NEAR INFRARED HYPERSPECTRAL IMAGING – BACKGROUND & APPLICATION FOR WOOD CHARACTERIZATION

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Motivation

- Determination of wood quality by hyperspectral imaging in the NIR .
- Using Hyperspectral Imaging to assess wood quality parameters (Fig 1 & Fig 2).
- Developing classification models for automatic detection of wood deficiencies.

resin pockets **knots** **rot + knot** **compression wood + rot**

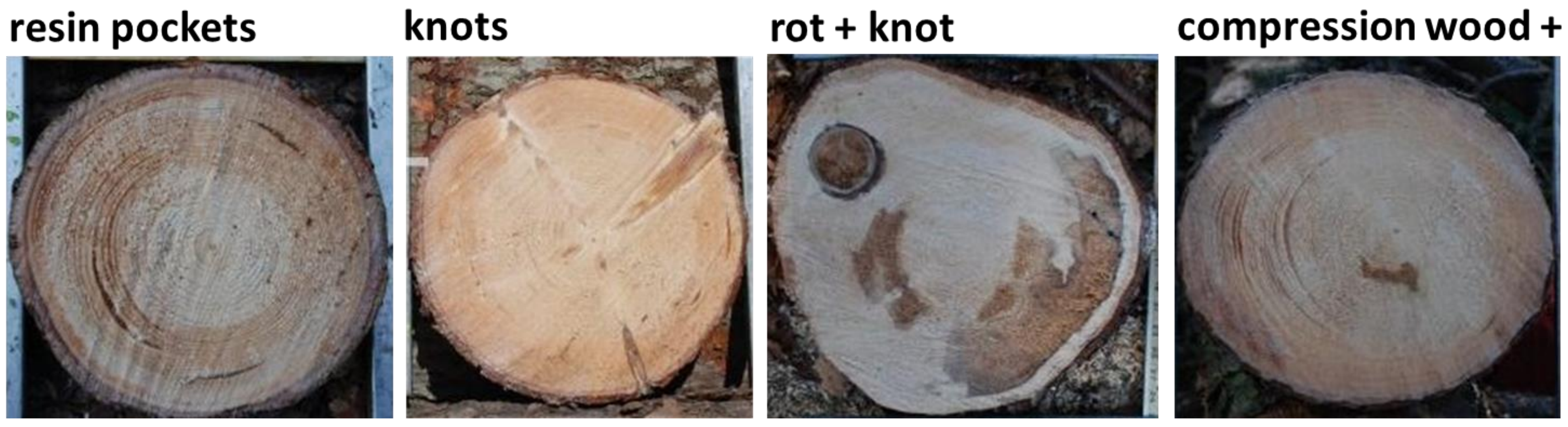

Fig. 1: Typical wood deficiencies: resion pockets, knots, rot and compression wood impairing the quality of wood.

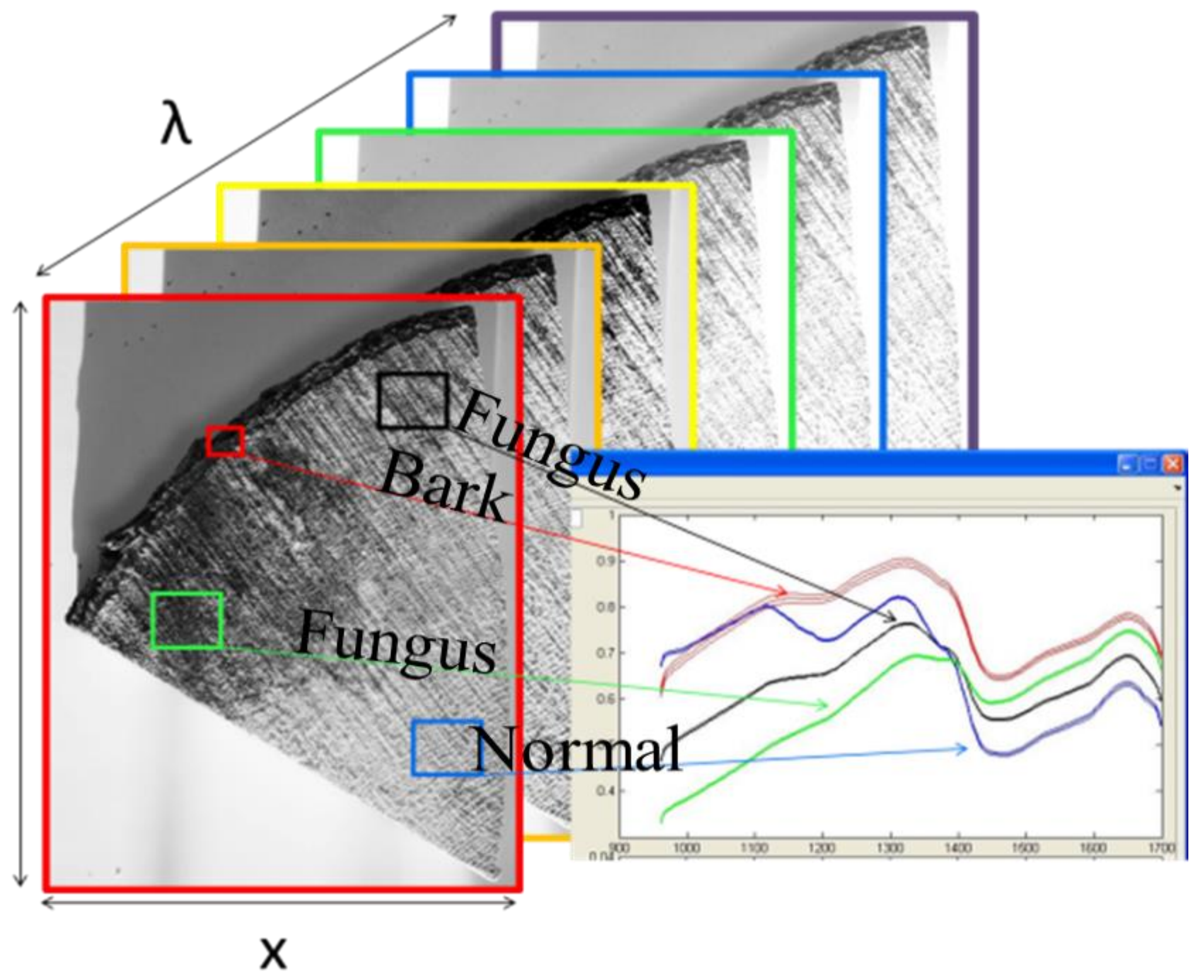

Fig. 2: The principle of Hyperspectral Imaging to characterize wood.

Characterization with NIR fibre probe

To determine the NIR spectra of the different wood deficiencies, measurements with a FT-NIR fibre probe BRUKER MPA on selected spots on wood discs at 15 ° C were made (Fig. 3).

To determine the reference spectra for resin, pure resin was collected from trees and filled into screw nuts to allow a measurement with the fibre probe.

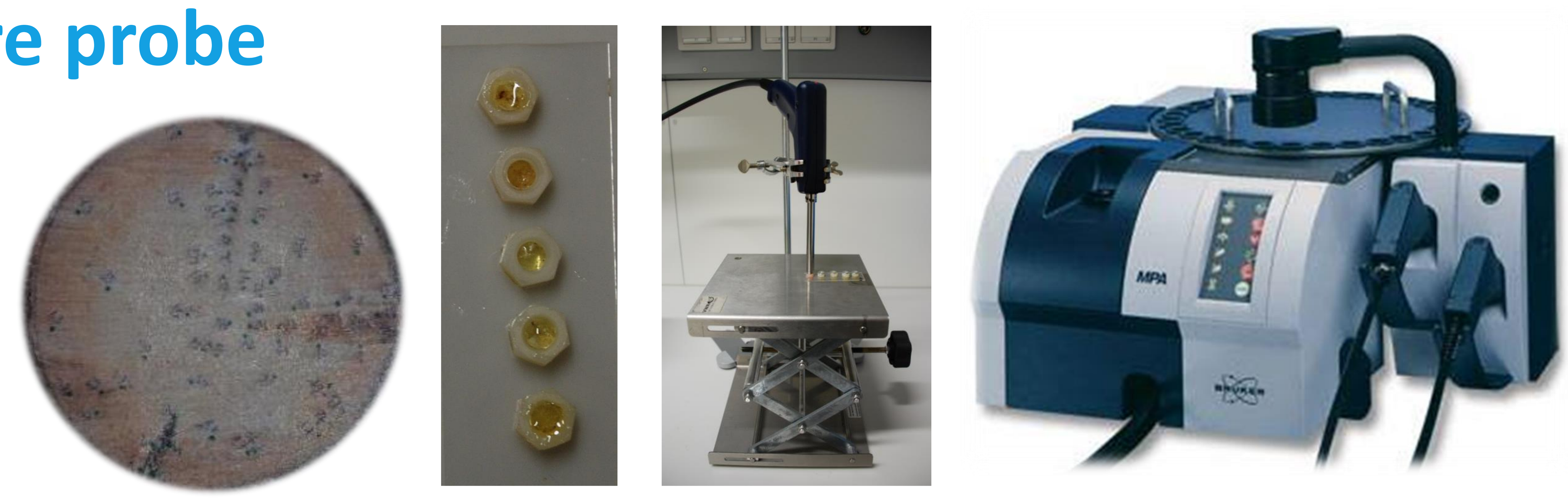

Fig. 3: Measurements of wood discs and pure resin using a FT-NIR fibre probe (MPA , 1000 to 2380 nm).

Measurement with HI-system

In addition, the wood discs were measured with a NIR Hyperspectral Imaging pushbroom system (900-1700 nm) (Fig. 5). Using PLS toolbox, the hypercubes were pre-processed and analyzed for the most significant wavelengths. At 1190 nm and 1377 nm the most significant differences between normal wood and resin were found (Fig. 4).

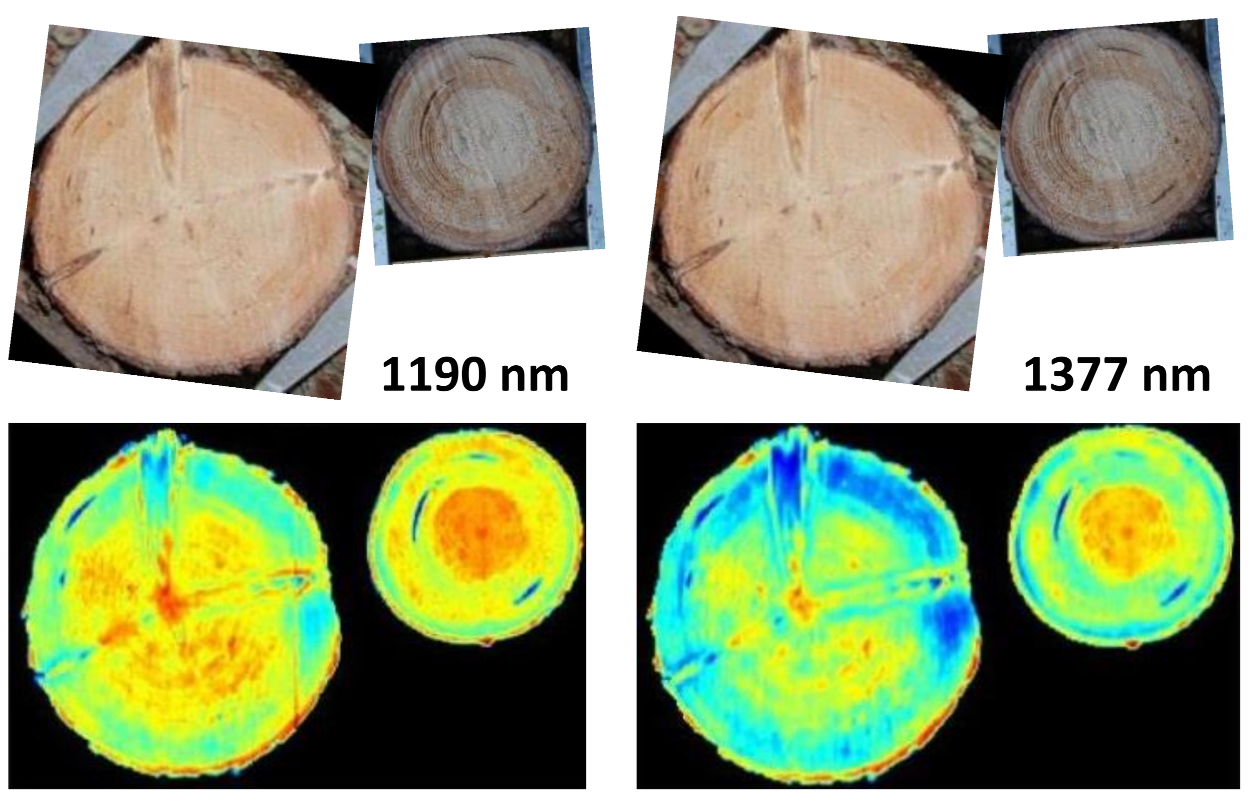

Fig. 4: Intensity slabs of reflection at selected wavelenghts to highlight areas with increased resin content on wood discs.

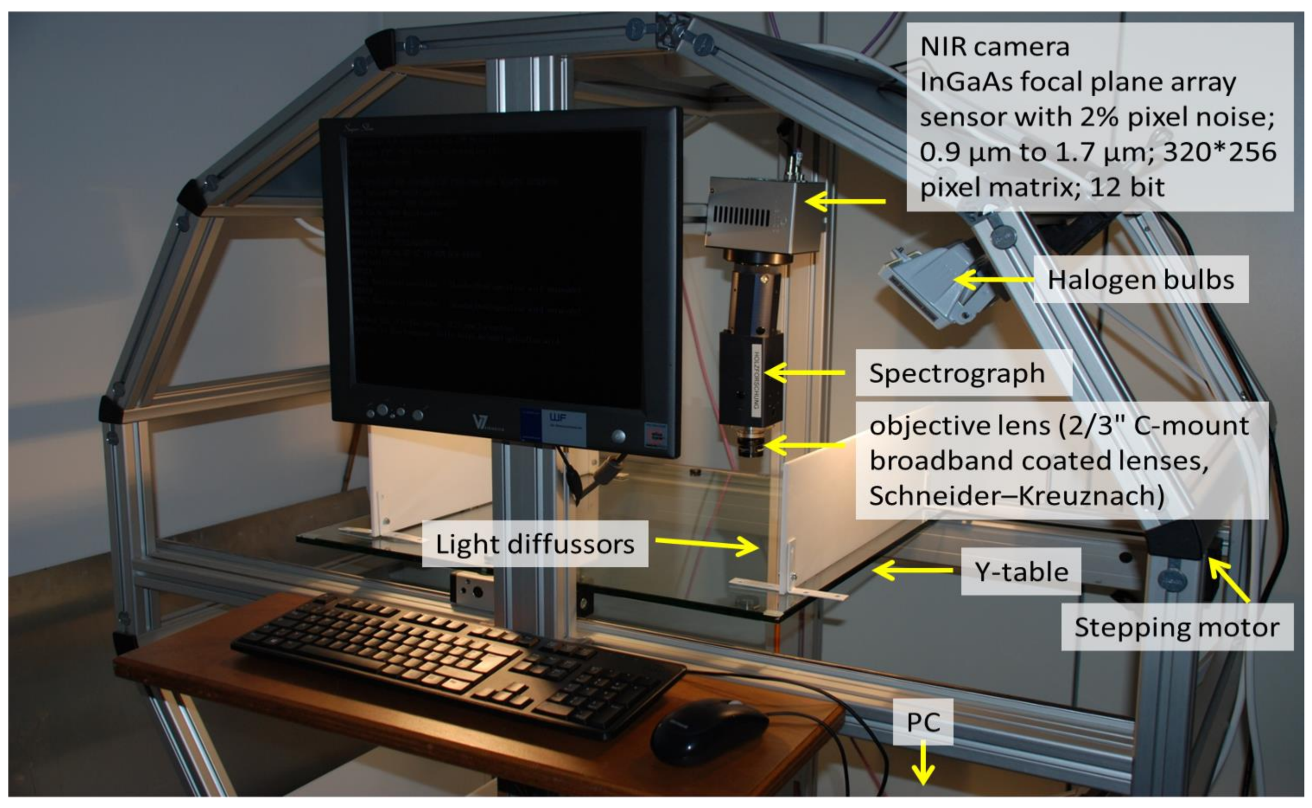

Fig. 5: Hyperspecral Imaging system with Xenics NIR camera (900-1700 nm) plus Specim N17E spectrograph, run by Argus Software (Firtha, 2010).

Model building and classification

A principle component analysis yielded a clear discrimination between wood, pure resin and resin pockets in wood (Fig. 7).

Finally, a supervised classification model based on selected pixels on training samples using PLS-DA was developed to predict resin areas on unknown samples (Fig. 6).

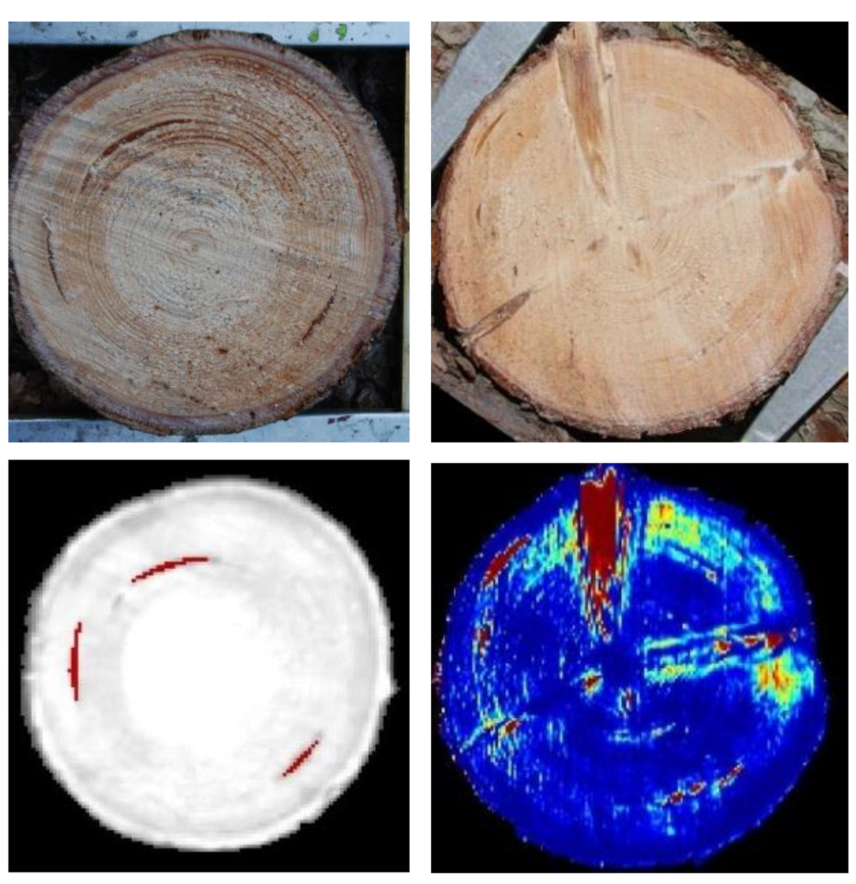

Fig. 6: Training (left) and test sample (right) for PLS-DA supervised classification of resin areas.

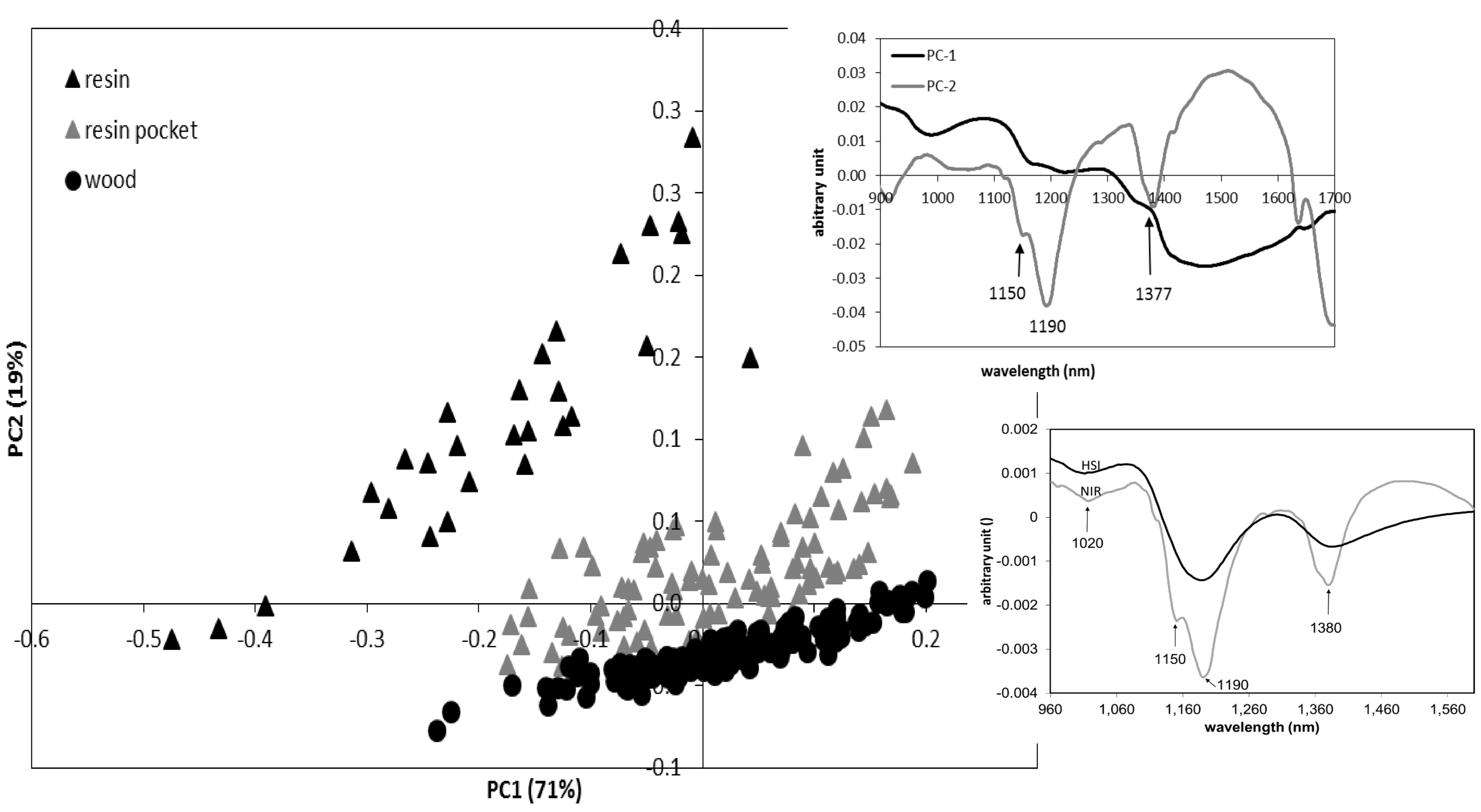

Fig. 7: PCA of FT-NIR measurement points pure resin, resin in wood and wood with loading plot of PC 1 and PC 2 (upper right); subtraction spectra of FT-NIR and HSI resin data (lower right).

Conclusion

Hyperspectral Imaging is a promising technique for investigating the quality of organic materials, e.g. wood. Wavelengths at 1190 nm and 1377 nm were most significant for resin pockets.

Literature: FIRTHA, F. 2010. Argus hyperspectral acquisition software, ftp://fizika2.kee.hu/ffirtha/Argus-CuBrowser.pdf, accessed 06.12.2016.

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