Contribution ID: **231** Type: **poster**

Hygro-mechanical behaviour of wood investigated by Synchrotron radiation X-ray Tomographic Microscope.

Wednesday 18 September 2013 12:15 (2 hours)

Wood exposed to air at different relative humidities (RH) swells and shrinks due to moisture content changes. High-resolution phase-contrast X-Ray Tomography at the TOMCAT beamline of the Swiss Light Source, PSI Villigen, is well suited to capturing micro and nano structures of wood and is used to investigate the hygro-mechanical properties of spruce wood (Picea Abies) at cellular and sub-cellular scales. In our previous work, we investigated affine deformations to quantify the global strains along the three orthotropic directions of wood (tangential, radial and longitudinal) but we could not detect local deformations. For this reason, we are currently working on a method to detect and quantify these local deformations using a non-rigid registration model. This type of registration employs a Free-Form Deformation (FFD) model based on B-splines. With the FFD model, an object is deformed by manipulating an underlying mesh of control points in order to produce a transformation which allows the contribution of the local deformations to the global strains to be quantified. In particular, we observed that:

- The anisotropy of swelling increases with increasing wood porosity, with a tangential/radial swelling ratio between 1 and 3.2 for porosities between 45% and 78%.
- The swelling anisotropy in low porosity wood could be due to the restraining behavior of rays, which seem to be the cause of local deformations at the cell wall level.
- Local deformations occur at the transition zone between high porosity and low porosity layers in wood, with higher influence in the more porous layer.
- The B-spline algorithm recovers both large deformations occurring at the wood edges during free swelling/shrinkage and the collapse of the wood cells due to swelling under mechanical restraint.
- The refined B-spline grid identified localized strains at the cell corners and close to some ultrastructure features of the wood cell wall, named bordered pits.

Primary author: Mrs PATERA, Alessandra (EMPA/ETH)

Co-authors: Dr DEROME, Dominique (Empa); Prof. CARMELIET, Jan (ETHZ / Empa)

Presenter: Mrs PATERA, Alessandra (EMPA/ETH)

Session Classification: Poster session I and lunch