RESEARCHES ON SURFACE ROUGHNESS OF NATURAL WOOD, IN PARTICULAR THE FILTERING

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Abstract
The surface roughness of wood products is depending on many factors related both to wood properties and wood working operational parameters. Probably this is the reason why we have no generally valid relationships determining surface roughness parameters as a function of influencing factors. An appropriate measuring instrument and evaluation software is required to measure the surface roughness of wood. These devices were originally developed for the metal industry; therefore in certain cases – i.e. when measuring the surface roughness of large-vessel wood species – they deliver false measurement values. In order to avoid similar errors we have developed a software programme, which is specifically designed for the characteristic of wood.

Key words: *surface roughness, filtering, LabVIEW, Computer Aided Measurement*

INTRODUCTION

Roughness characterises the fine irregularities on a machined surface. These irregularities can be determined by measuring the height, width and shapes of the peaks and valleys produced by wood working operations or by internal structural properties. The surface quality is a complex definition and it is characterised today by different parameters such as the more common R_a, R_z and R_{max} parameters. Further details can be established using the Abbott-curve and its related parameters R_{pk}, R_k and R_{vk}. These parameters are standardised (DIN 4768 and 4776) and for their determination modern measuring units are commercially available.

During the evaluation of the roughness due to woodworking operations we could observe that the surface of the given probe will have an even finish when optimal cutting parameters are applied.

The anatomical roughness is located below the even surface, while the roughness due to woodworking operations is located above this surface line Fig1.

However an improperly chosen cut-off (length) for large-vessel wood species will produce artificial peaks in the profile, which also changes the values of roughness due to woodworking operation. (Fig. 2).

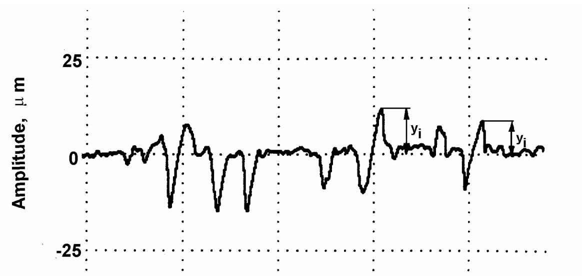


Fig. 1. To the calculation of roughness component due to woodworking operation

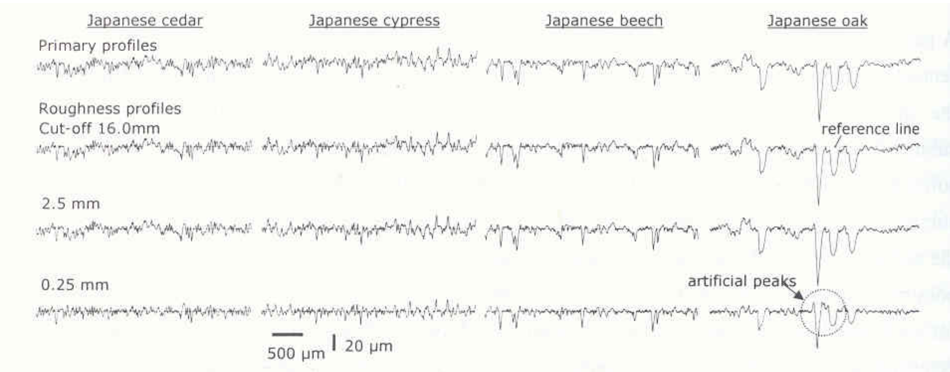


Fig. 2. The appearance of artificial peaks due to inappropriate cut-off [3]

MATERIAL AND METHODS

We needed a special software to process the measurement data. The software has to be able to evaluate the measurement data in two different ways: on one hand it should apply a robust Gaussian regression filter in order to avoid (exclude) the artificial peaks in the area of the large vessels that are cut. On the other hand it should provide the option to manually remove the large vessels, which is required during the detailed evaluation of the roughness due to woodworking operations.

The versions of the software „CurveCutter" were developed for the Department of Wood Technology and Department of Wood Machining at the University of West Hungary.

The software communicates with the measuring unit via serial port. It also displays the co-ordinates of the measured points and the measured profile The calculated data can be saved and subsequently opened in a Microsoft Excel spreadsheet for the purpose of further processing.

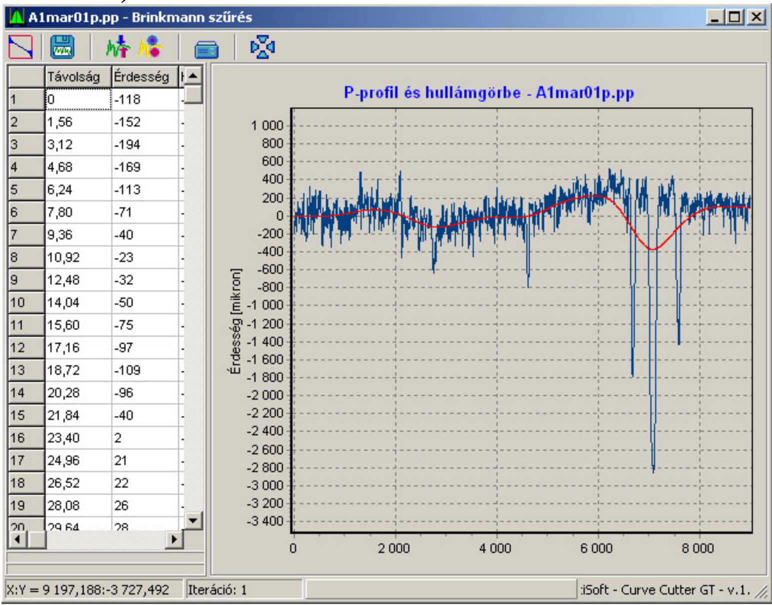
The program is convenient for the calculation of the standardized parameters of surface roughness based on the profile P. It goes without saying that it also can display the material content curve (Abbott curve) and calculate the corresponding roughness properties of P and R profiles in every case.

In the industrial world it is well known that linear filters are non robust, which means that any protruding peak or valley (artificial peak) leads to a distorted roughness topography and effects the calculation of surface parameters directly. One solution is the robust Gaussian filter according to ISO 11562, by means of which you can „flatten out" the profile extension/distortion in the area of the vessels cut.

Using the “Curve Cutter” the filtering method is changeable by programming work. During the research we evaluated the applicability of the software LabVIEW. The LabVIEW is a measuring and controlling frame system for measurement processes. In the near future it could be a base of an automated multi-point surface quality analyzer system.

RESULTS

If we want to evaluate the roughness due to woodworking operations of large-vessel wood species, it is reasonable to remove the vessels form the evaluated profile. In this case we can use the mouse and mark two points in the profile. The area between the two marked points (the vessel cut) will be removed and excluded from further evaluation.



The tasks of these software are:

- reading of P profile data measured by Mahr Perthometer S2 via RS232 serial port;
- visualizing of the profile data;
- filtering of the roughness profile:
  - cutting of vessels manually,
  - P-R profile conversion based on Brinkmann-filter (robust Gauss regression),
  - cutting of vessels based on Csiha-method (based on frequency curve) and P-R profile conversion based on Brinkmann-filter (robust Gauss regression);
- calculating the roughness properties and the material content curve (Abbott curve) of P and R profiles in every cases;
- saving the roughness data rows and the calculated values into files to ensure further evaluation;
- printing of the profile diagrams.

The LabVIEW could control the surface measuring machine Perthometer. The filtering method easily changeable and parameters adoptable to the preprocessed data. The cutting off of the vessels manually makes real figures, but this method is not applicable in automated measuring processes.

DISCUSSION

The software can calculate the roughness values (P_z, P_a, P_t, P_v) of the **P** profile (with vessels) and it determines the corresponding material content curve with its parameters (R_k, M_{r1}, M_{r2}, R_{pk}, R_{vk}). To calculate the Abbott curve the horizontal secants can be set by number or by distance. (EN ISO 4287:1997, EN ISO 13565-2:1997)

Filtering with robust Gauss regression

By using the robust Gauss regression the "push-up" of the edges of (large) vessels can be bypassed.

The following parameters can be calculated:

- **W** wave profile of the actual **P** profile (with vessels) by using of robust Gauss regression (*Brinkmann regression*) - ISO/CTS 16610-31:2002,
- roughness/wave parameters (P_z, P_a, P_t, P_v, W_z, W_t) and material content curve and parameters (R_k, M_{r1}, M_{r2}, R_{pk}, R_{vk}) of the actual **P** profile and the corresponding **W** wave profile,
- **P** profile conversion to **R** profile based on the corresponding **W** wave profile,
- roughness parameters and material content curve and parameters of the actual **R** profile (with vessels) (R_z, R_a, R_t, R_v).

CONCLUSION

The software can calculate the roughness values (P_z, P_a, P_t, P_v) of the **P** profile;

A profile extension in the large-vessel area can be avoided by using a robust Gaussian filter;

The effect of woodworking parameters on the surface roughness can be better pursued when the large vessels are mechanically removed.

The developed filters could be used to eliminate the manual vessel mechanical removing. The quality of the filter means the filter cutting the vessels only and all of that ones from the measured profile. Changing the parameters of the filter called tuning of the filter. The fine tuning of adaptive filters requires more comparisons. From the first results seems that the different kind of species demands differently tuned filters.

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