Spatial distribution of shrinkage properties in white spruce tree stem from different tree spacing

Mingkai Peng (PhD Candidate)

Advisory committee: Dr. Ying-Hei Chui(Supervisor)
Dr. John Kershaw(Co-supervisor)
Dr. Meng Gong

University of New Brunswick

NSERC CRSNG

ForValueNet ForêtValeur

FPInnovations

UNB UNIVERSITY OF NEW BRUNSWICK

Outline of presentation

- Back ground
- Study site and tree cutting plan
- Shrinkage specimen and measuring technique
- Shrinkage variation for white spruce
- Conclusion

NSERC CRSNG

ForValueNet ForêtValeur

FPInnovations

UNB UNIVERSITY OF NEW BRUNSWICK

Background

Dimensional stability of lumber is one of the major reasons why wood is losing market share in construction to other materials e.g. steel studs

NSERC CRSNG

ForValueNet ForêtValeur

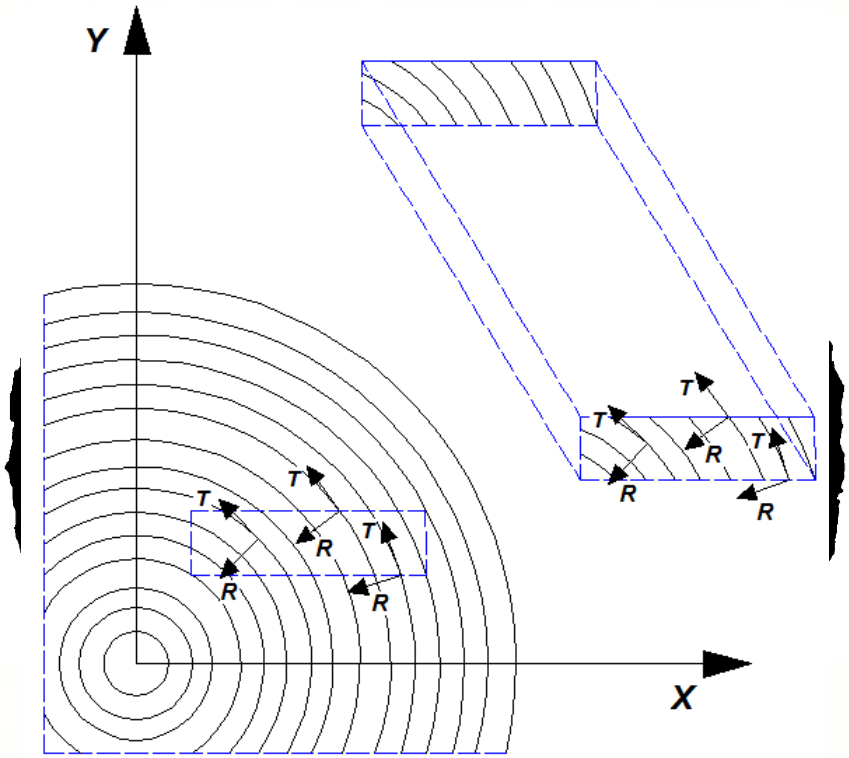
FPInnovations

UNB UNIVERSITY OF NEW BRUNSWICK

Properties influencing lumber distortion

Distortion is a complex process caused by:

- Orthotropic properties of wood - shrinkage differs in tangential, radial and longitudinal directions;
- Growth ring curvature;
- Shrinkage of juvenile and mature wood differs



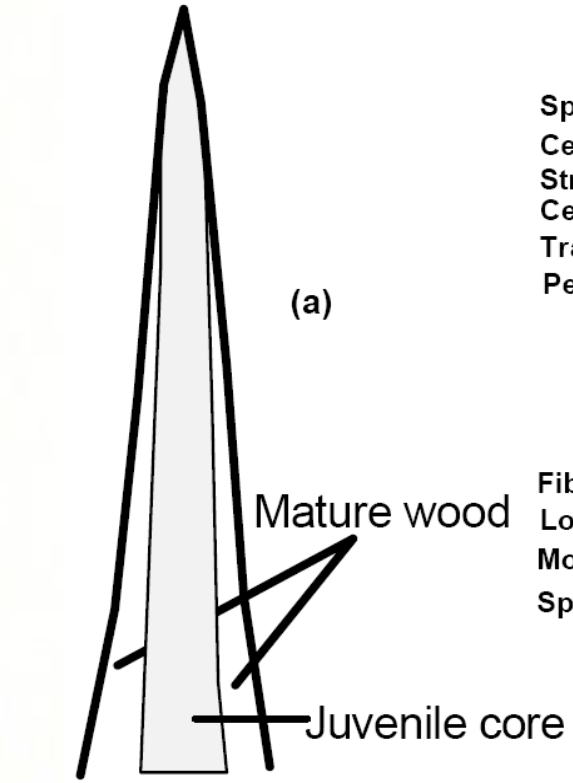
NSERC CRSNG

ForValueNet ForêtValeur

FPInnovations

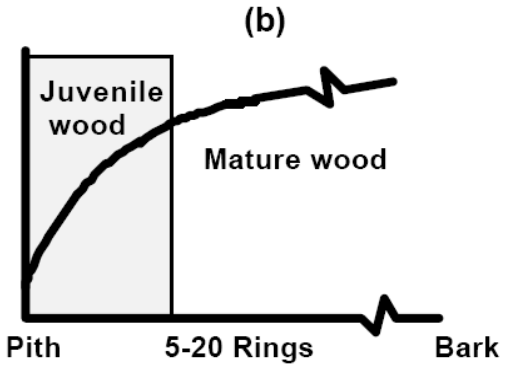
UNB UNIVERSITY OF NEW BRUNSWICK

Juvenile and Mature Wood

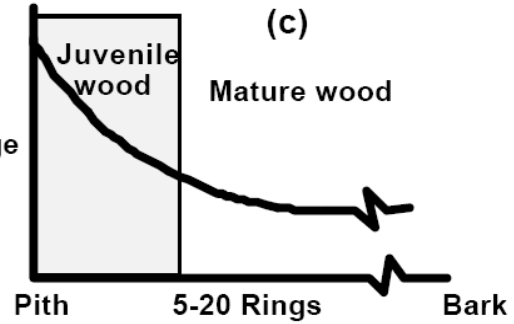


Bendtsen, B.A, 1978

Specific gravity
Cell length
Strength
Cell wall thickness
Transverse shrinkage
Percent latewood



Fibril angle
Longitudinal shrinkage
Moisture content
Spiral grain



Silvicultural practices have large influence on formation of juvenile wood and mature wood

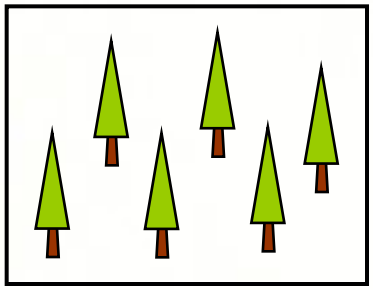
NSERC CRSNG

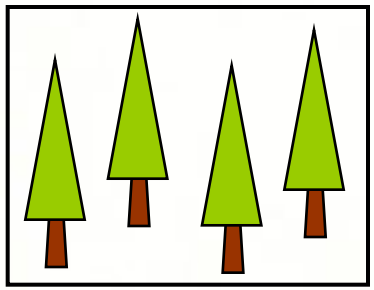
ForValueNet ForêtValeur

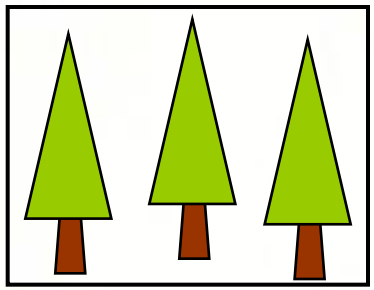
FPInnovations

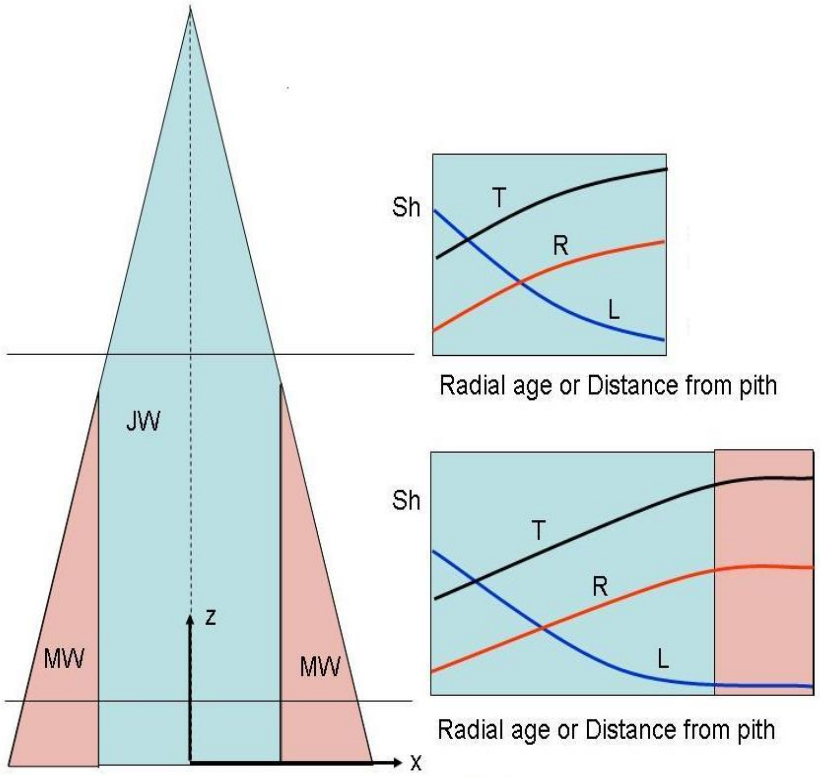
UNB UNIVERSITY OF NEW BRUNSWICK

Target Accomplishment 1 – Empirical models of shrinkage properties in L, R and T directions









Shrinkage = f (Ring age, depth relative to live crown, tree spacing)

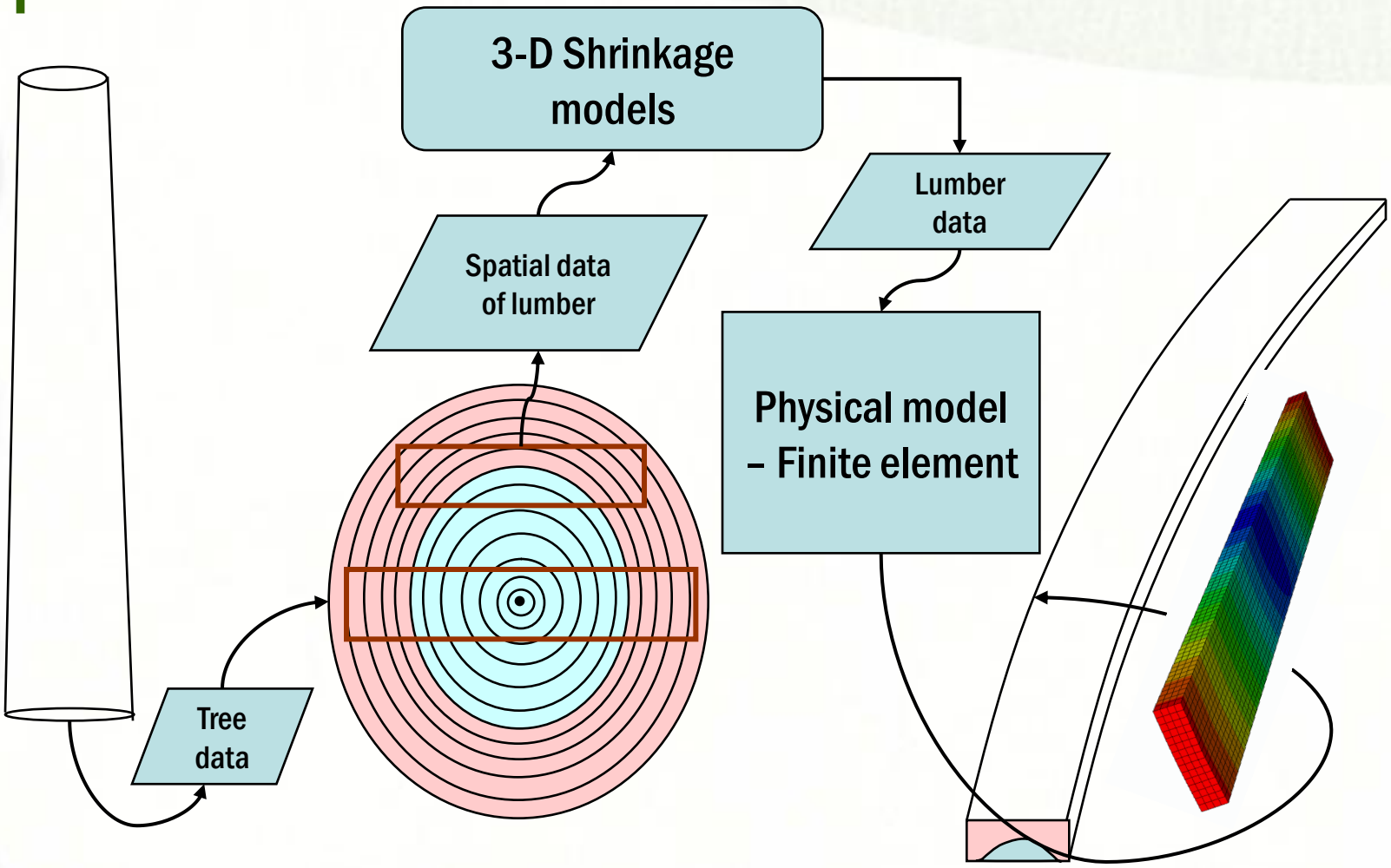
NSERC CRSNG

ForValueNet ForêtValeur

FPInnovations

UNB UNIVERSITY OF NEW BRUNSWICK

Target Accomplishment 2 – Physical model to predict distortion of lumber



NSERC CRSNG

ForValueNet ForêtValeur

FPInnovations

UNB UNIVERSITY OF NEW BRUNSWICK

Study site

Nelder tree spacing trial site located in Woodstock, NB

Two tree species: white spruce (*Picea glauca*) and jack pine (*Pinus banksiana*)

White spruce

Jack pine

NSERC CRSNG

ForValueNet ForêtValeur

FPInnovations

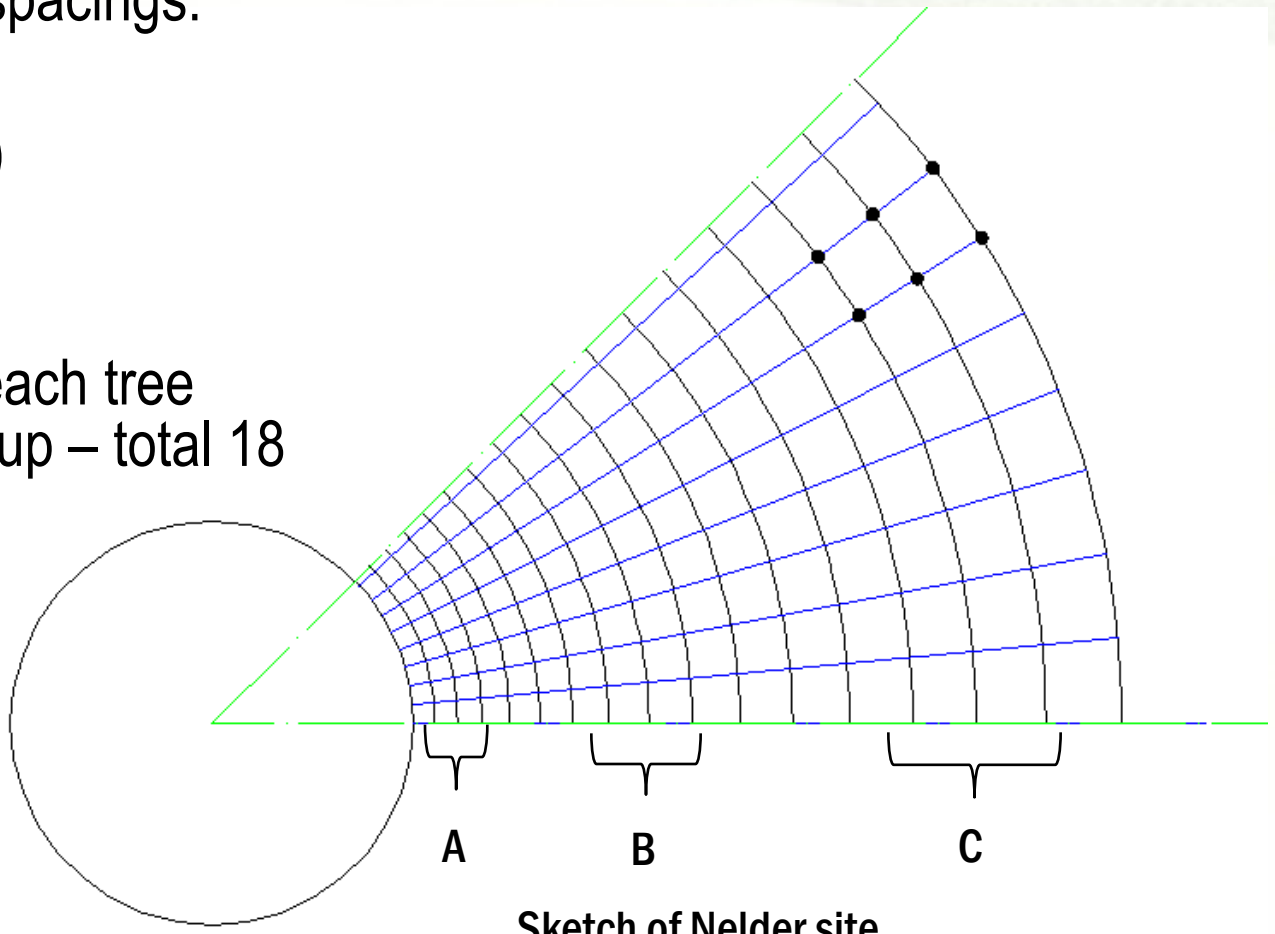
UNB UNIVERSITY OF NEW BRUNSWICK

Study site and tree selection

Three tree spacings:

- A (1.05m)
- B (1.83m)
- C (3.2m)

3 trees for each tree spacing group – total 18 trees



Sketch of Nelder site

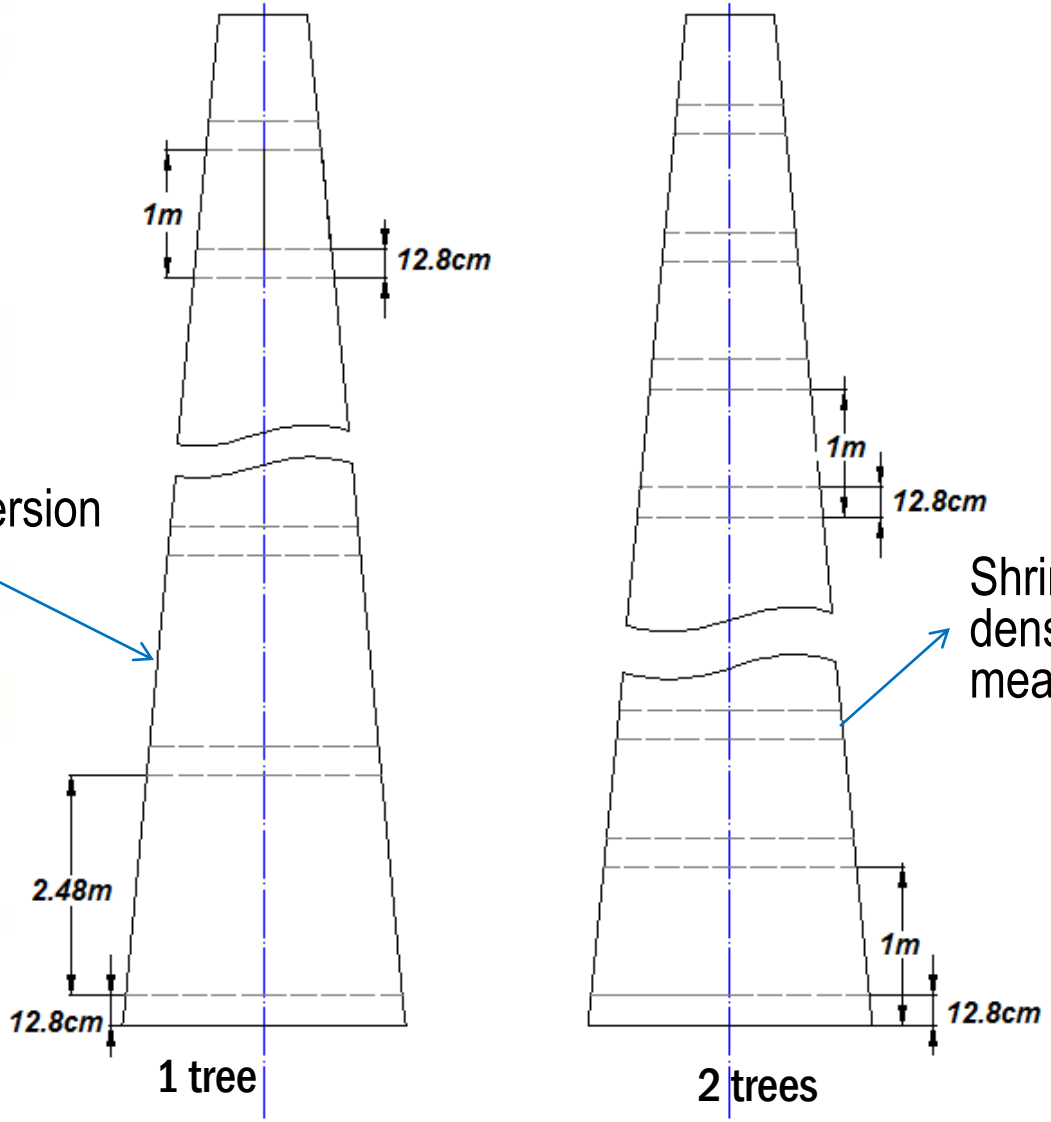
NSERC CRSNG

ForValueNet ForêtValeur

FPInnovations

UNB UNIVERSITY OF NEW BRUNSWICK

Tree cutting plan for each group of 3 trees



Lumber conversion

Shrinkage and density variation measurement

NSERC CRSNG

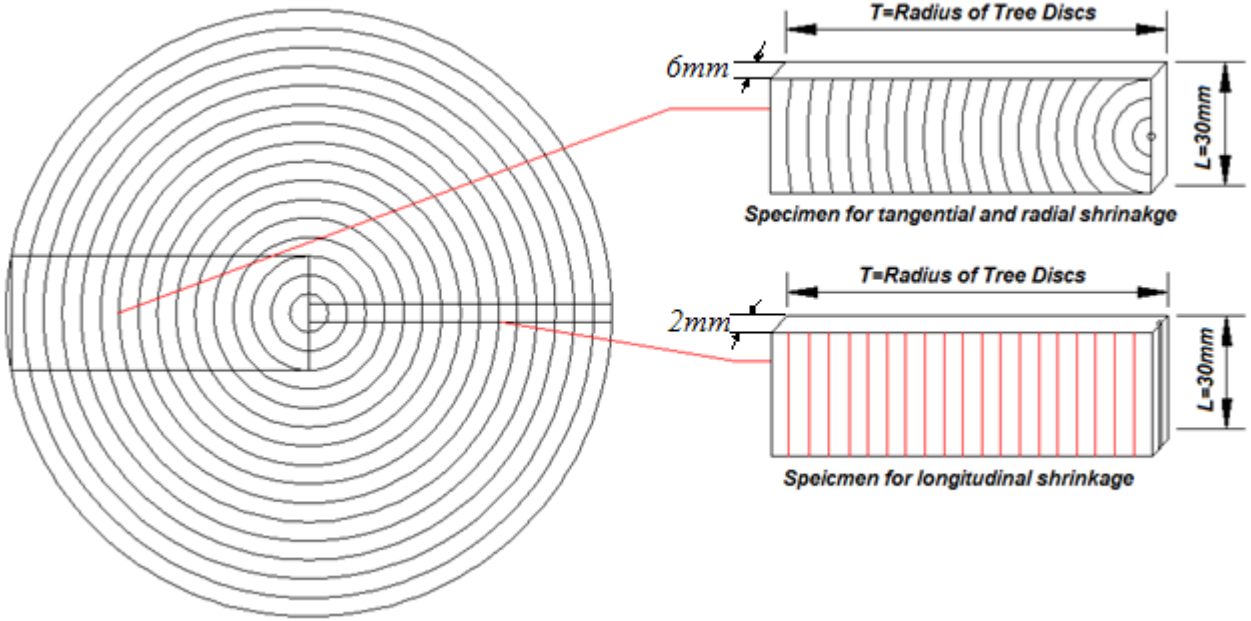
FORVALUENET ForêtValeur

FPInnovations

UNB UNIVERSITY OF NEW BRUNSWICK

Specimen for shrinkage measurement

- Tangential specimen: 30mm (T) x 6mm (L)
- Longitudinal specimen: 30mm (L) x 2mm (T)



Tangential Specimen – T & R

Longitudinal Specimen – L & R

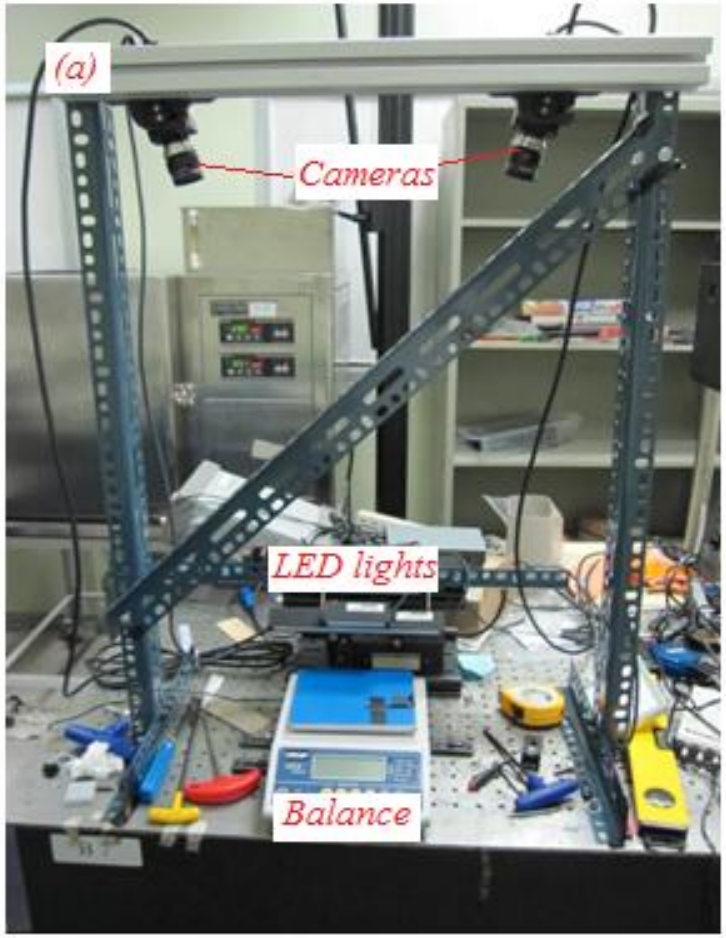
NSERC CRSNG

ForValueNet ForêtValeur

FPInnovations

UNB UNIVERSITY OF NEW BRUNSWICK

DIC equipment set-up and Specimens

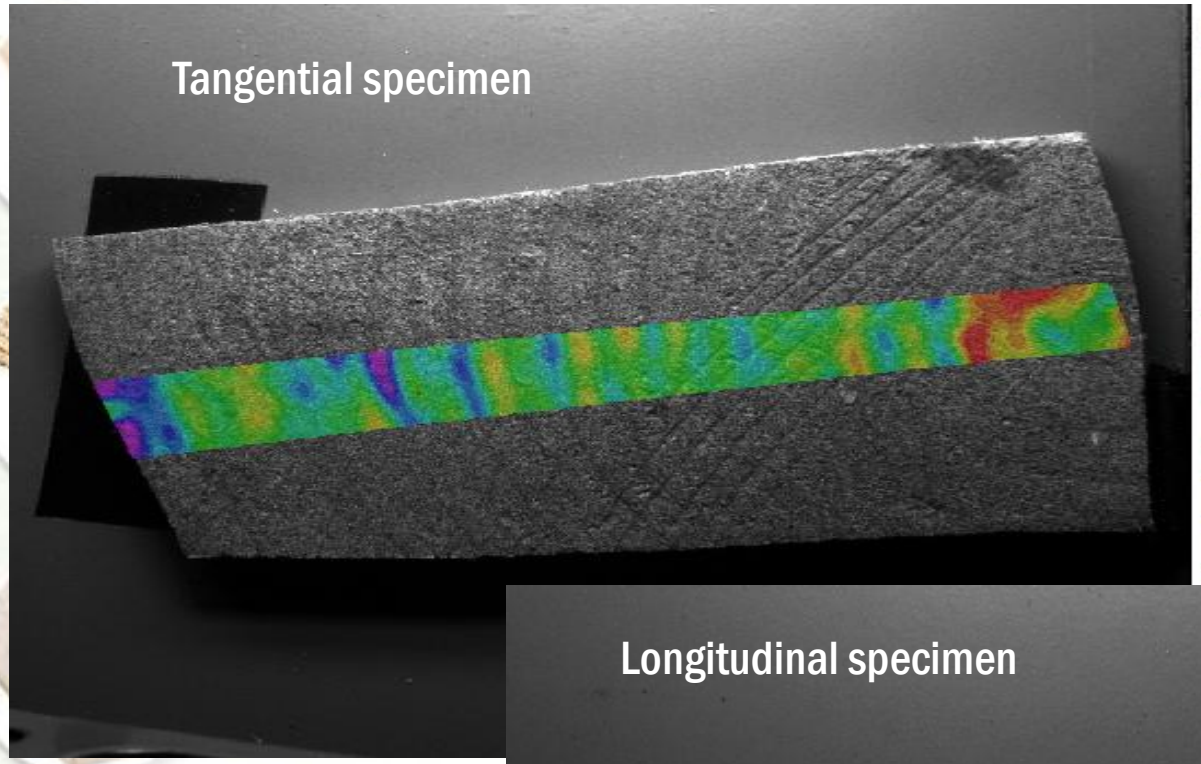


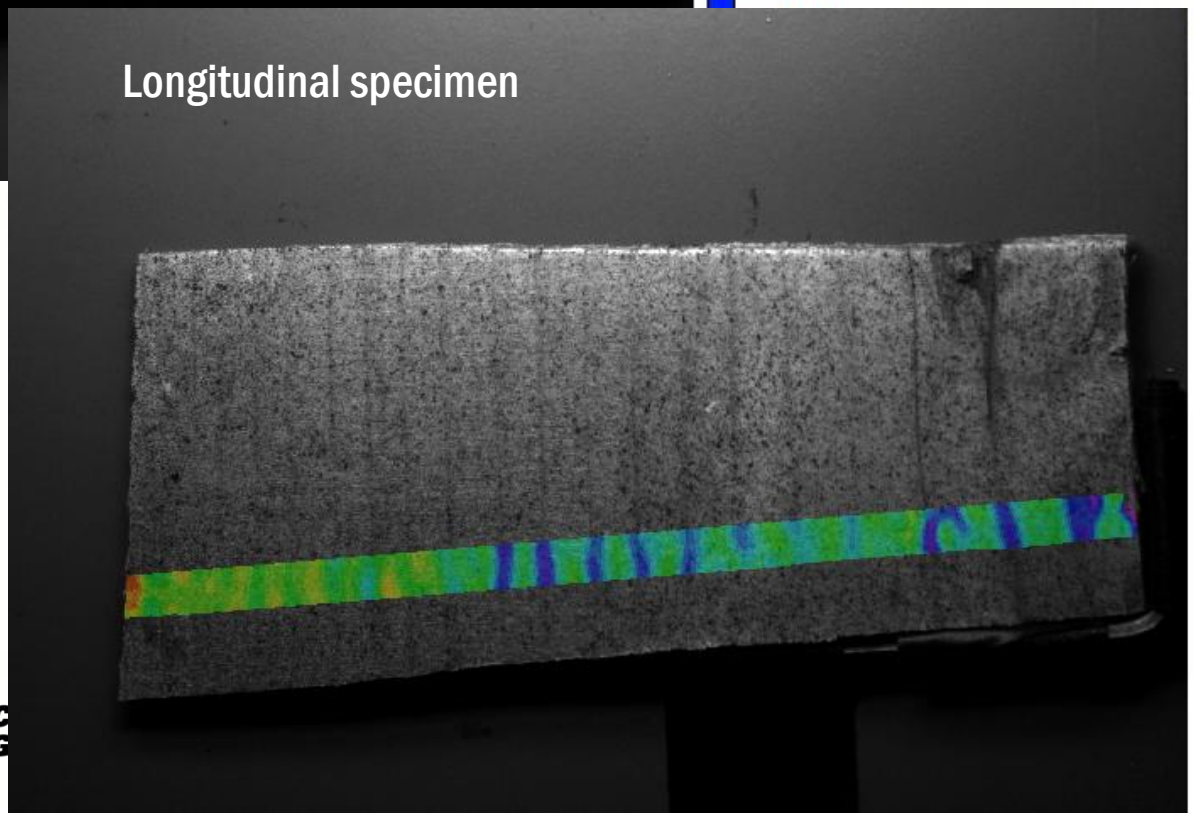
NSERC CRSNG

ForValueNet ForêtValeur

FPInnovations

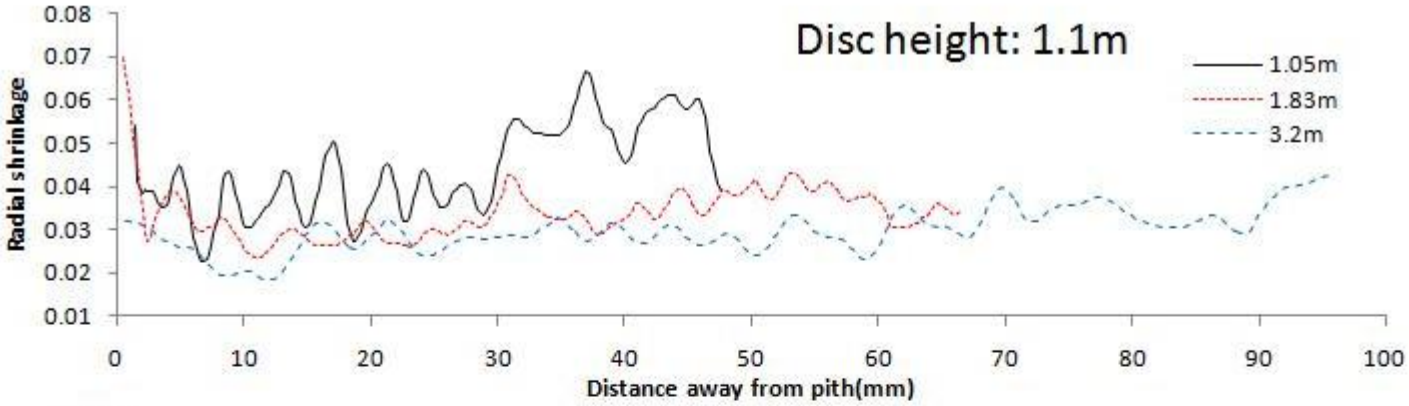
UNB UNIVERSITY OF NEW BRUNSWICK

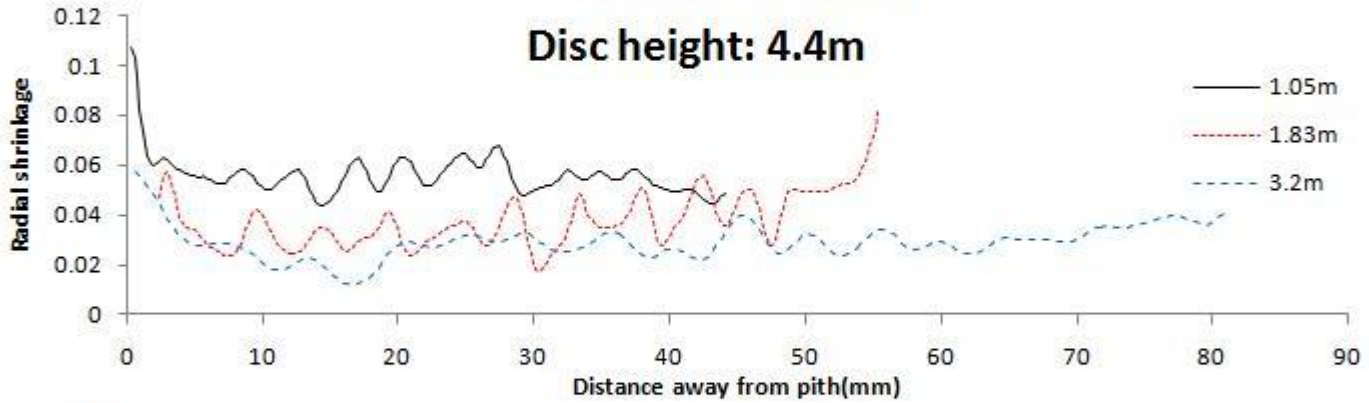

Tangential specimen
e1 [1] - Lagrange
-0.0156
-0.0170375
-0.018475
-0.0199125
-0.02135
-0.0227875
-0.024225
-0.0256625
-0.0271
-0.0285375
-0.029975
-0.0314125
-0.03285

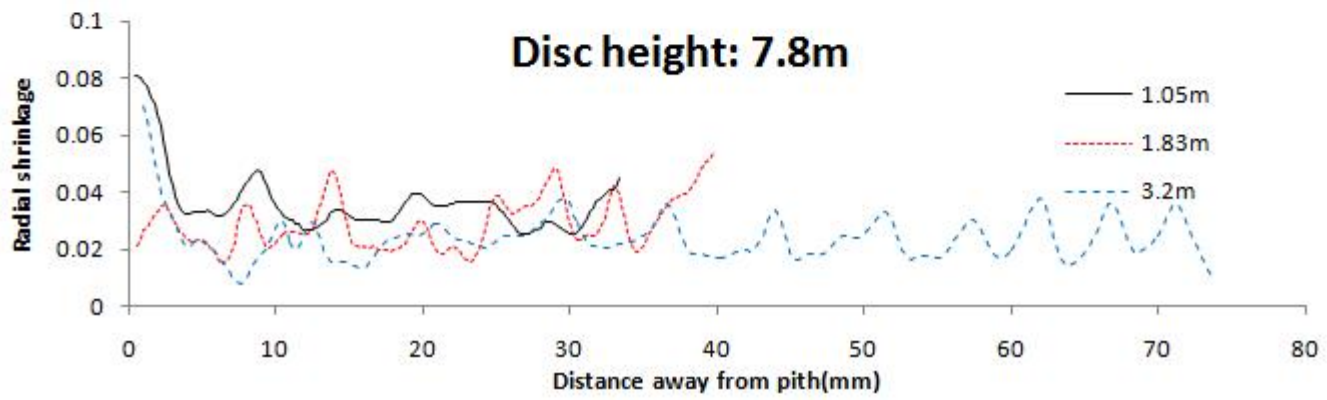

Longitudinal specimen
e2 [1] - Lagrange
0
-0.0028125
-0.005625
-0.0084375
-0.01125
-0.0140625
-0.016875
-0.0196875
-0.0225
-0.0253125
-0.028125
-0.0309375
-0.03375
-0.0365625
-0.039375
-0.0421875
-0.045

NSERC
CRSNG

Effect of tree spacing on radial shrinkage in white spruce

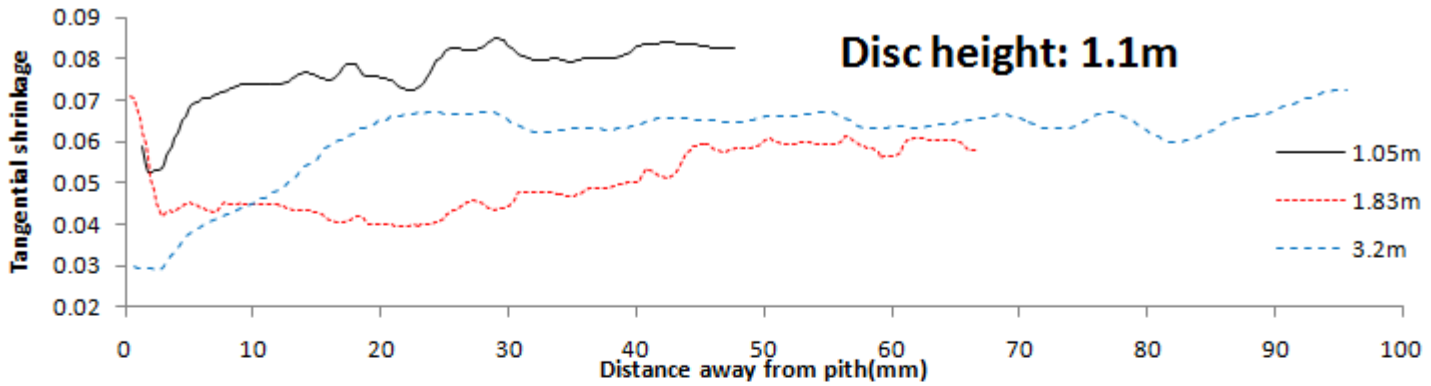


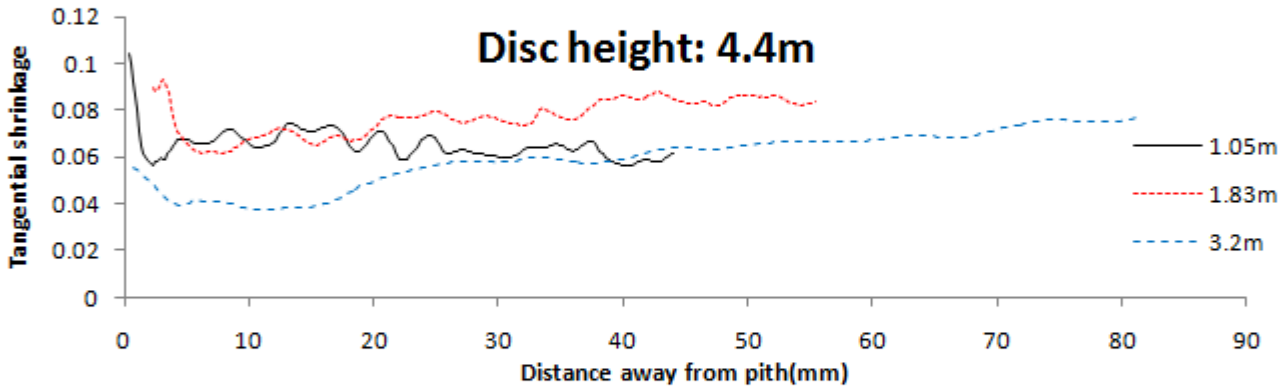


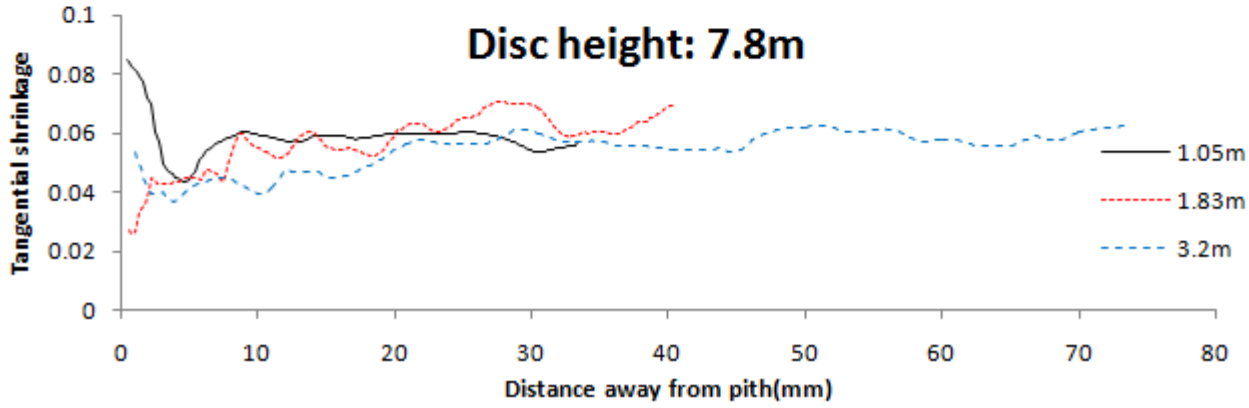


UNB
UNIVERSITY OF NEW BRUNSWICK

Effect of tree spacing on tangential shrinkage in white spruce

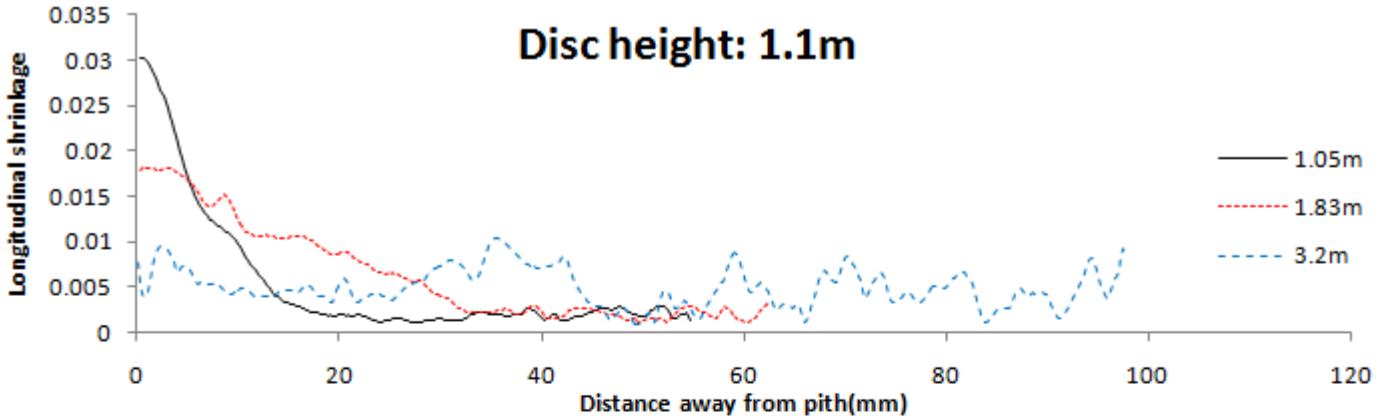


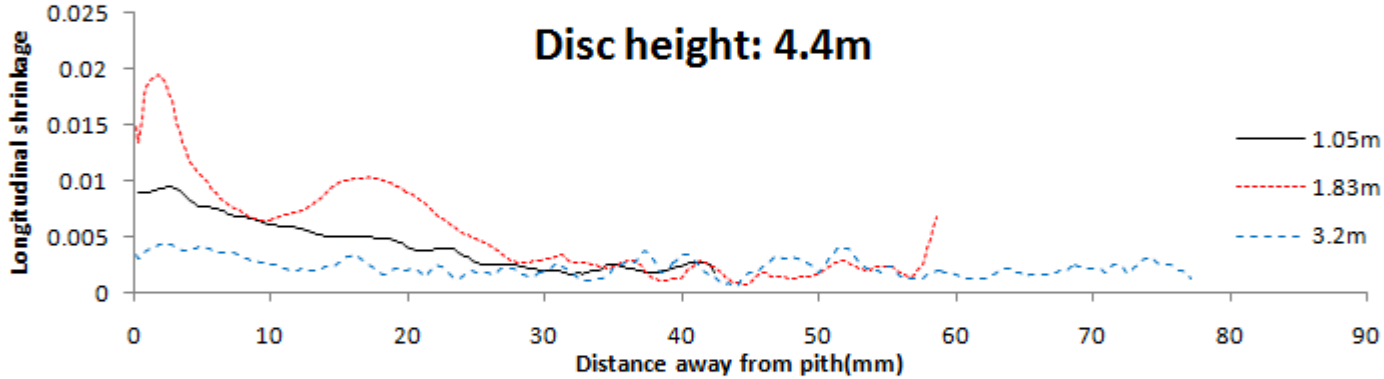


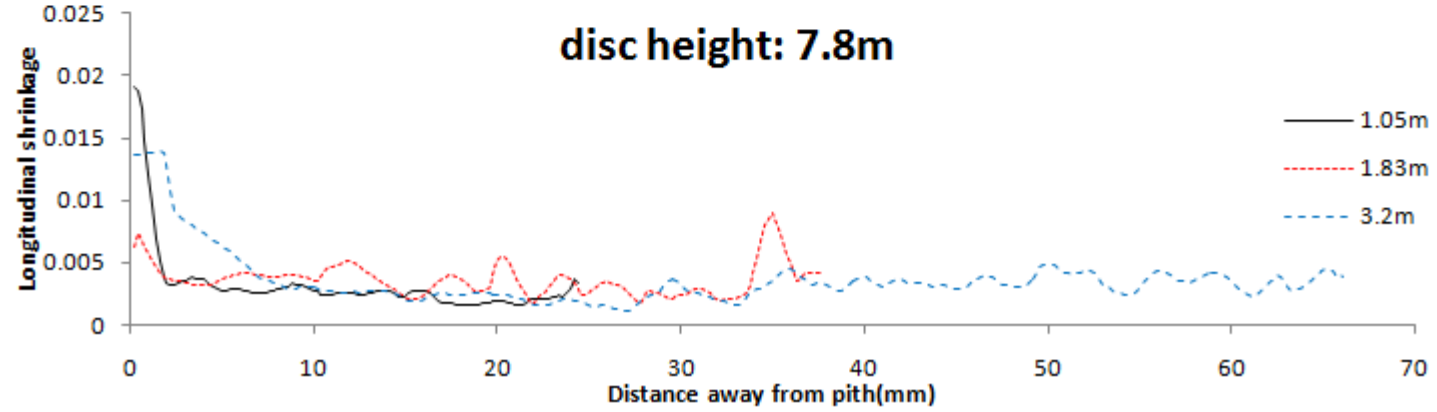


UNB
UNIVERSITY OF NEW BRUNSWICK

Effect of tree spacing on longitudinal shrinkage in white spruce







UNB
UNIVERSITY OF NEW BRUNSWICK

Conclusion

- Radial shrinkage, tangential shrinkage and longitudinal shrinkage measured by DIC is close the value reported in literature(4.7% (R) and 8.2%(T)) for white spruce.
- wood show different shrinkage variation pattern in radial, tangential and longitudinal direction.

NSERC CRSNG

ForValueNet ForêtValeur

FPInnovations

UNB UNIVERSITY OF NEW BRUNSWICK

Acknowledgements

- Edwin Swift (CFS) and Dr. Isabelle Duchesne (FPInnovations) as Network collaborators
- Dr. Wei-chung Wang, Yichiech Ho (National Tsinghua University, Taiwan), and all the members in the Photomechanics Lab.

NSERC CRSNG

ForValueNet ForêtValeur

FPInnovations

UNB UNIVERSITY OF NEW BRUNSWICK

Questions?

NSERC CRSNG

ForValueNet ForêtValeur

FPInnovations

UNB UNIVERSITY OF NEW BRUNSWICK