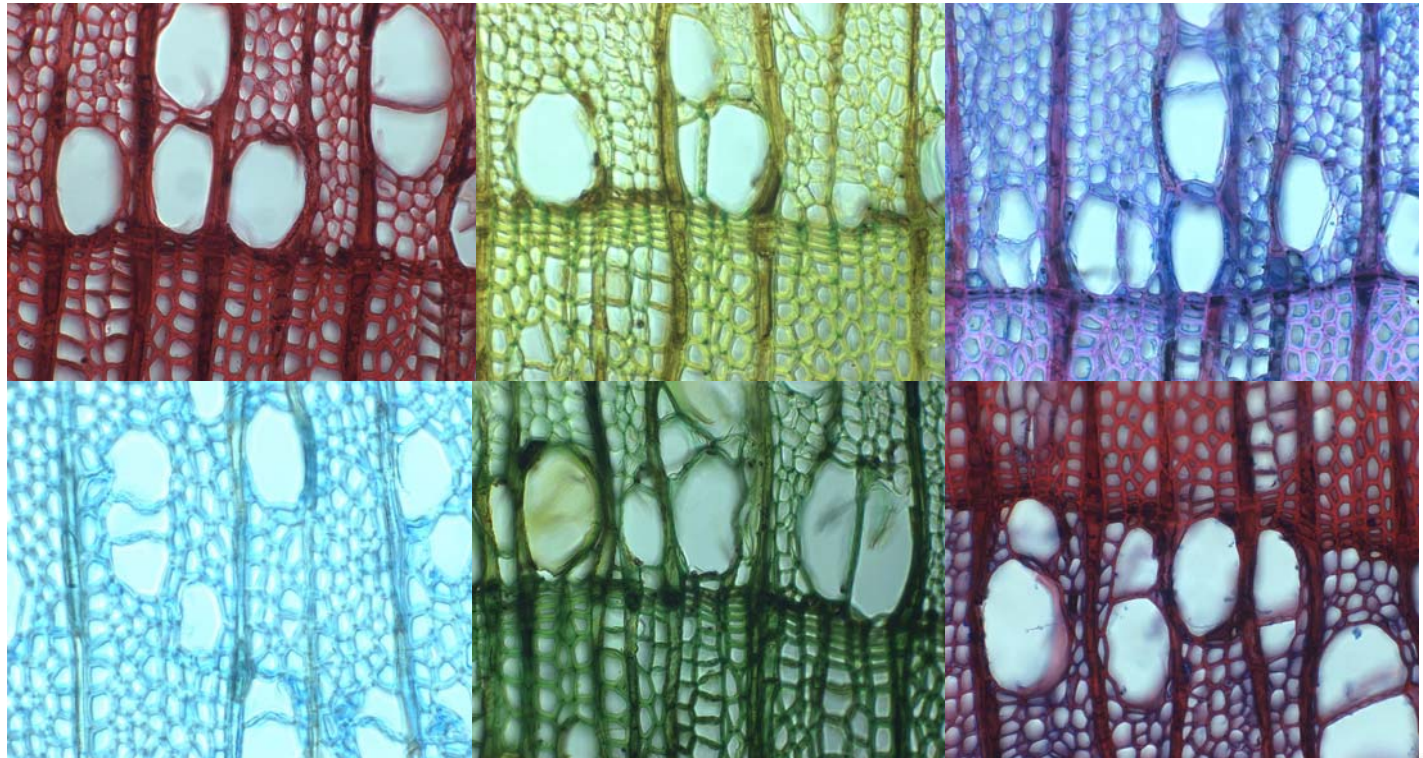
**Determine parameters who can provide
a direct and useful link**

- **Translating tension wood occurrence**
 - **to envisaged application**
- **Provide a feedback to the selection process**
 - **“early assessment”**

METHODOLOGY – DISCUSSION

Classic approach

- Anatomical slides – coloring agents
 - Very time consuming / Staining for automation
 - Very accurate / Up scaling ?



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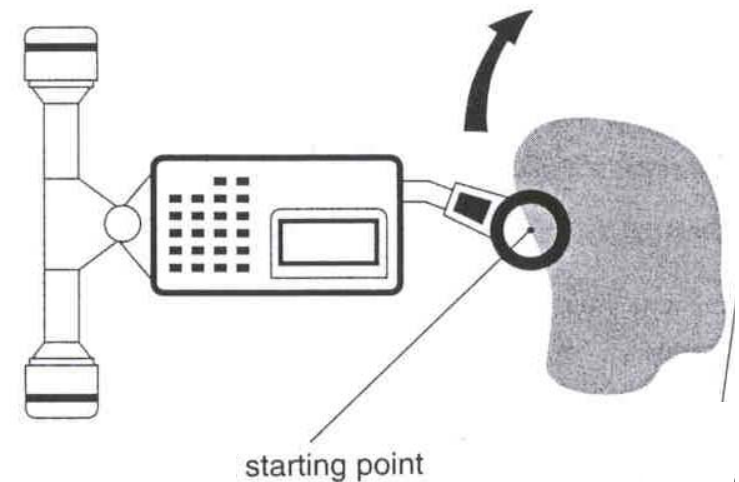


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METHODOLOGY – DISCUSSION

Classic approach

- Macroscopic staining - Zn-Cl-I-solution
 - Rapidly on full stem discs (freshly cut !)
 - Accuracy ? – Up scaling ?





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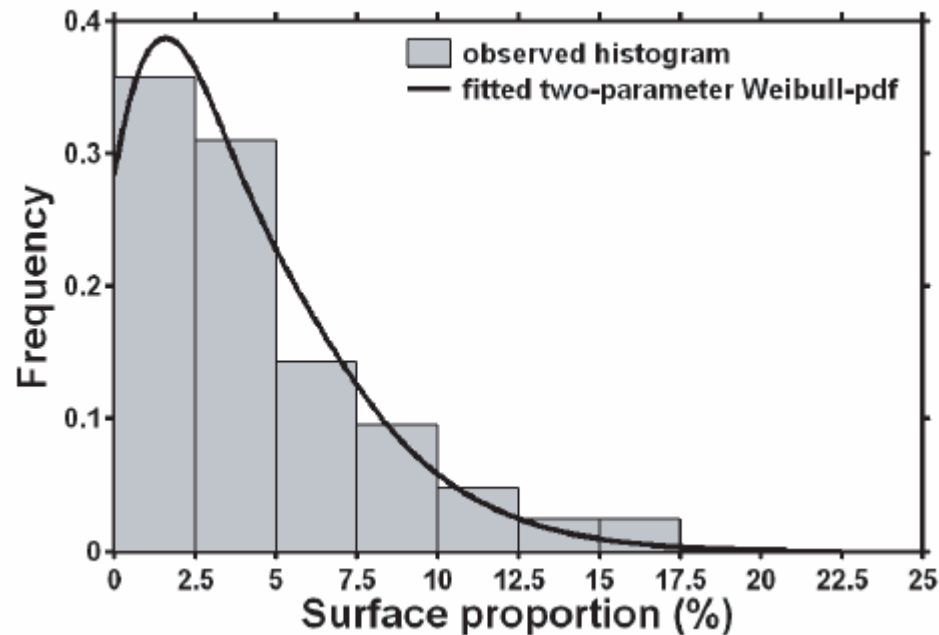


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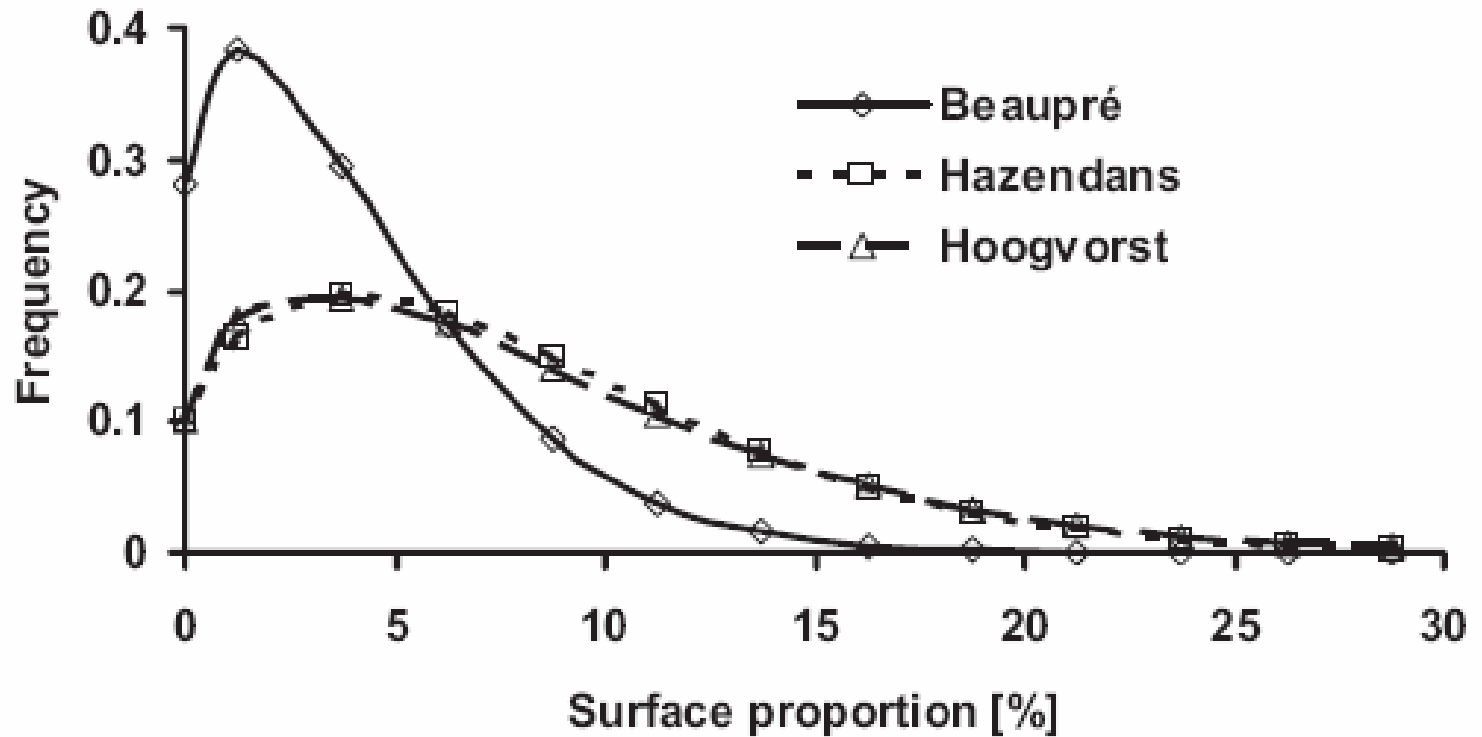
METHODOLOGY – DISCUSSION

Evaluation distribution

- No mean values ! – Distribution with tail analysis !
 - Use individual tension wood zones ! (per height – tree – site)
 - Linking to outcome of veneer production (after drying)
 - Differential shrinkage -- > Waviness



METHODOLOGY – DISCUSSION



	Loss of veneer (%)		
	Loss by drying		
	Cracks	Waviness	Total
Beaupré	3.9	5.9	9.8
Hazendans	0.0	19.8	19.8
Hoogvorst	0.0	15.6	15.6

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METHODOLOGY – DISCUSSION

Tension wood diffusion coefficient (TWDC)

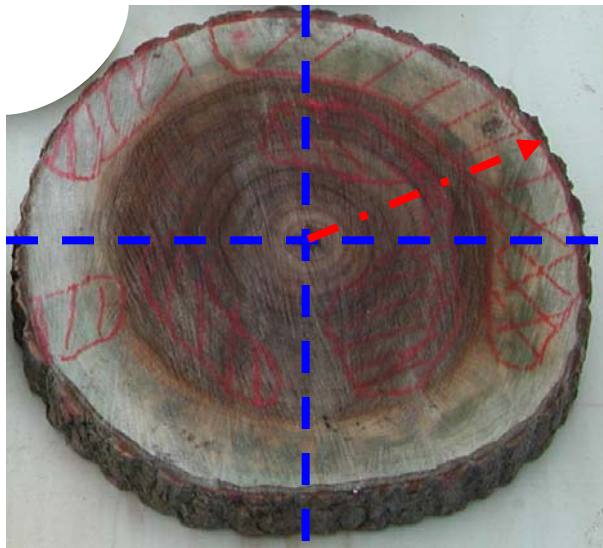
- Aiming at spatial parameter that :
 - Can express the an accumulating and diffusion character of tension wood occurrence.
 - Be linked towards an application at hand (peeling, sawing, pulping,...)



METHODOLOGY – DISCUSSION

Tension wood diffusion coefficient (TWDC)

- Cumulated vector length with tension wood occurrence
- Graph from 0 to 360 ° with tension wood occurrence ranging 0 to 100 %
- Min – Max (range) for whole spectrum or per quadrant or, ...
- Same average can lead to several distributions of spatial vector !

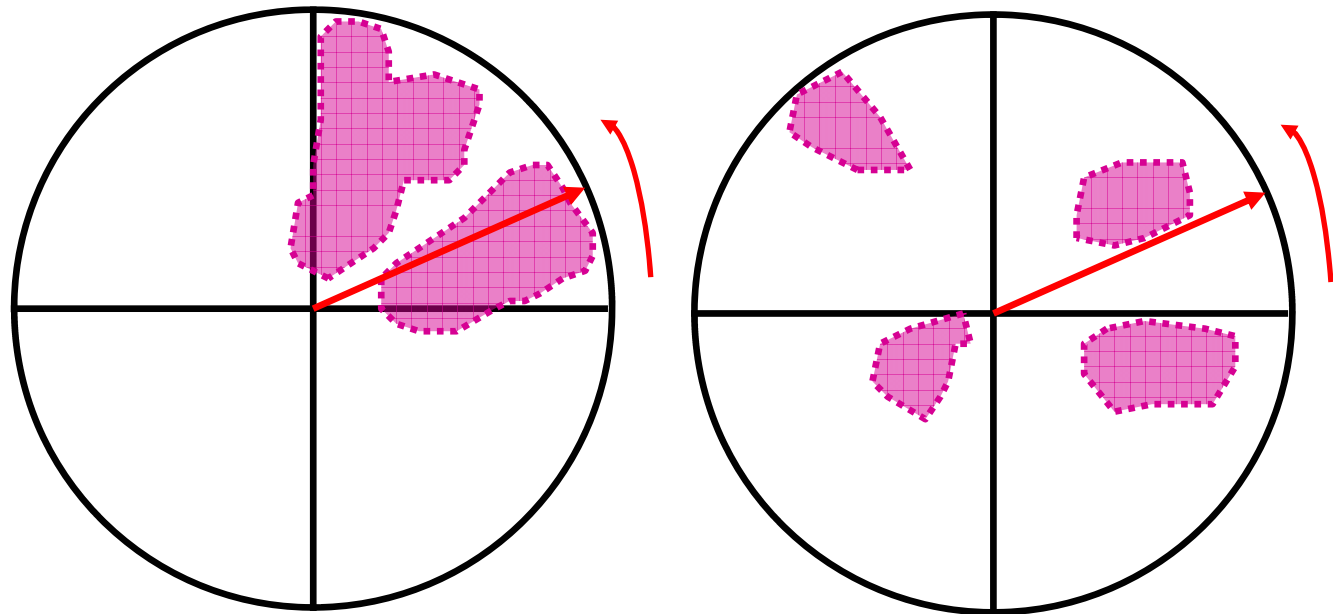


$$\frac{V_{\max} - V_{\min}}{V_{\text{average}}}$$

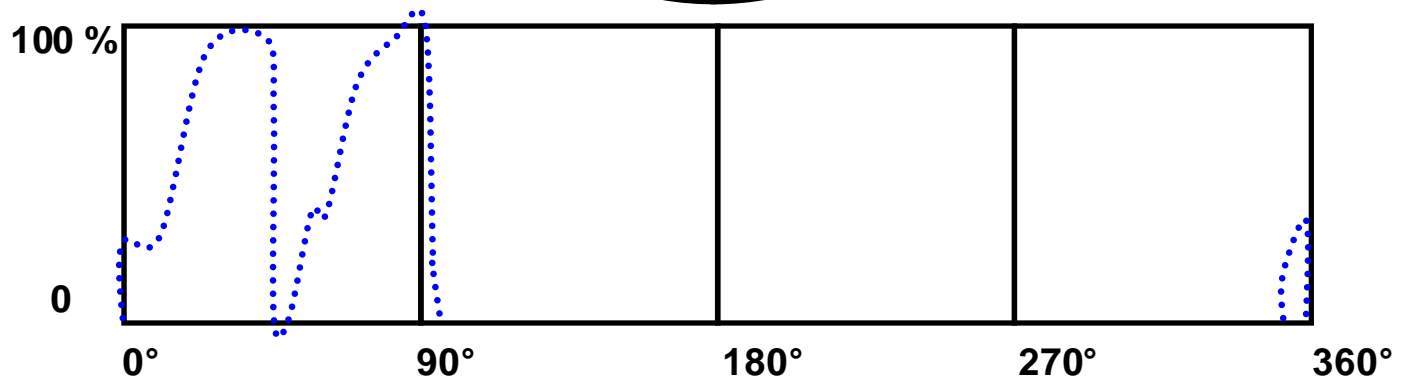
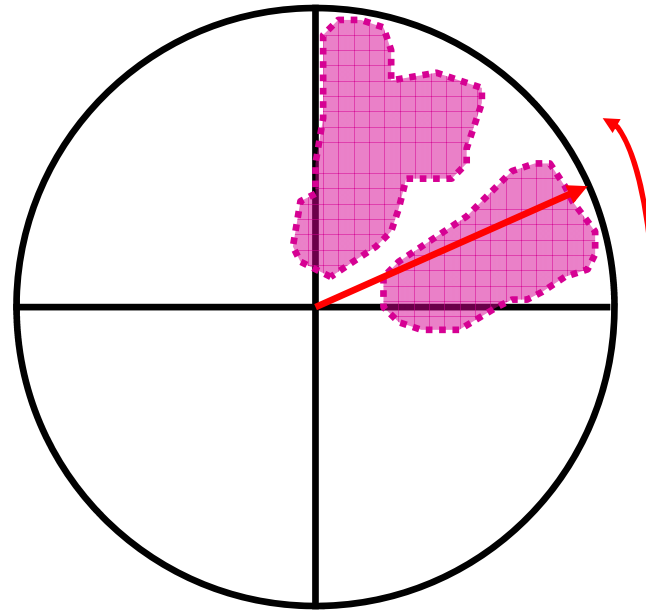
	Range <	Range >
$V_{\text{average}} <$	-	↑↑
$V_{\text{average}} >$	↓↓	-

METHODOLOGY – DISCUSSION

Two disc with the same amount of tension wood : 20 %



METHODOLOGY – DISCUSSION

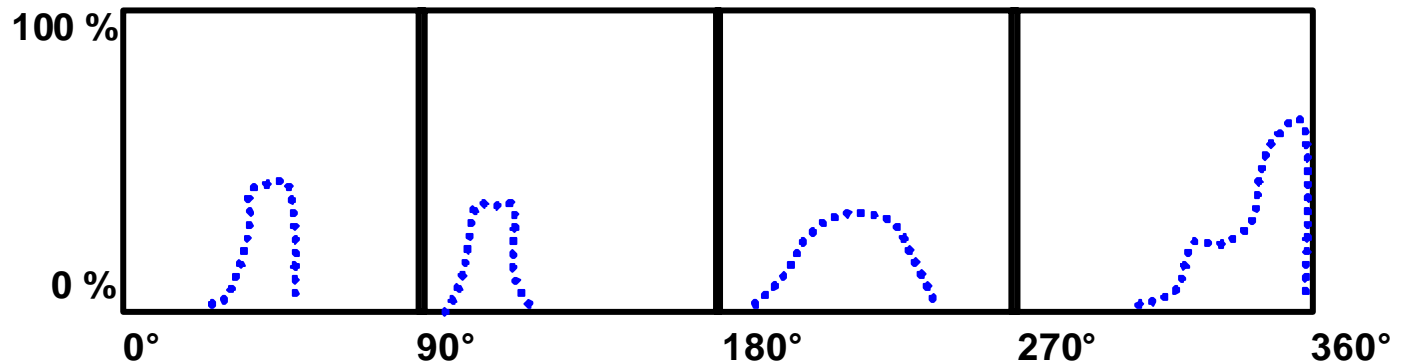
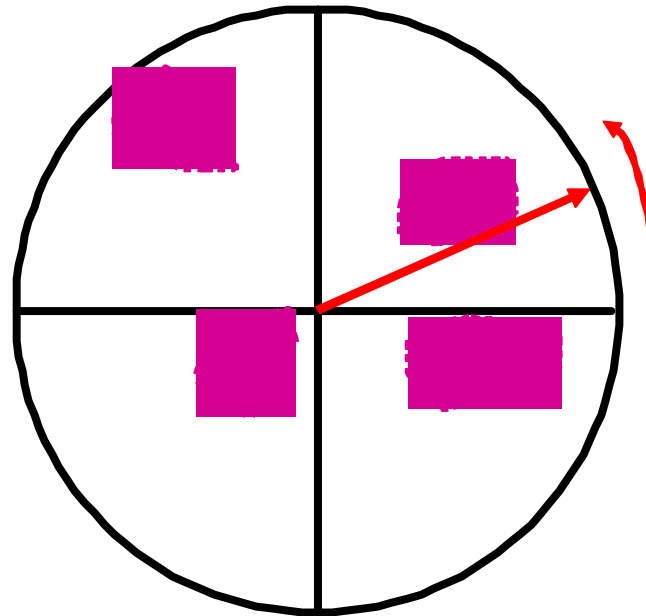


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METHODOLOGY – DISCUSSION



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METHODOLOGY – DISCUSSION

Two disc with the same amount of tension wood : 20 %
(surface percentage)

	I	II	III	IV	Average	Stdev
Disc 1	90	15	0	15	30	41
Disc 2	20	18	18	48	26	15

$$V_{quadrant} = V_{\max} - V_{\min}$$

$$\bar{V}_{quadrant}$$

$$DWTC = \sigma_{V_{quadrant}}$$

FUTURE CHALLENGES

- More than one vector → Volume based / application based
- More than four quadrants (volume related)
- Determination of the number of disc necessary to derive TWDC
- Transfer functions from TWDC and applications
- TWDC in very young trees ? Relation to full grown trees ?

CONCLUSIONS

- Tension wood occurrence is inherent to poplar and willow wood
 - Translation necessary specified per application
- TWDC can point out the diffuse character of the tension wood
- Transfer functions from TWDC to be developed for the different applications at hand.

THANK YOU

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