Development of a numerical model for computation of the weather dose in natural weathering of biomaterials

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Presented research is a result of STSM performed within COST action FP1303. The goal was to develop a novel numerical model for computation of the weather dose on the base of meteorological data and other geo databases. It could be considered as an alternative approach for assessing incursion of the environment, including longitude, latitude, solar radiation, rain and air humidity. The model provides a single (or multiple) indicator precisely quantifying the weather dose to be later used for determination/modeling of the aesthetical changes of biomaterials exposed to natural weathering as well as for technical characteristics influencing service life performance. The challenge is to apply the available numerical procedures and algorithms to the available data, but most of all to define an original approach for the weather dose determination.

A preliminary numerical model to be used for explaining weathering process of biomaterial (wood) samples obtained during Round Robin test of COST Actions FP1006 and FP1303 were developed with a subset of samples exposed in Ås (Norway). This test was conducted in parallel to the Round Robin test program, with higher frequency of sample collection. The test was conducted on the private building located in an open field, therefore allowing direct access of the sun radiation during the whole test. Five cycles of sample exposure were performed, each of 21 days duration. All samples within single cycle were exposed together, but the collection moment (and resulting exposure duration) was different for each sample. The collection frequency was 1 sample/day. Five consecutive cycles were conducted in total assuring the time shift of one week. The samples were stored after collection in a dark climatic chamber in order to avoid any further weathering. After the experimental campaign all the samples were carefully characterized including:

- NIR hyperspectral imaging
- TGA
- CIE Lab
- FT-NIR
- X-ray attenuation mapping

The detailed weather data were acquired form the local weather station located closely to the exposure site. The weather dose D, defined as an amount of energy provided to the system and affected the changes of material due to weathering was calculated directly on the base of CIE L, CIE a, CIE b and CIE dE (as linear interpolation of the tabular values obtained with the fitting function) and alternatively by means of the weathering indicator obtained with chemometric modelling methods, such as PLS.

The main goal of the developed software (Fig. 1) is to visualize the whole collection of the available results, including:

- appearance of the weathered sample
- measured CIE LAB colour coordinates
- modelled CIE LAB colour coordinates
- RGB colour coordinates and distribution on the image (histogram)
- weather data: (surface temperature, relative humidity, direct solar radiation, cumulative hours of relative humidity >80% in the period of the sample exposure, cumulative solar radiation)

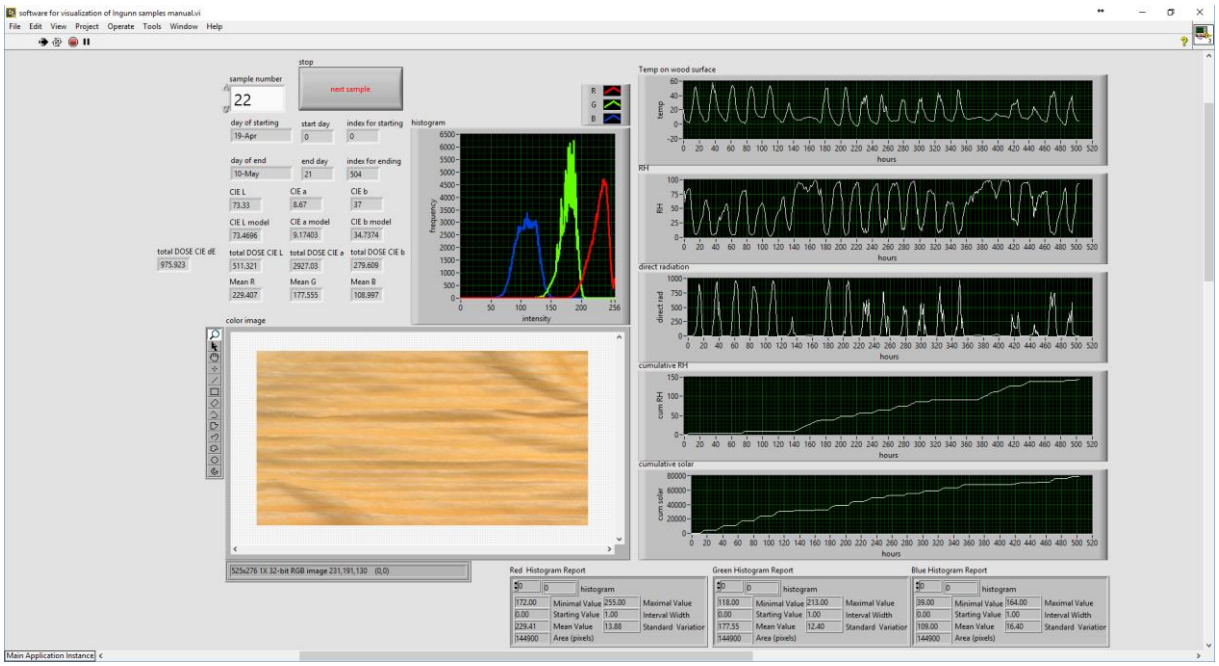

Figure 1. The user interface of the software usable for analysis of the weathered wood samples

The software is recently updated to accommodate weathering data from other locations and visualization of the any additional characteristics available for other samples

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