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Doctoral thesis (PhD)

Offer for the quantitative determination of selection of stacked wood photo analytical processing algorithm by using spline functions

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1. Introduction

The determination of stacked wood overall mass can be measured either in solid cubic meter or stacked meter. Between the two units conversion factors used to a convert values. In the first half of 19th century, the convert values were configured with measurements and statistical calculations, and later it was also distinguished for the different assortments. In recent decades, the number of assortments has been reduced, and in most cases the producers ~~produce~~ put the different sizes and quality of timber ~~on~~ in a single stack.

Emerging from the forests in Hungary is very high proportion of cylindrical timber nearly 70% – is stacked wood. In contrast to previous years, today's sophisticated practice of forestry practice does not distinguish multiple stacked wood for choice, but only one type of selection the selection of previous materials. The single choice of previously developed assortment cubic-steres conversion factors, significant practical measurements, can be charged with a difference.

In the first half of the XX. century based on measurements have been developed conversion factors between cubic meters and steres for the stacked wood assortments. Despite of the high volume of measures because of the diversity of nature there is a very high standard deviation between tree species, loads, regions. To specify the methods at that time the species and assortments were differentiated. Different conversion factors were assigned to the hard-and soft woods and separated to the coniferous. As the matter of quality there were fiber, chips and firewood. Thanks to this differentiation they could achieve a higher approximation accuracy. Back to the origins of the differences there are more factors, such as the production conditions, the choice of standard deviation of the diameter, and ~~of~~ the crook, the knots, or the quality of piling.

Over the past two decades, several changes determined the accuracy of conversion factors in most cases in negative direction. Today, the forest stack cannot provide the wood quality than could 50-100 years ago. The diameter dimensions are reduced and the wood crooks and defects are more common. It is unfortunate that with the advent of the weather extremes of the biotic and abiotic impairing also became more common, as a result, in most of the cases the rotation periods cannot hold on the 50-100 year earlier levels. The weather is becoming more extreme conditions in the forests; it is now uncommon to have dry summers, sometimes a sudden large amount of precipitation socked the forests. Because of wind breakings, the volume of exploitation of timber having increased over the past quarter century. Therefore, one need to write up developed conversion factors. That is, nearly a century old forest management practices industrial wood assortments experience technology needed to be replace with today's modern technology, with an innovative method.

2. The aim of the research

At the determination of the stacked wood volume the assumption is that the wood butt surface area ratio is the same than the solid content ratio in the volume. If the stacked wood were made in an intersection plane perpendicular of the butt edge we would get similar surface ratio. By the development of mathematical and data processing tools opens the door to processing algorithms and hardware, which implements the ability to individually determine the conversion factor for a given load or burden. It makes a more accurate and faster material survey then the ~~one we have now~~practice have used till now.

One of the possible new technology based on photo analytical and mathematical methods. Computer processing of the high-resolution images requires serious computing capacity and a longer processing time, for this reason, one important objective is to develop algorithms for faster processing. By using scientific, mathematical tools help to reduce on-demand computing and the processing time. Processed by the specified pixels algorithm the butt edge interface, ~~correct size~~right scale transformed photo, task faster and smaller-capacity machine also can be used. The main task of the research is to develop smoothing algorithm which make possible a more accurate determination of stacked wood volume.

3. The research method

The digital photography and digital imaging, is now allows making and processing 10-12-megapixel images. The importance of high resolution is that how many pixels needed for example a 10 cm diameter butt edge disk. If 10 pixels cover 10 cm length, then we have 1 pixel per cm resolution, in case of 20 or 30 pixels the resolution will be 5 and 3.3 mm respectively. Based on high-resolution images using suitable algorithms one can scan and obtain information from images. The retrieval of this information requires the development of intelligent algorithms to extract, which is based on the measurement and continuous monitoring of many refinements. This is achieved too in the present research aims.

Other possible acceleration option is available in the application of statistical methods. The pixels properly (samples, distribution) selected from the sample can infer to the entire image. By varying, the number of the selected pixels can determine the required number of samples and during processing one should process only this calculated number of pixels.

Development and verification of the functioning of the algorithms is a significant step forward in professional and processing accuracy for wood and forestry professions.

4. Results

The thesis aim is to present a digital imaging method by which wood assortment butt edge interface-made image analysis to determine the volume of wood in the test, assuming the same length of the logs.

The purpose of the development of the method for the further development of existing instruments and procedures. The earlier results significantly depended on the operator, i.e. the measurement of the individual carrying out the professional preparedness. The target was, therefore, an automated analysis method of treating, which is not, or only slightly dependent on the vocationally of operator.

By developing the method have been used in a variety of different disciplines: statistics, mathematics, physics, computer graphics. The procedure described in the case of a digital image in several steps determine the most commonly occurring pixels which are marked with neutral color at results.

To test the method in a JAVA programming language, the Eclipse integrated development environment written program was implemented, which called WSA (Wood Spectrum Analysis).

During experimental measurements of the initial assumptions are met, based on a butt edge image the cargo or shipment of butt edge shall be at liberty to determine the ratio of the volume of the solid.

5. Scenarios of moving forward options

There must be a light intensity measure in the new device. One of the main problems of the analysis were ~~because of~~ the different quality of butt edge interfaces digital image. The optical resolution could be solved with better lenses, but after a certain level ~~it~~ of this cannot improve the picture quality of the preparation. Greater concern was the quality of the surface of butt edge (for example, contaminated), and making the image lighting. The latter measured by installing light intensity measure device, and this could be clarified by further parameters described in section 4.3. This could be made even easier for users to use the program and greater accuracy could be achieved.

Testing the WSA program with random grids. 4.4 chapter dealt with statistical principles of the method based on acceleration. The rectangle (square) grid of the analyses showed that the method can speed up within the margin of error. To report the estimates of sampling the great analogy it is also supported by a variety of random sampling by the results.

Edge Finder. Inlay method referred to in section 4.5 as an alternative to testing the WSA program can be developed further and changing the parameters of an edge algorithm. After determining log perimeter, even the colorization process can be simpler. During preliminary inquiry could determine a linear or non-linear correlation between values of H- S-V, which indicative of the existence of the edge finding process during logs examination.

6. The thesis

I. The method of photo analytical receipt of stacked wood materials has been further developed. Instead of the RGB Spectrum Analysis the HSV color space transition was used to analyze the device control systems. Main reasons for this are: this is the most appropriate for computer graphics, on the other hand, the tasks can be done and analyzed by changing a single component. The analysis method was automatized with statistical methods, i.e. by selecting the manual reference points as opposite to the procedure automatically chooses the wood color reference values after the initial default settings.

II. With the help of HSV scene analyses, empirical parameter values were determined by specifying the S and V values into partial sections. This way in different light conditions and in addition to the contamination, digital image can be analyzed supremely.

Based on the method the WSA (Wood Spectrum Analysis) program was written in JAVA. The program allows you to define suitable environmental conditions, optimal default values after comparing multiple analyses of the results of the tests carried out.

III. Statistical procedures were used to reduce written software running time and memory usage.
Digital image of the timber made millions of pixels. The issue was raised that with many samples, sampling procedures can the number of pixels to be processed, or what is the actual result accuracy of the reduced amount of dataset.
The examination on the grid verified the expected values of the distribution of the dimensional distribution in the method of determining the sample size, which resulted in the choice of the optimal grid.

IV. To study the accuracy of the method has been developed for testing a theoretical procedure, since the problem is practical there is not a standard model, which can be compared with the accuracy of the method.
An examination of the correctness of digitally created and edited images could be verified. In the first case WSA was executed on a so-called idealized stump and after it on an idealized string edited out of the pictures of real strings. The measurements are fully confirmed the accuracy of the method and functioning within the margin of error.

V. To further clarify the results, spline functions were used to approach the logs boundary.
Ideally, we could assume circular logs, but in reality, they are more likely to differ from butt edge interfaces. The splines could describe more accurately the surfaces of the boundary of butt edge interfaces, and accordingly can be estimated more precisely the area ~~too~~.
Splines can be easily to algorithmable, which is why it is common in the computer evaluations.
During the test, the generalized splines were applied, whereas the matching task is solved simultaneously with data smoothing.

7. Publications and presentations

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