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Application of artificial intelligence in the wood industry

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Abstract: *Application of artificial intelligence in the wood industry*. Computer performance is to carry out the tasks arising from the algorithm. Artificial Intelligence is to create a machine that mimics human thinking. The study characterizes the various systems of artificial intelligence and their application in the woodworking industry.

Keywords: artificial intelligence, wood industry

INTRODUCTION

The history and development of artificial intelligence systems can be distinguished from the knowledge base called ekspert systems, controllers with fuzzy logic, artificial neural networks, genetic algorithms and hybrid systems, such as a combination of neural networks with genetic algorithms.

CHARACTERISTICS ARTIFICIAL INTELLIGENCE SYSTEMS

Expert Systems are complex computer programs from the encoded knowledge of people - experts in the field. The decision in expert systems is taken on a subsequent election to the most accurate comparison of the situation to the system resources. Working the system is thus not exactly as a man - an expert who can decide not only on the basis of familiar patterns and rules, but also intuition and experience. Another disadvantage of the expert system is the need to process a large number of parameters needed to strictly define the situation.

Fuzzy Logic responds to the need to define vague terms, or even abstract. Machine, whose task is turning on the lights after dark, it is easy to adapt to the task: "If the light intensity is x, then attach lighting". In everyday life we do not use too often, however, numerical terms. As a rule, we want the machine was able to accomplish the task: "When it gets dark a light switch". Fuzzy logic is just clarifying concepts such as "When it gets dark". For several years there is an increasing number of application drivers whose working principle is based on fuzzy logic. They are implemented successfully for both household use and for complex processes.

Genetic Algorithms algorithms are modeled on the mechanisms of natural selection and heredity. In every generation there arises a set of new organisms, created from fragments of the fittest organisms of the previous generation. The basis for the functioning of the genetic algorithm is a computerized imitation of a chromosome. It is usually a string by pre-specified length, subject activities simulating the process of evolution. All activities are dependent on "environment" as to whether the chromosomes will survive or not depends on the particular method of assessing how well they excel in your environment. Genetic algorithm works in several stages. The first step is to generate a population of chromosomes. The next step is the process of evaluation of each chromosome from the generated population. Depending on the outcome of this assessment, the system selects the best suited to this environment chromosomes and combines them in pairs, simulating the reproductions, or creating new chromosomes, which are a random combination of individual elements of "parents." In addition, the new chromosomes are subjected to a simulated mutation / substitution of a string of random elements / and the units do not meet environmental requirements after a while they die.

The most popular system of artificial intelligence is neural networks. The neural network is a simplified model of the brain. It is capable not only to the inference based on clear evidence and act in accordance with the agreed schedule, but also to remember, clear facts and make their own decisions. Neural network - like the brain - is composed of neurons connected to each other in different schedules /in neural network in this role satisfy simple processors/. It has many entry points, for which information is transmitted from the external world / are mostly simple figures /, and many outputs points, which occur when processing information. The result of the network is a system of information on output, so the network operates on the principle of separation and sorting, and not data processing. Adaptation of the neural network to solve a particular task is carried out through its learning using the standard stimuli and the corresponding desired response, rather than clarify the algorithm and save it as a program, as with traditional methods. The result is that neural networks are used where the use of traditional methods encounter great difficulties, especially in tasks requiring matching of information, such as the prediction, diagnosis, classification and diagnosis. Other frequently encountered application of neural networks relate to robotics, automation and optimization problems.

In technical applications are used primarily single-cell many-layered networks. Figure 1 shows an example of such a network. Marked with circles and segments connecting the neurons represent the weighted connections, where information flows only one way.

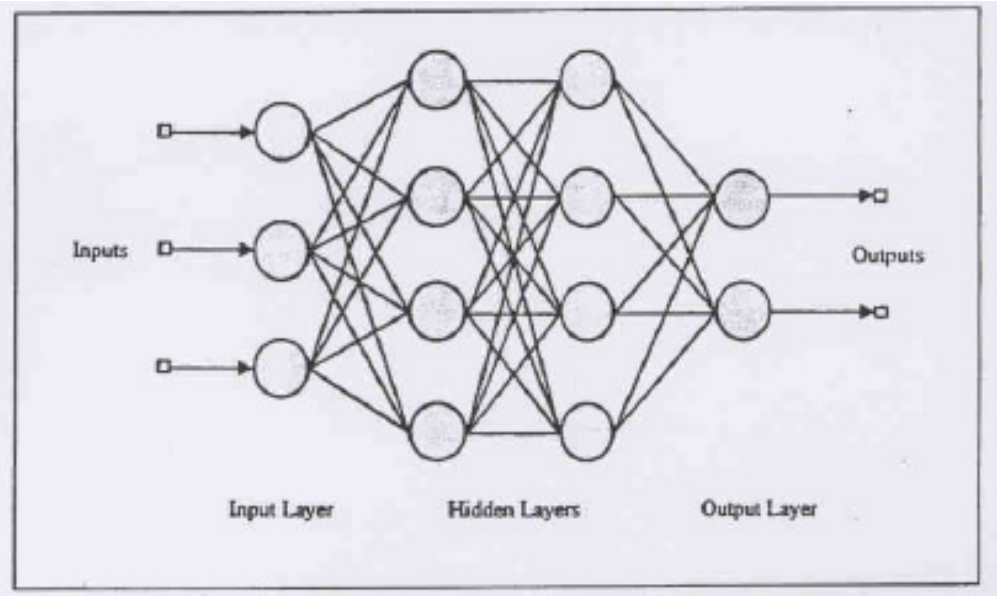

Fig. 1. Unidirectional layer neural network

The network performs a nonlinear function depending on the output from the input whose shape is appropriately adjusted during the learning process. Well-designed neural network is able to "learn" the approximate any function of many variables. In the process of learning network, practically speaking, it creates a statistical model of a recognized relationship. Furthermore, neural networks are well placed to process data that contain noise or are incomplete.

Improved process control of drying process on the measurement of wood moisture content is to use expert systems, Figure 2 (Laco, Čičel 1991, Malawka 1996, Larsson, Moren 2003). The source of knowledge is a human-expert / in our case, knowledge of lumber drying and automatic control of continuous processes / encoding of this knowledge deals with the

system designer, and computer generated solutions. How to deal expert system is similar to the process of finding a solution for professionals working in the field. However, in the traditional methods it is necessary to conduct the precise wording of the algorithm solve the problem.

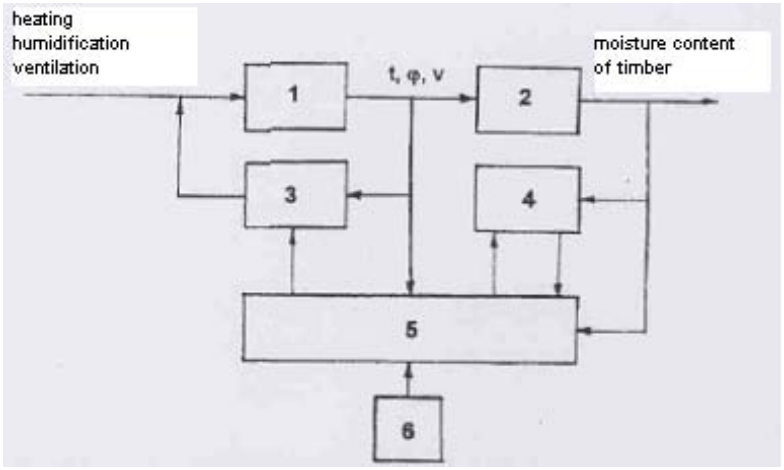

Fig. 2. Block scheme of control system of the dryer with the use of expert system: 1 - dryer chamber. 2 - timber in the dryer, 3 - controller, 4 - computer, 5 - expert system, 6 - operator

The wood industry has increased the number of research in which computer-assisted image-processing systems are used for automatic visual inspection. First promising results were obtained when detecting holes knots, cracks, resin pockets, etc. One takes place also also the classification of wood in the structure of machined surface. This is important, for example, to sort parguet blocks (www.ipa.fhg.de/600/620/mess/scannen2.html). Hand sorting eg oak parquet blocks is made by the following criteria: natural oak, band oak, rustic oak. These same principles also used with automatic classification of parquet blocks. The foundation of this course of action is to characterize the surface by analyzing the characteristics of wood, consisting of 128 elements. Applied to describe the global characteristics of machined surface structure, while local changes are largely not taken into account. Analysis of characteristics allows for proper classification of parquet bloks. As a classifier, on the basis of the characteristics of wood, using neural network. This network has the capacity to adapt quickly when changing the product or product classes.

The importance of the sawmill industry has the proper classification of lumber. The implementation of the automatic classification of timber due to the presence of knots using neural networks (www.lut.fi / smog / knotclass / smoeng.html). Knots have been divided into seven classes. The point is classified based on the code of knot shape using the appropriate filter. The signal from the filter is the input to the neural network. Neural network output signal is information on the degree of suitability for further processing boards.

Detection of internal structural defects in the logs on the principle of defectoscope is used in recent years increasingly. Most of this is used for computed tomography, to obtain information on the location, size and type of internal defects in logs (www.srs4702.forprod.vt.edu/pubsub/abstract/ab9519.html). In order to automatically interpret the information received from the scan log apply neural network, which provides the operator saw the data needed to perform the right decision sawing.

In order to determine the blunt blade tool analyzes the sound during the cutting of wood on the machine. The intensity of the sound caused by hitting the blade in the wood depends on its degree of blunting. During operation, the tool changes to both the intensity of the emitted acoustic signal, and how the spectrum. Observing the change in the level of the

acoustic signal intensity and spectral characteristics of the changes determines the condition of cutting tool wear. For the identification of tool wear indicator used a neural network (www.metla.fi/conf/infro95abs/d5pos25.htm). On the basis of changes in the intensity of the acoustic signal and its frequency spectrum changes in the neural network identified three stages of tool wear. This gives the opportunity to assess the degree of cutting tool wear without interrupting the machining process. This is important in automated machining systems.

The density of wood chips is an important factor in the quality and efficiency of the pulp. Using neural network predicted the scattering density chip, depending on the characteristics of crop and trees (Schultz, et al., 1998). Four groups of age of stand, five classes of diameter at breast height (breast height diameters) and three fixed position tree trunks were used as inputs of neural network. The analysis found to be higher density chips were manufactured by the younger stands, and the lowest position of the trunk. On this basis, the simulator was designed to predict the performance of pulp, depending on the characteristics of the stand.

When the control quality of construction should take account of their strength by controlling the elasticity of wood materials, expressed in terms of elastic modulus. The dynamic modulus can be determined by examining the phenomena of wave propagation in a vibrating sample. Forced oscillations in the sample raises through ultrasound waves or impulse hammer with a hammer striking the forehead of the sample. For the classification of pieces of wood used neural network (www.ndt.net/abstract/wcte98/data/12.htm). Network input parameters are the resonant frequency of vibration, wave propagation velocity, humidity, density, shape and dimensions of samples. At the output of neural network we obtain a signal indicating the value of dynamic modulus of elasticity.

CONCLUSIONS

There are several significant disadvantages of expert systems. Expert systems do not have the skills to learn, generalize solutions, also can not properly respond to the noisy, incomplete, or previously unknown information. Also, fuzzy systems are not systems of learning: "knowledge" that contain placed there by experts in other fields. Genetic algorithms are primarily used in the optimization techniques. The condition for efficient use of neural networks is considerable knowledge and experience in the field of neural networks, as well as in discipline, in which networks are to be applied. The wood industry is increasingly used various methods of artificial intelligence, especially neural networks.

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Streszczenie: *Zastosowanie sztucznej inteligencji w przemyśle drzewnym.* Działanie komputera polega na wykonywaniu zadań wynikających z zastosowanego algorytmu. Sztuczna inteligencja /Artificial Intelligence/ polega na stworzeniu maszyny naśladującej myślenie człowieka. W pracy scharakteryzowano różne systemy sztucznej inteligencji oraz ich zastosowanie w przemyśle drzewnym.

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