Mapping of moisture on wood surface with hyperspectral imaging

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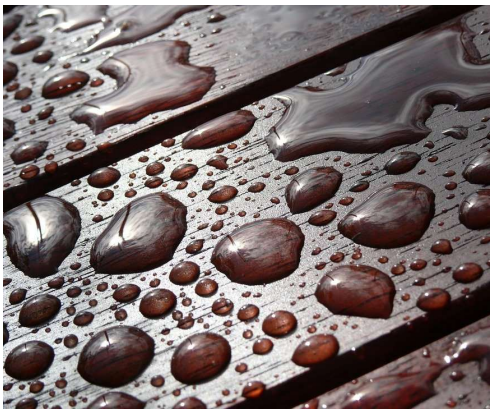
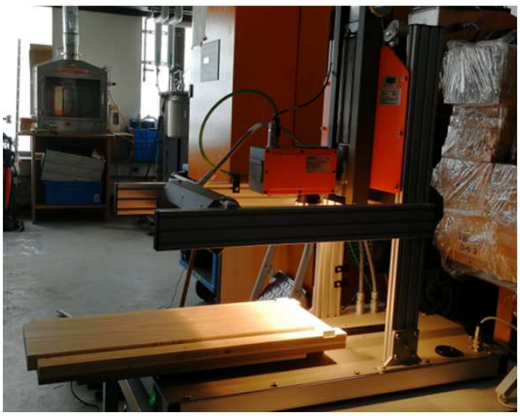
The water and wood relations influence greatly the technological processes of timber transformation as well as the performance of diverse products derived from wood. It is extremely important therefore to control moisture content at all stages of its use in order to assure optimal, functional and long-life service. The near-infrared spectroscopy was recently identified as highly suitable technique, combining ease of use, high sensitivity, and superior accuracy. Even if this technique enables rapid estimation of the wood moisture content (as well as several other properties, such as density, chemical composition, mechanical strength, etc.), most of the available instruments are limited to off-line applications and measurement of a single point at each scan. As an alternative, the latest developments of hyperspectral imaging enable scanning of object surface with very high speed (up to several hundred spectral profiles per second) still assuring superior spatial and spectral resolution.

The goal of this work was to test the suitability of such state-of-the-art hyperspectral imaging system in mapping of wood moisture presence on the surface of wood.





Hardware

Hyperspectral camera FX17 (900-1700nm), 250 frames/s, SPECIM (Oulu, Finland)

Software

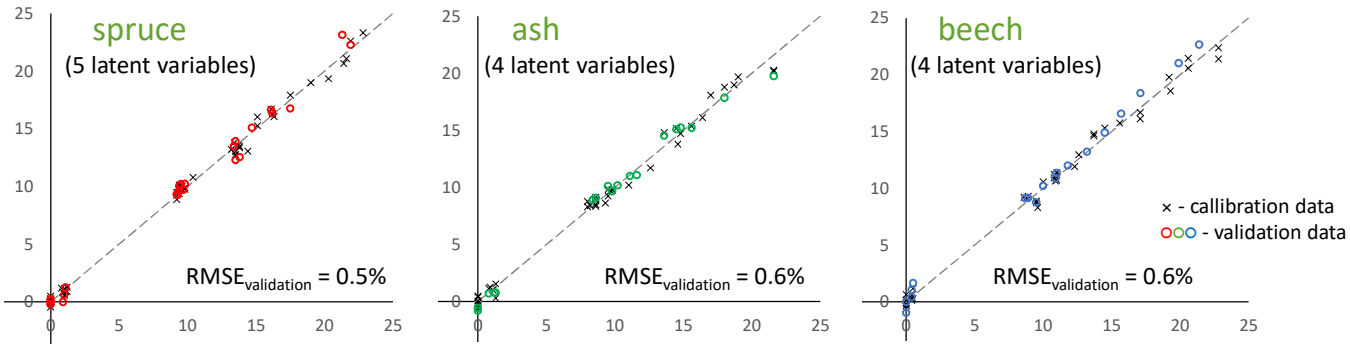
Evince (exploratory) and Breeze (in-line application) package (Prediktera, Umea, Sweden)

Materials

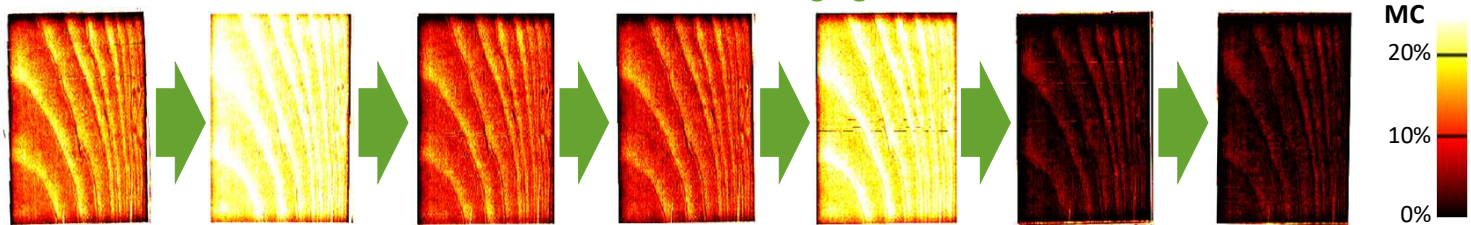
- softwood: Norway spruce (*Picea abies*)
- ring-porous hardwood: European ash, (*Fraxinus excelsior*)
- disuse-porous hardwood: European beech (*Fagus sylvatica*)

- conditioned in three climatic chambers (45%, 80%, 95%) x 5 random cycles, concluded by freeze drying + oven drying (100°C)

PLS models for predicting wood moisture content (+SNV correction)



Distribution of moisture over the wood surface when changing climatic conditions



air-dry (13.8%) | 95% RH (22.8%) | 80% RH (10.4%) | 40% RH (9.4%) | 95% RH (21.6%) | freeze dry (0.8%) | oven dry (0.0%)

The performance of FX17 camera was satisfactory and the root mean squared error of validation was <0.6% for prediction of MC in all species investigated. A unique advantage of hyperspectral imaging system was a possibility for mapping of the moisture distribution over the surface of scanned samples. **The tested camera proved to be suitable for practical application in the wood industry, including on-line wood quality control.**

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