Paweł Brzoza
Applied Computer Science
22.11.2018r.

# Report – multiscale modelling

## Intro

Project was created to simulate grain growth. Is possible to specify various parameters to own needs and generate plenty of different microstructures. The growth process is carried out in accordance with assumptions of Cellular Automata method. Resulted structure is displayed on the right side of the panel.

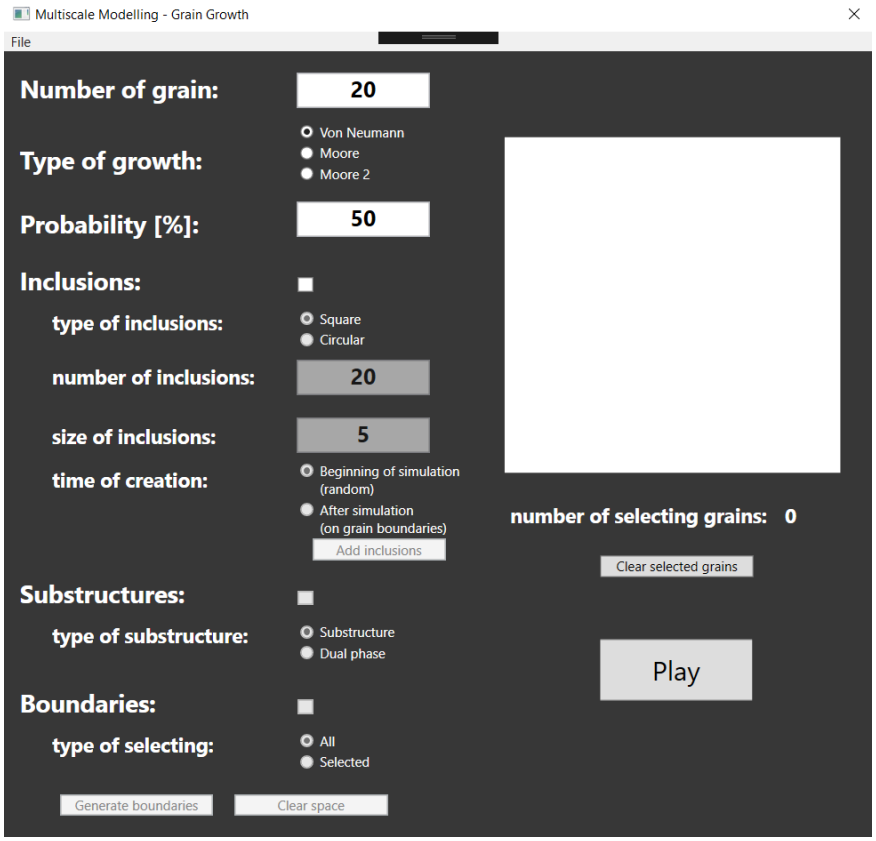
## Technology

For the purpose of building this application I used the C# programming language with WPF framework which resulted easier way creating a GUI.

## Main interface

At the beginning we have to specify parameters like:

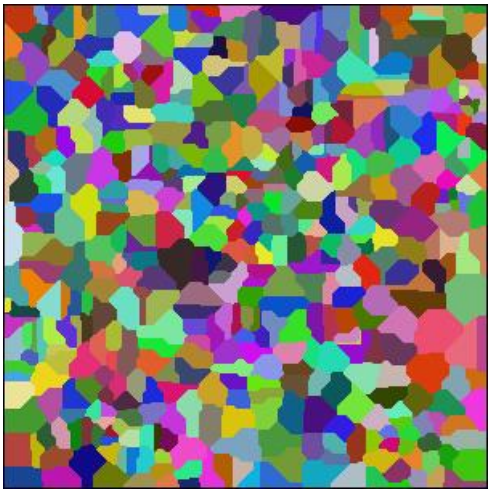
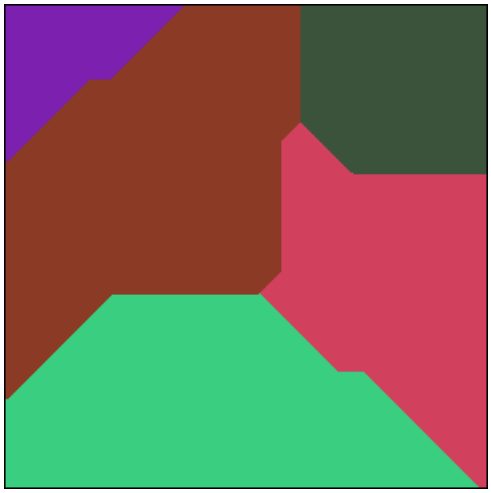
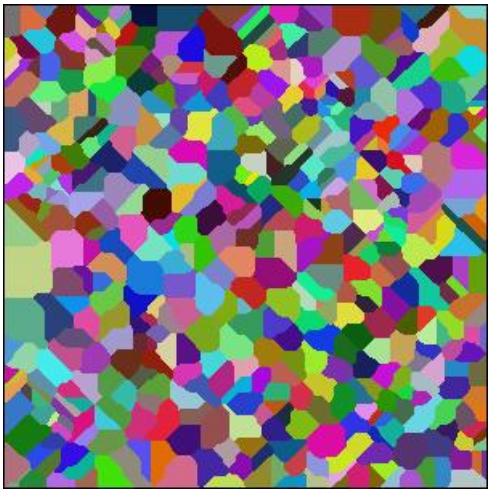
- Number of grains
- Type of growth (von Neumann, Moore, Moore 2 (with probability)
- Probability [%]
- Inclusions (type, amount, size, time of creation)
- Substructures (last substructures or dual phase)
- Boundaries (type of selecting)

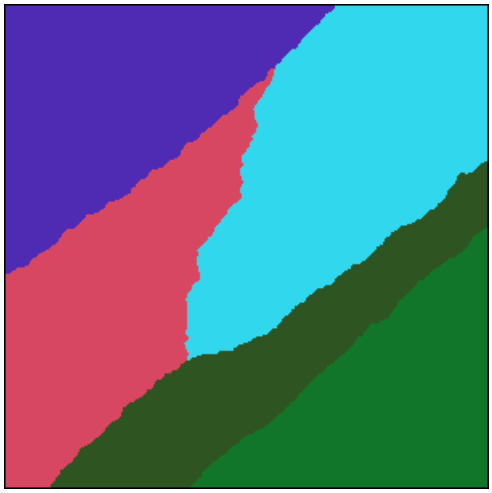
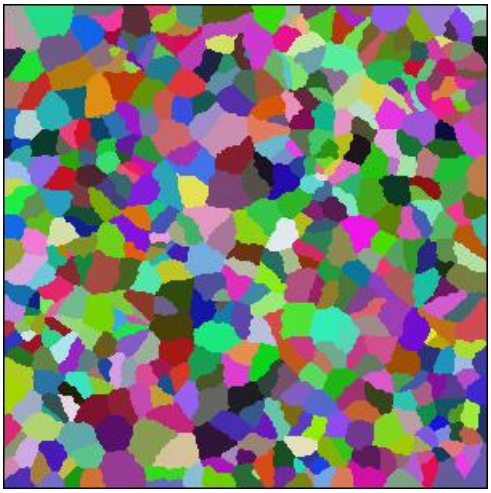
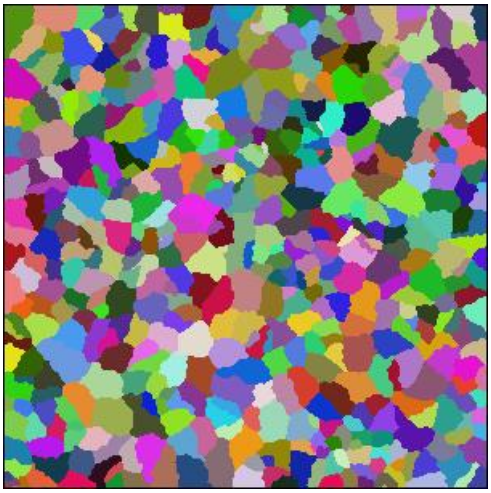


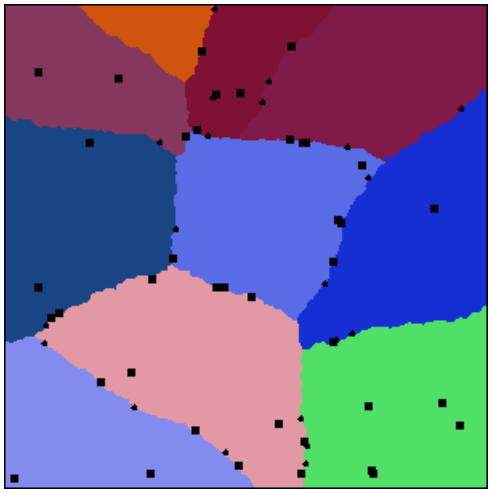
Elements which was implemented in project:

1. Two simple method grain growth cellular automata (von Neumann and Moor methods).
2. Microstructures import/export to/from .txt and .bmp files.
3. Inclusions possible to add at beginning or on the end of simulation.
4. Extended Moore with probability and influence of grain curvature.
5. Creation substructures.
6. Creations specify boundaries.

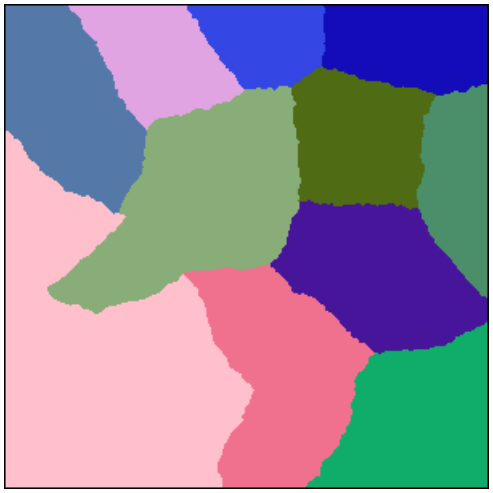
The following illustrations shows resulted structures created with specify parameters configuration:

| | |
|---|---|
| Number of grains: 5<br>Type of neighborhood: von Neumann<br>  | Number of grains: 500<br>Type of neighborhood: von Neumann<br>  |
| Number of grains: 5<br>Type of neighborhood: Moore<br>  | Number of grains: 500<br>Type of neighborhood: Moore<br>  |
| | |

| | |
|---|---|
| Number of grains: 5<br>Type of neighborhood: Moore 2<br>Probability: 50%<br>  | Number of grains: 500<br>Type of neighborhood: Moore 2<br>Probability: 50%<br>  |
| Number of grains: 5<br>Type of neighborhood: Moore 2<br>Probability: 10%<br>  | Number of grains: 500<br>Type of neighborhood: Moore 2<br>Probability: 10%<br>  |
| Number of grains: 10<br>Type of neighborhood: Moore 2<br>Probability: 50%<br>Inclusion: square at the beginning and square/circle after on boundaries | Number of grains: 10<br>Type of neighborhood: Moore 2<br>Probability: 50%<br>Inclusion: circle on boundaries |



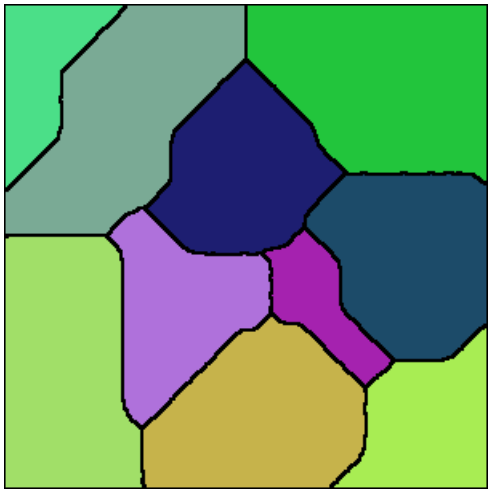
Number of grains: 10
Type of neighborhood: Moore 2
Probability: 50%
Substructures: Dual phase

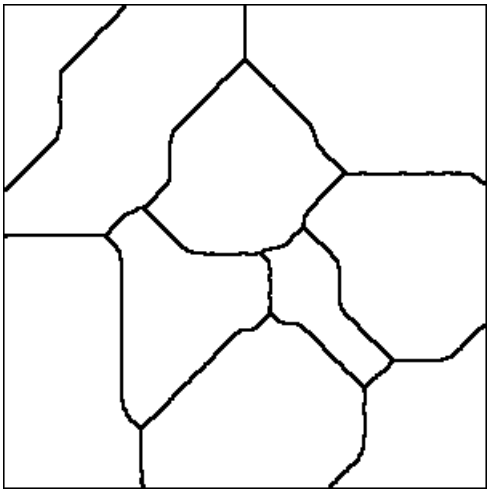


Number of grains: 10
Type of neighborhood: Moore 2
Probability: 50%
Substructures: last substructure

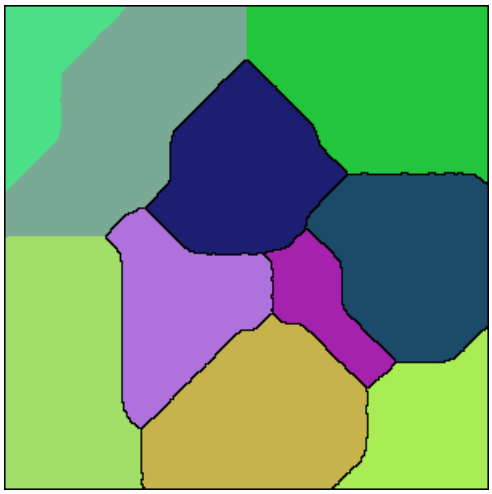
Number of grains: 10
Type of neighborhood: Moore 2
Probability: 90%
Boundaries: All

Number of grains: 10
Type of neighborhood: Moore 2
Probability: 90%
Boundaries: All and space clear

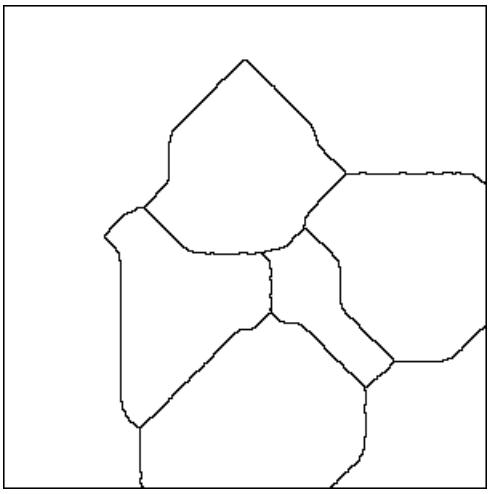




Number of grains: 10
Type of neighborhood: Moore 2
Probability: 90%
Boundaries: Selected

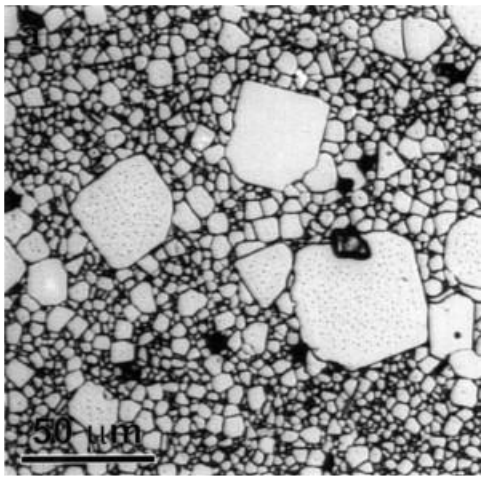


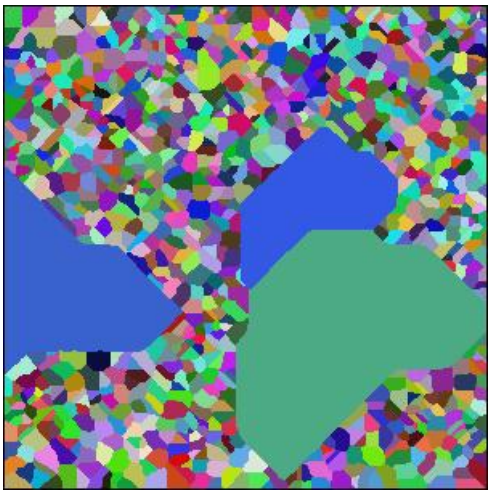
Number of grains: 10
Type of neighborhood: Moore 2
Probability: 90%
Boundaries: Selected and space clear



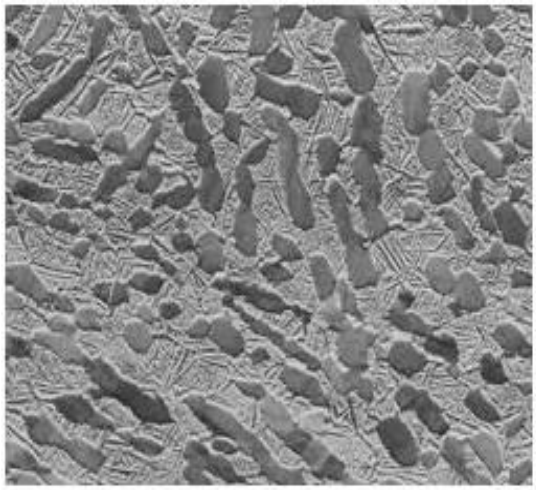
# Comparing with real structures:

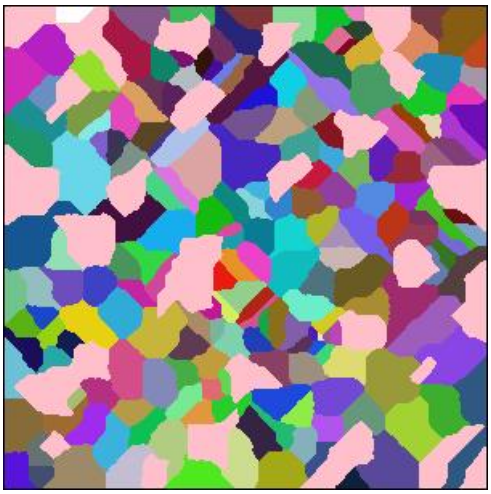
| | |
|---|---|
| Type: Exaggerated grain growth in polycrystalline materials | Generated: |



Type: DP Steel





Type: CP titanium