

ANALYSING THE SEPARATION PROCESS THROUGH THE CELLULAR AUTOMATICAS' METHOD

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Summary:

The practical application in which the cellular automates will be used is represented by the peas, pods and other impurities' separating process. The way the peas react to the sloping strip has been studied with the simulation programs

1. Cellular automates used in analyzing the separation process

The discrete character of the cellular automates enables them to contribute to the description of various phenomena which contain a large variety of objects, or granular material [5],[6].

It has been established that the strip's oscillating movement as well as the way in which the impact between the strip and the pea takes place play a highly important part. If the peas, pods and other impurities fall on the separating strip in the same time, extremely complex processes occur (collisions between different types of objects, with each other and with the separating strip), which cannot be exactly described by any mathematical model. In this situation, a probability approach of the problem has to be used, which consists in defining a number of random variables and establish their variation field. Using these random variables, simple rules can be stated regarding each object that interacts with any other one, every single one of them having a specific behavior. In the Informatics field, this kind of process can be studied using the cellular automates.[3]

The calculus algorithm, in the cellular automates' method, can be easily implemented by using the matrices calculus.

Achieving an algorithm based on cellular automates requires choosing an appropriate programming language. In the current case the MALAB language was chosen, because it provides an easy to use matrices calculus. In the framework of the MATLAB menu, images and matrices can be interchanged, which obviously lightens the presenting of the simulation's evolution.

2. Describing the modulation program

The simulation programmer has a graphical appearance that allows watching the time evolution of the simulation, considering its number of steps. This graphical system includes the "Start", "Stop" and "Exit" buttons. In the corner of the screen one can observe the number of the simulation step that were reached at a certain point in time.

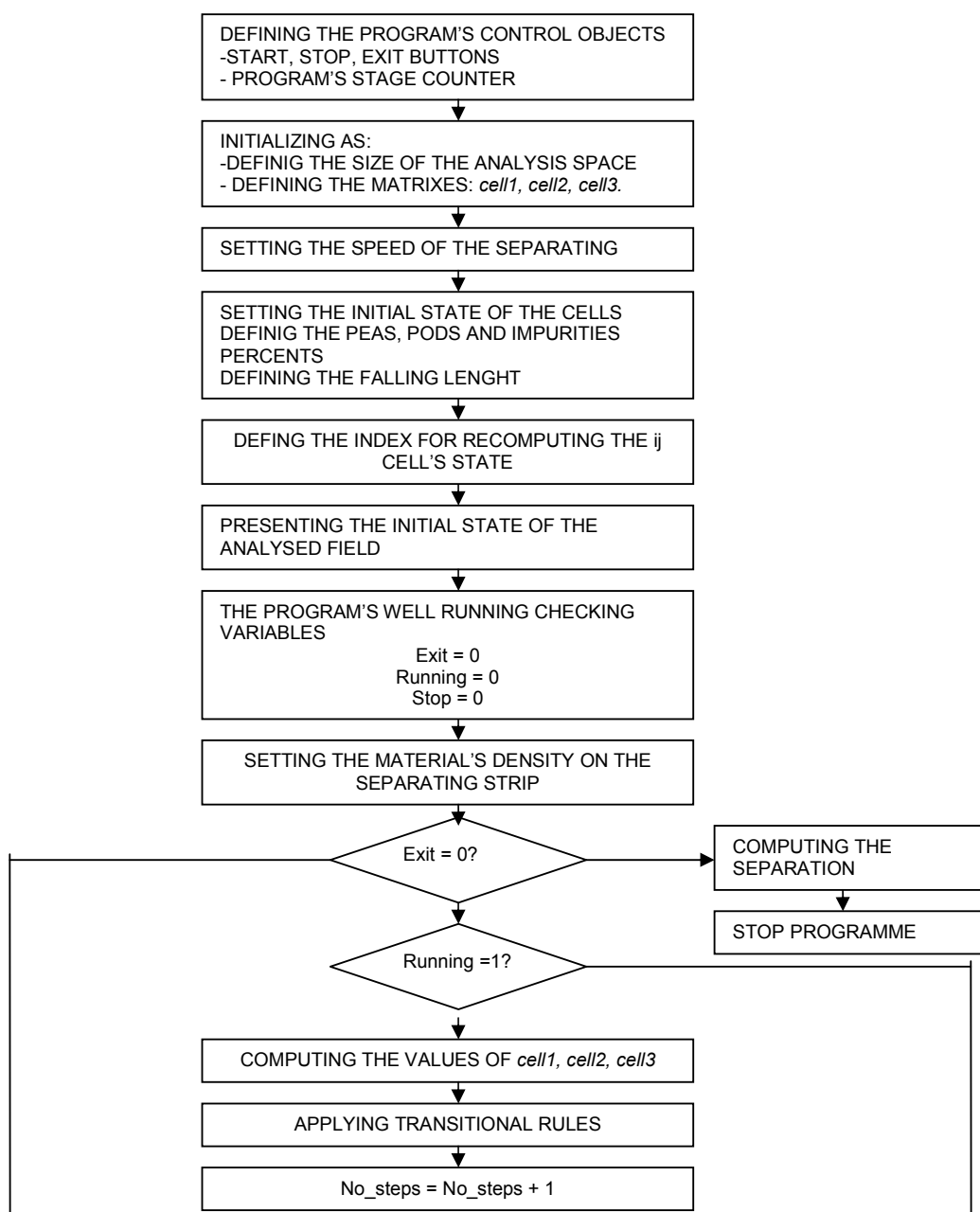
When activating the "Start" button the simulation begins. The simulation can be ceased at any time, for a better visual analysis of the cells' state and can be restarted by reactivating the "Start" button. Stopping the simulation and leaving the program can be achieved with the help of the "Exit" button.

The flowchart of the program is presented in fig. 1.

This program carries out the adaptation of the material flood on the separating strip. Using the cellular automata three types of objects are defined, each one of them having a corresponding matrix: *cell1* (impurities), *cell2* (pods), *cell3* (peas). Using three

different matrixes gives the advantage of a relatively simpler visualization of the simulation, because it offers the possibility of displaying the cells' state with a RGB (Red Green Blue), which associates the first matrix *cell1* with the color red, the second matrix *cell2* with green and the third one *cell3* with blue.[1]

The falling of the studied objects (pods, impurities, peas) on the separating strip is achieved through generating a number of cells, using probability functions. The impact area of the different objects with the separating strip is being reproduced some cells coming into sight randomly. The number of cells is adjusted by the *dens* variable, which can be set within the program. In the impact area, the cells that represent the pods and impurities shift in the direction of the strip's movement, upstream, and the cells that represent the peas move downstream. The flowchart and further explanations of the model are presented in fig. 2.



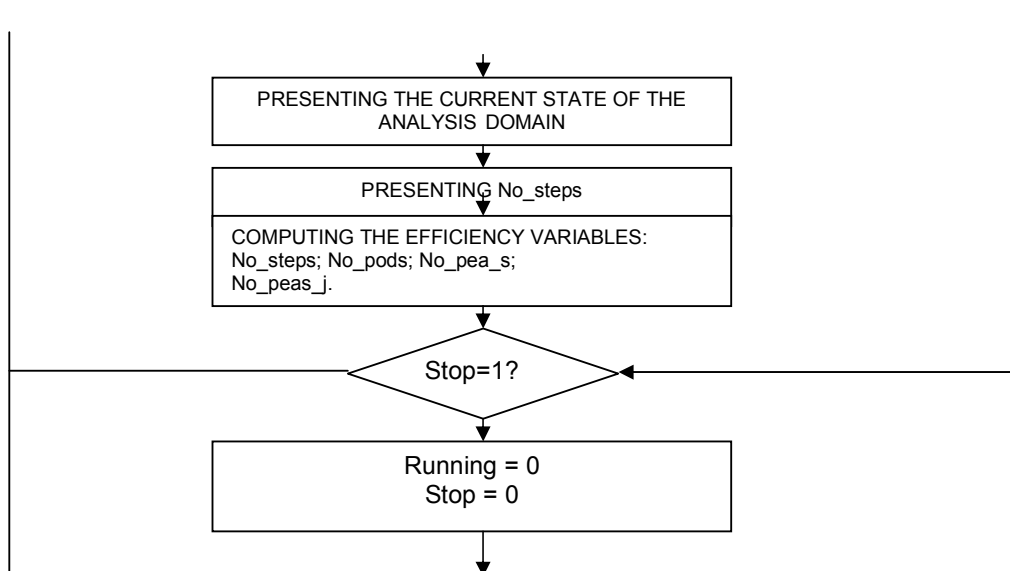


Fig.1 Program's flowchart

The cellular automatic machines will be used for separating the peas from the pods and other impurities.

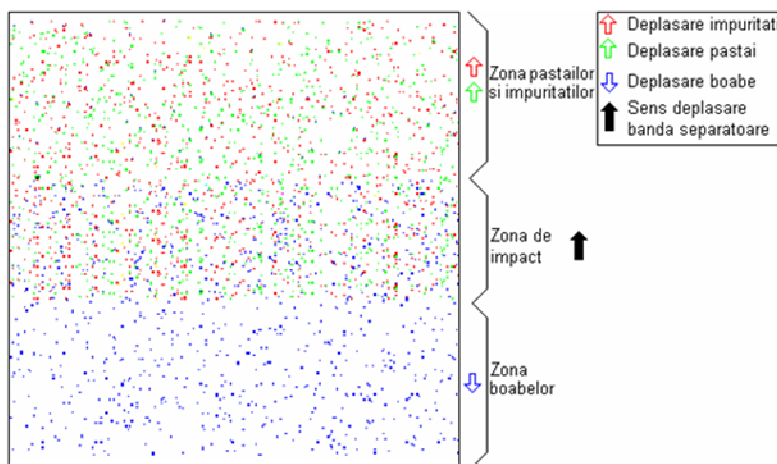


Fig.2. The explicative sketch of the simulation

(The pods and impurities area, the impact area, the peas area; The shift of the impurity, the shift of the pod, the shift of the peas, the direction in which the separating strip moves)

Using the simulation program, the K_{ns} indicator of the separating strip was studied..

$$K_{ns} = \frac{\text{Unseparated peas quantity}}{\text{Total peas quantity}} \quad (1)$$

Secondly, the dimension of the impact area (D_{imp}) is defined with respect to the total dimension of the separating strip (D_{tot}), through the equation:

$$k_{imp} = \frac{D_{imp}}{D_{tot}} \quad (2)$$

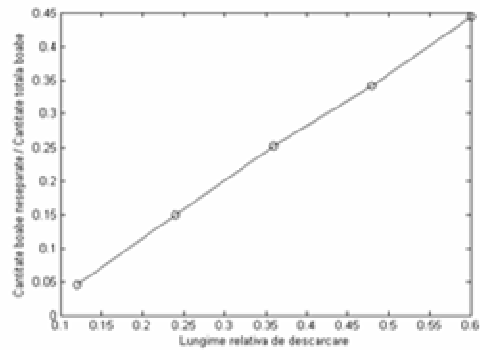


Fig.3. The diagram showing the evolution of the k_{ns} indicator regarding k_{imp}

The material layers thickness growth on the strip also depends on the relative unloading length (k_{imp}). The diagrams showing the variation of the layers thickness are shown in pictures 4-8. [2]

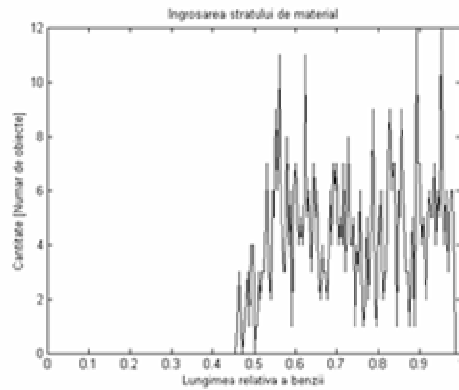


Fig.4. The diagram showing the layers thickness growth for $k_{imp} = 30/250$.

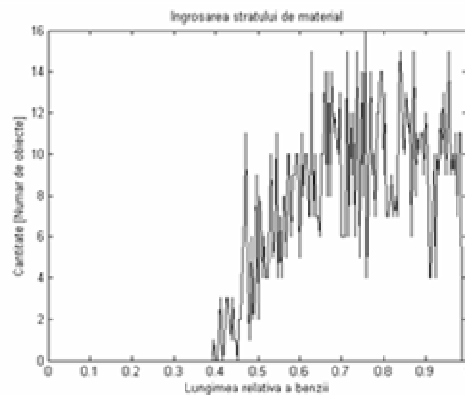


Fig.5. The diagram showing the layers thickness growth for $k_{imp} = 60/250$.

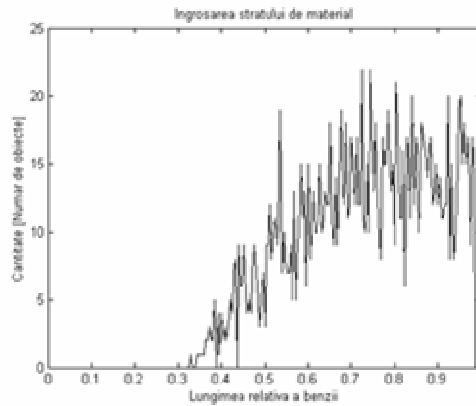


Fig.6. The diagram showing the layers thickness growth for $k_{imp} = 90/250$.

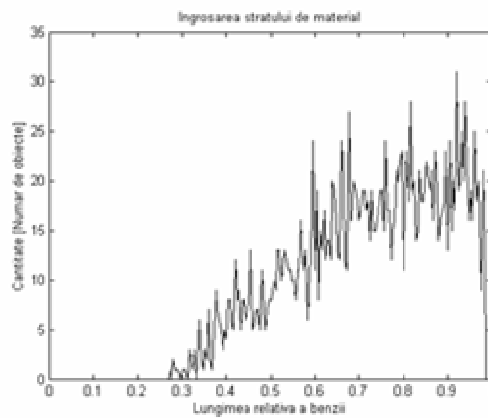


Fig.7. The diagram showing the layers thickness growth for $k_{imp} = 120/250$

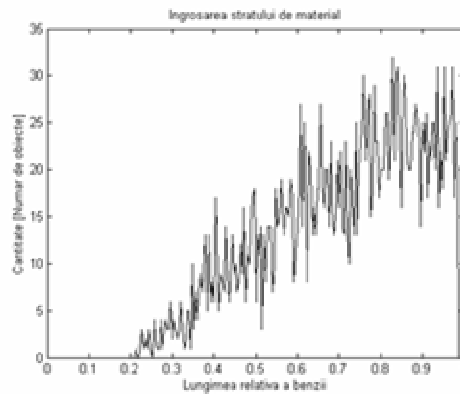


Fig.8. The diagram showing the layers thickness growth for $k_{imp} = 150/250$

The data obtained through the simulation process can be used in the practical evaluation of the layers thickness growth for the real values of the separating machine M1. They are presented in table 1 and picture 9. [2]

Tabel 1

No.	k_{imp}	The real impact length [mm]	Material layer's thickness [mm]
1	30/250	240	23
2	60/250	480	43
3	90/250	720	66
4	120/250	960	91
5	150/250	1200	109

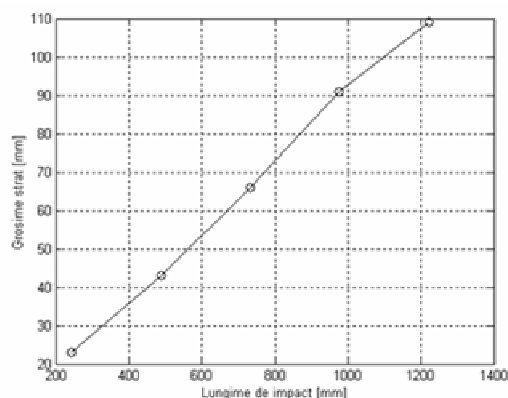


Fig.9. The diagram showing the layers thickness growth regarding the impact length

3. CONCLUSIONS

The influence of the separating strips different engineering parameters has been studied, using the movable, self-acting machines:

- from this analysis we can conclude that the number of un separated pea increases with the increase of the impact area. We must emphasize the fact that a small impact area will decrease the processed volume of material, as well as the productivity of the separating strip.

- after the studies performed on the M1 machine we can conclude that as the impact area increases, the layer's thickness considerably increases as well.

4. BIBLIOGRAPHY

- [1] Abrudan, G.,- Contribuții teoretice și experimentale privind aplicarea șocurilor în procesul de lucru al separatorului cu bandă, Teză de doctorat, Universitatea "Politehnica" Timișoara, 2007.
- [2] Abrudan, G.,- Dinamica separatorului cu bandă oscilantă, Editura Politehnica Timișoara, 2007.
- [3] Alonso-Sanz R., A structurally dynamic cellular automaton with memory, Chaos, Solutions & Fractals, Volume 32, Issue 4, May 2007, Pages 1285-1295;
- [4] Brady M., R., Raghavan, J., Slawny, Probabilistic Cellular Automata in Pattern Recognition. Proc. Inter. Conf. Neural Networks. Washington DC, USA, 1989
- [5] Kozicki., J., Teichman, Application of a cellular automata to simulations of Granular flow in silos, Granular Matter, Springer Berlin / Heidelberg, ISSN 1434-5021, Volume 7, Number 1 / April, 2005
- [6] Kıtarev, D., E. Wolf, Stratification of Granular matter in a rotating drum: cellular automata modeling, Granular Matter, Springer Berlin / Heidelberg, ISSN 1434-5021 , 2004;