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SOFTWARE AND ALGORITHMIC SUPPORT FOR WORKING WITH CELLULAR AUTOMATA

The primary objective of this work is the allocation of a fixed size timber on 3D cubes, which then will be used for distribution in 2D neighborhood von Neumann. For the distribution of lumber, it is necessary to take into account a number of rules, among which:

- It is necessary to divide the stack on a certain number of lumber, which will be divided into 3D cubes of the same size.
- The number of 3D cubes is limited and is determined by the cutoff density that is given in advance.
- The cut density should be sufficiently small to ensure that there are enough 3D cubes in the depth of the lumber.

In order to comply with the above rules it was decided to cut the lumber according to the scheme of uniform section with identical parts. The selected lumber has the following dimensions: height and width of 100 mm, and length 1 m.

Further, according to the developed software application, the form of which is shown in Figure 1, the calculation of the number and size of 3D cubes was performed. Consequently, with such dimensions of the lumber can be built 3D cubes, which can have 15 different sizes of external facet. If we take the largest dimension of the facet, which is 100 mm, then we will have only 10 cubes, which of course is not enough.

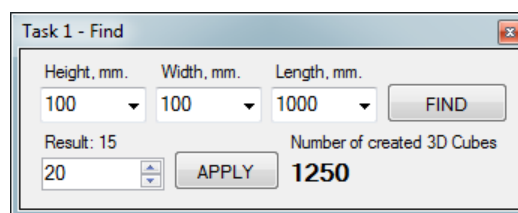


Fig. 1 – View of the software application that is used to calculate the number of required 3D cubes

When selecting the size of facet at 0.25 mm, we get 640 million 3D cubes, the calculation of which, even on powerful computers take long. That is why it was decided to select 3D cubes, the outer edges of which have a size of 20 mm. With such dimensions of external facet, the total number of 3D cubes will be 1250 pieces. After calculation of the required 3D cubes were made the timber section of a given size. This process is fully automated and was achieved by using developed software application that uses capabilities of the SolidWorks API.

The following parameters that will be assigned to 3D cubes include: Height, length and width are given according to the size of created 3D cubes, for example, 20 mm; Wood species; Initial temperature and humidity. If they are different, then it is necessary to uniform distribution along the length of a given timber. The rest of the initial parameters are transmitted to the airspace surrounding the stack. Air space similarly will be presented as an array of 3D cubes of the same size. This representation will allow us to calculate a mathematical model that serves to change the parameters of the drying agent in space and time.

Consequently, when we having 3D cubes, it is necessary to make their transformation in order to represent them in the form of 2D squares. This step is very important and necessary, because with this transformation we will be able to use cellular automata.

To represent cellular automata, we can use one of the two most popular 2D nodes, namely 2D Moore's area and 2D Von Neumann Fields. If we talk about the Moore countryside then it represents a set of eight cells on a square parquet, having a common vertex with this cell. In turn,

the von Neumann occipital represents a set of four cells on a square parquet, having a common side with this cell. It is clear that in order to accomplish this task, the 2D field of von Neumann is best suited to the 1st order.

Therefore, we can see how one 3D cube facet can affect to another. Based on these relations was developed a general scheme for the internal and external facet of the created 3D cubes. The form of this schema is shown in Figure 2. The values of X [1-6] are the own facet of the selected 3D cube, and the value Y [1-6] is the facet of the outer 3D cube that is adjacent to the selected one.

Consequently, each facet of the selected 3D cube can have a relation with only one facet of the outer 3D cube.

To solve this problem, it is necessary to develop several basic classes. With these classes, you can implement a scheme of interconnections between the faces of 3D cubes. The graphical relationship between the above-described classes is shown in Figure 3.

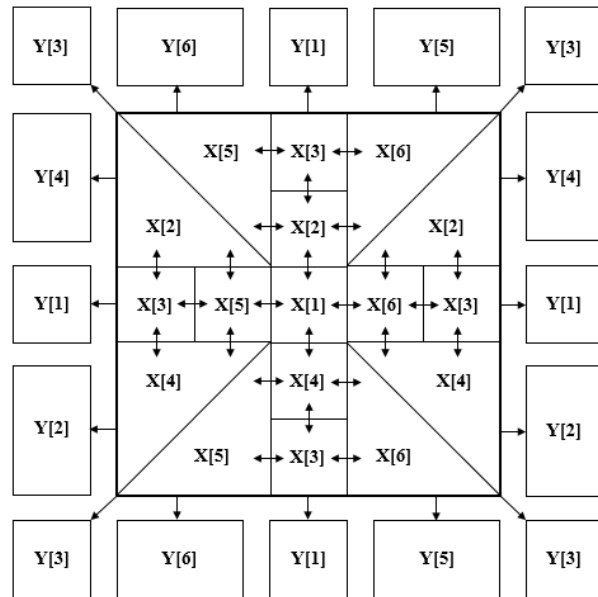


Fig. 2 – General scheme for the internal and external facet of the created 3D cubes

As a result of this work, was developed a concept for using the cellular automata for the study of three-dimensional objects. In addition, was created a software with which you can download a 3D model of lumber piles and instantly calculate the number of possible variants of cutting each of the lumber into 3D cubes of the same size. The cutting process takes place using the SolidWorks API.

The resulting 3D cubes were presented in the form of 2D neighborhood of von Neumann 1st order. Another important task that was accomplished in this work is the development of system classes, their further description, and a description of their interactions.

In general, in this work, we examined the possibilities of using the theory of cellular automata in studying models presented in a three-dimensional coordinate system. To study this concept, by conducting various types of experiments, was created an appropriate software in environment Microsoft Visual Studio C#.

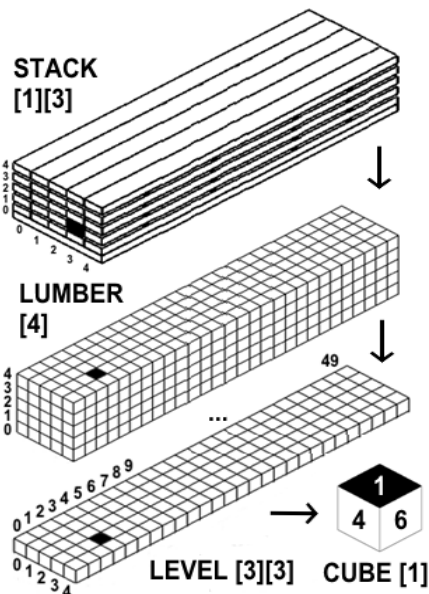


Fig. 3 – Graphic interrelation between developed classes

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THE USE OF A SINGLE-PARAMETRIC REGRESSIONAL ANALYSIS FOR CHROME(VI)-SELECTIVE ELECTRODE MANUFACTURE PARAMETERS OF MODELING AND OPTIMIZATION

The use of ion-selective electrodes (ISE) in the flow-injection method extends the range of application of potentiometric methods of analysis in technological processes and systems of automatic control of the chemical, light, processing and food industries. To provide information and measurement systems for water quality control, various solid-state ISEs with an increased selectivity coefficient have been developed [1-2]. Solid-state electrodes can be made from various materials and in different ways [Patent UA 3914]. By selecting a suitable material, almost any membrane electrode reversibly functioning with respect to any type of ion can be created. The greatest phytotoxicity in chromium compounds is hexavalent chromium, since it is an anion of chromic acid and is practically not fixed by soil colloids bearing predominantly a negative charge. To ensure information environmental safety in industry, we made a chrome(VI)-selective electrode using the method of anodic polarization of electrode-active substance $PbCrO_4$. A powder of finely dispersed metallic lead with a binder polymer was chosen as the basis of the ISE.

Figure 1 shows the dependences in the coordinates of the values of $pCr(VI)$ corresponding to the potential values in mV.

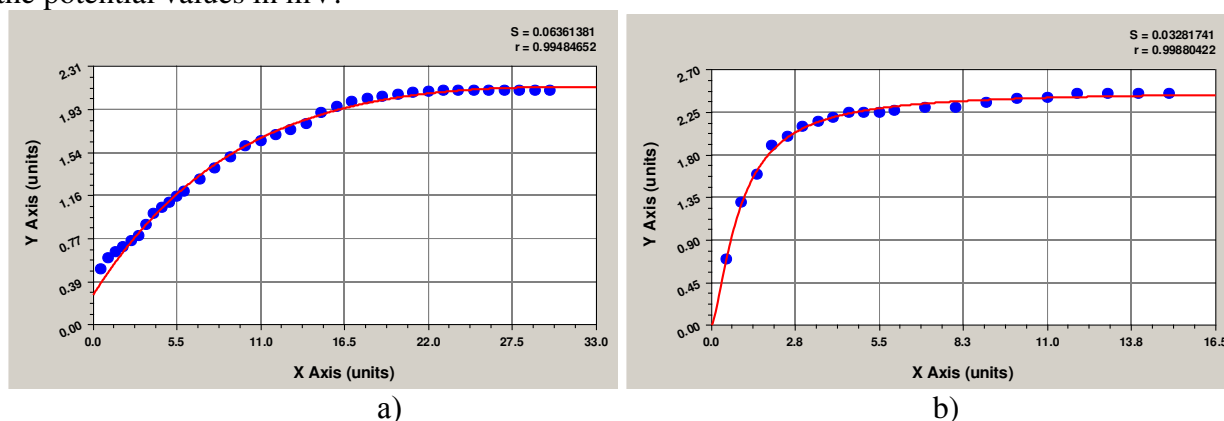


Fig.1 – Dependences in the coordinates of the values of $pCr(VI)$ corresponding to the potential values in mV: a) for 10 µA, b) for 20 µA

Tables 1 and 2 show the mathematical models of the anodic polarization of the electrode-active substance $PbCrO_4$ ranked by the correlation coefficient using single-parameter regression analysis.

The calculation of the anode polarization time at 10 mA is 1340 seconds; at 20 mA, it is 289 seconds. The thickness of the electrode-active substance $PbCrO_4$ in the first case was 10^{-4} cm, in the second case $1.34 \cdot 10^{-4}$ cm at an anode polarization voltage of 1.8 V. The electrode area was 0.038 cm^2 . The resistance of the electrode is 13 MΩ. In the second case, with a decrease in time