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Influence of Colors Compression on Performance of Neural Model to Identification of Mechanical Damages of Corn Kernels

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ABSTRACT

The presented in work model to identification of mechanical damages of corn kernels basis on the digital images. Produced model operate support by two technologies: computer image analysis and artificial neural networks. First technology analyses corn kernels images and saves gain this way information to the learning files. The artificial neural networks conduct the process of damages identification basis on produced learning files. Analysis of sensibility produced neural model showed on key part information about color of corn kernel in process identification. Information about shape of corn kernels have smaller significance. Base on mentioned analysis was decided to check influence of colors compression on working quality of neural identification model. Applied method of average information of color value in one teaching example. Also executed division to percentage participation color three basic colors according to the

RBG model in one teaching example. So processed learning files were presented again to the artificial neural network. The results of working neural identification model, learning on modified teaching files, appeared significantly worse from trained on learning files including the full information about color.

First method of compression showed larger error of model working than second method, with proportional part of basic colors. Obtained confirmation the key meaning information about corn kernels color in process of damages identification.

Keywords: Neural image analysis, color compression effect, Poland

1. INTRODUCTION

Presented at work Nowakowski and Boniecki neural model is used for the identification of mechanical damage of corn kernels from their digital images (Nowakowski et al. , 2009, Boniecki et al., 2012a, Boniecki et al., 2009). Produced model can be based on two technologies: computer image analysis and artificial neural networks. The first technology analyzes the digital image of corn kernels (Nowakowski et al, 2012, Nowakowski et al., 2012). Data obtained in this way are saved in the form of learning sets. Artificial neural networks based on learning sets carry out the process of identifying defects in corn kernels (Osowski, 2008). The shape of the kernels are described by the aspect ratio. With many well-known factors are taken that help identify shapes similar to the circle. The first of the selected aspect ratio is a dimensionless ratio of RS to quantify the shape characteristics of objects:

$$R_S = \frac{L^2}{4\pi S} \quad (1)$$

where:
L – circumference
S – area

Another is the Feret ratio (R_F) in the literature also called Feret diameters characterized extension of object:

$$R_F = \frac{L_N}{L_V} \quad (2)$$

where:
L_N - the maximum size of the object vertically,
L_V - the maximum size of the object horizontally.

Two factors of circularity R_{C1} and R_{C2}:

$$R_{C1} = 2\sqrt{\frac{S}{\pi}} \quad (3)$$

$$R_{C2} = \frac{L}{\pi} \quad (4)$$

The first of the above (3) defines the diameter of the circle with a circumference equal to the circumference of the analyzed object, while second (4) diameter of the circle of which the field is equal to the analyzed object. The last selected aspect ratio is the Malinowska ratio R_M:

$$R_M = \frac{L}{2\sqrt{\pi - S}} - 1 \quad (5)$$

The last two parameters from image analysis is the circuit and field seeds. Are necessary for determination of the shape and well characterized grain damaged. A set of features also include information about the color, coded according to the RGB color space model. Direct entry the RGB model to training set carries a risk of falsification of information or its misinterpretation. This is due to the fact that all three color components are stored as values from 0 to 255 each (Boniecki et al. 2012b, Boniecki et al., 2011). To avoid the error suggested the option of encoding information in color according to the diagram shown below (Fig. 1) [Nowakowski 2008].

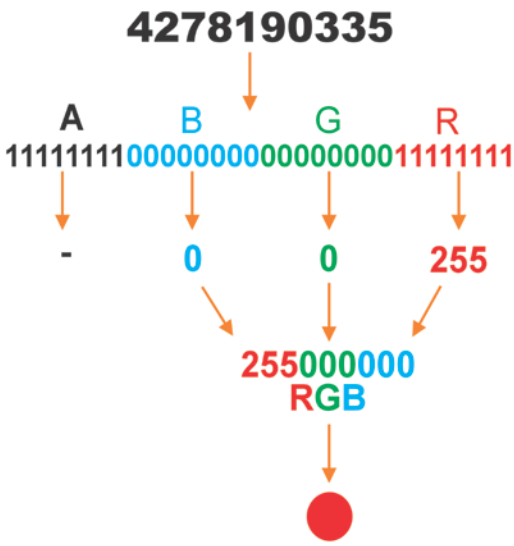

Figure 1. The encoding scheme information of the color.

Sensitivity analysis of neural identification model indicated as key parameters, with the highest ranks, the color information. The number of information depending on the adopted methodology ranged from 256 to 1024 variables. It seems advisable to try to compress the information and study of the impact on the work quality of neural identification model (Cerbin et al., 2012).

2. RESEARCH OBJECTIVE

The purpose of this study was to investigate the effect of compression of color information to the identification process. Information about color is one of the characteristics by which it is possible to correctly identify damage corn kernels by neural model. Compression of this information reduces the number of data. From the perspective of the model and the learning time after the operation is desirable. However, compression also reduces the detail information in the learning vector. Therefore, it was decided to investigate the effect of this operation on performance of the neural identification model.

3. METHODOLOGY

Originally prepared learners collection included data the state of kernels, based on their digital images with a resolution of 512x512 pixels.
Then the images were subjected to the image processing and computer analysis. The specific parameters read from and written to the image data sets included information

about the color of each pixel according to the author's color system of RGB format.. To standardize the learning vector size photograph divided into fragments of fixed size 32x32 pixels (Fig. 2).

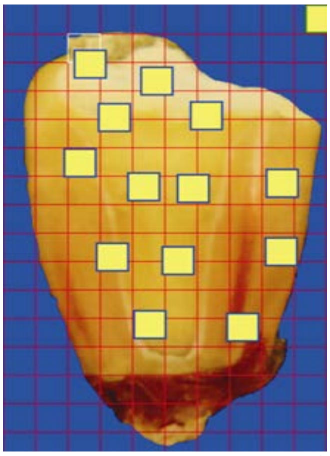

Figure 2. Divides the image into fragments.

This approach gives the learner vector complex with 1024 variables that contain information about the color. In addition, learning vector contains nine variables describing the shape of the kernel. The significant size of the learning vector extends the learning process of artificial neural network. So it is desirable to search methods reduce information in learning vector, while maintaining the quality parameters of the neural identification model.

The reduction of colour information is performed in two ways:

1. Averaging the information about color pixels within a segment of an image (size 32x32 pixels) (Fig. 3).

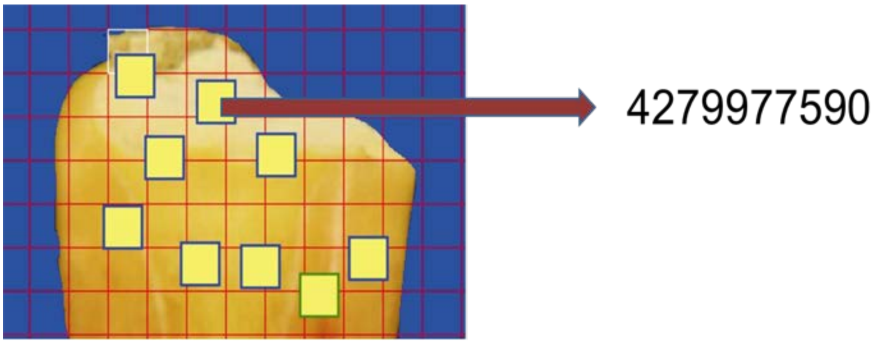

Figure 3. The result of compression of color information first method.

2. Percentage of the three primary colours (format R - red G - green B - blue) within one segment of the image (Fig. 4).

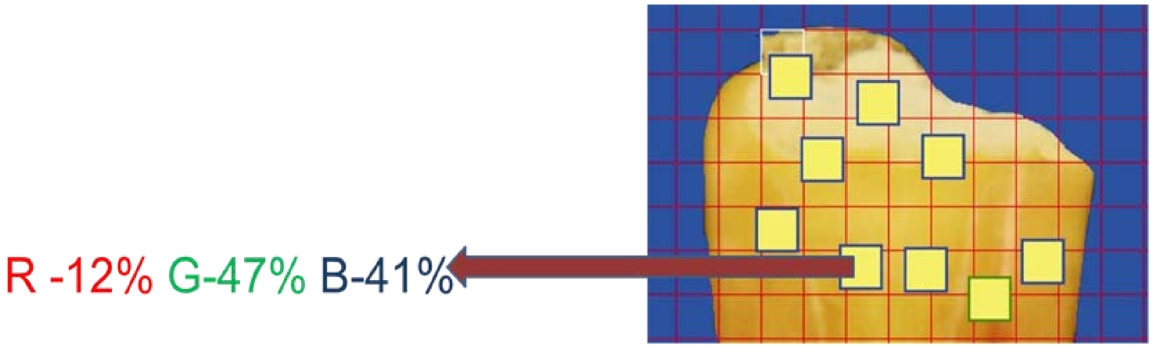

Figure 4. Result compress the second color information by.

First method reduced learning vector to 10 variables, and the other to 12

4. RESULTS

Results of identification from neural model based on the modified learning sets, proved to be significantly worse than the model learned on files contain full information about color. Operating model based on learning sets generated by the first method of averaging colors within the learning activities had a greater error than the second model, operating on the basis of data sets to the percentage of primary colors. High error of the first model shows the key role of color information to identify the damage kernels. Averaging the colors resulting effect of "blur" the image. Model to detect damage looking for information about major colors changes. Averaging the color information makes such changes were not recorded.

Table 1 summarizes the parameters of the two models discussed above, and a third model that had been taught on the basis of full color information. All models were built based on the topology of the multilayer perceptron with one hidden layer. To evaluation models were used values of: learning error, validation error and test error. Also an important indicator is the quality of the network. The final classification was based on the ROC curve (Receiver Operating Characteristic). The area under the curve values closer to 1 the more accurate is the classification of kernels. These results also confirm the crucial importance of color information in the identification of defects in kernels.

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Table 1. Summary of the results of neural models of identification.

NETWORK TYPE	METHODS OF LEARNING	NEURONS IN THE HIDDEN LAYER	ERROR			QUALITY			AREA UNDER THE ROC
			learning	validation	test	Learning	validation	test	
MLP **	BP50 CG173 *	43	0,2868	0,3071	0,3152	0,7453	0,7423	0,7705	0,8161
MLP **	BP50 CG173 *	43	0,2252	0,2431	0,2568	0,8961	0,9073	0,8912	0,8901
MLP **	BP50 CG173 *	43	0,1069	0,2371	0,2384	0,9907	0,9385	0,9118	0,9713

* BP - back propagation error algorithm, CG - conjugate gradient algorithm, the value is the number of learning epochs.
** MLP (Mulit Layer Perceptron) - a multi-layer perceptron network.

The proposed compression method does not bring the expected results. The proposed compression method does not bring the expected results. It is necessary for further exploration of effective compression methods that allow to maintain the quality parameters of the neural model identification.

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