

# AGH

**AGH UNIVERSITY OF SCIENCE  
AND TECHNOLOGY**

Multiscale Modelling

Report

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# 1. Application Requirements

## 1.Simple grain growth CA + import/export

In board in project we can choose dimensions of project, we can chose size of square and rectangle, and set up. We can choose number of grains, and they will be created in random places. If we want to start simulation, we must choose Moore(Image 2) or VonNeumman(image 3) neighborhood. After click button of one of this method, simulation will be started.

After simulation you can export microstructure to txt file with parameters(x, y, k[colour]), and import saved microstructures when do you want.

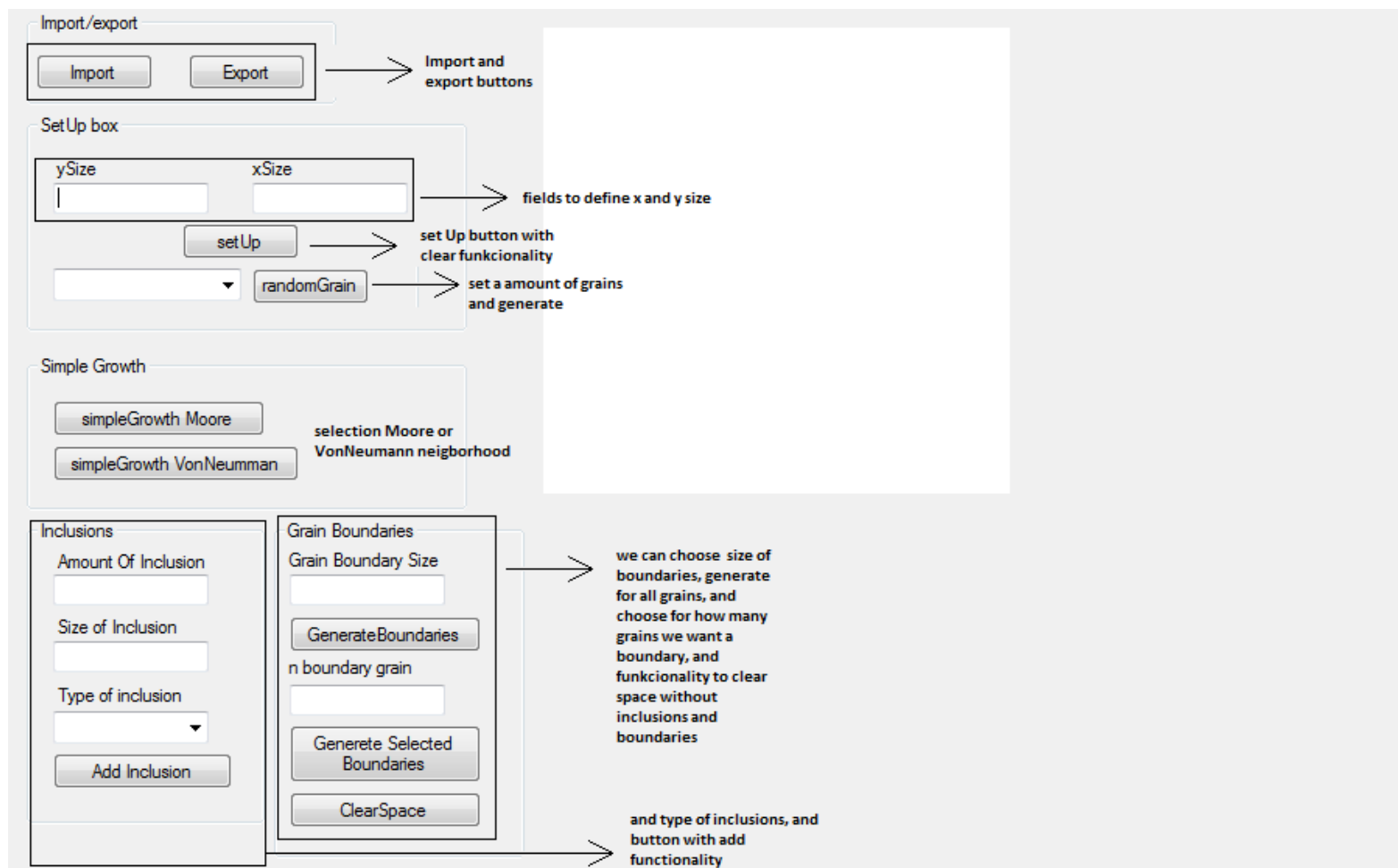
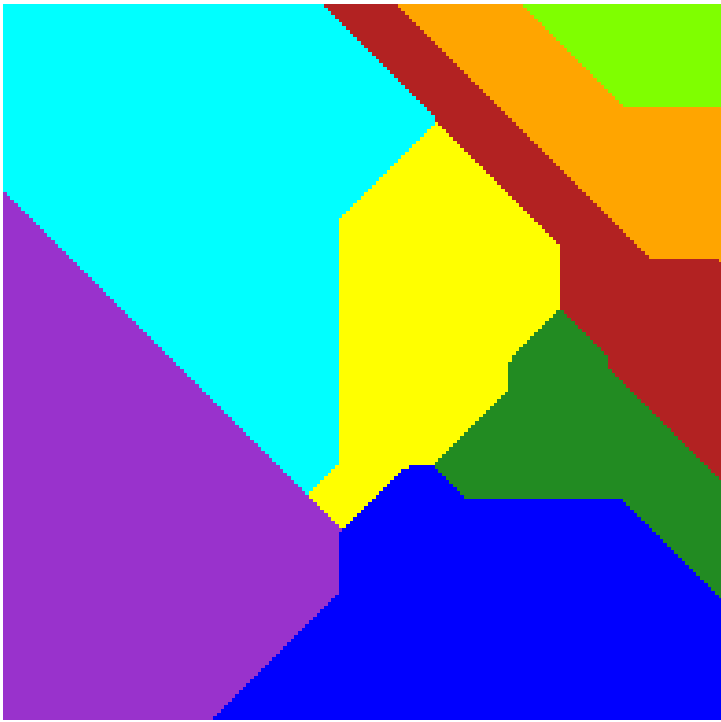


Image 1. Graphical interface with introductions



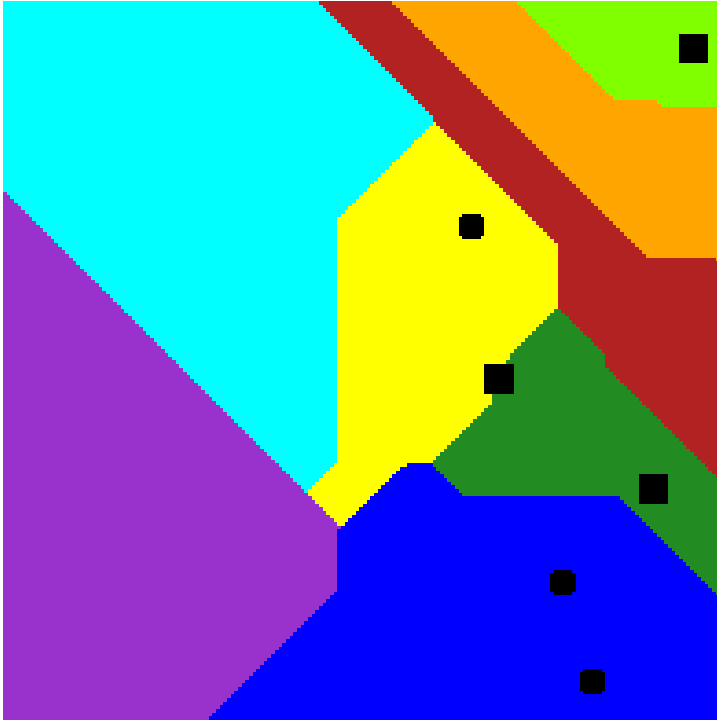
*Image 2 Moore method of grain growth*



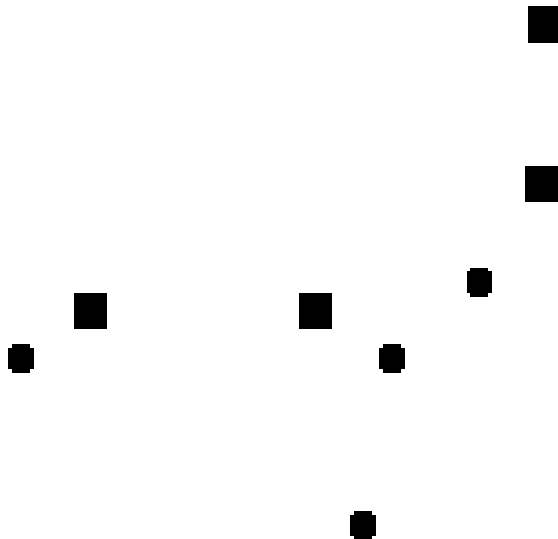
*Image 3 VonNeuman method of grain growth*

## 2. Inclusions

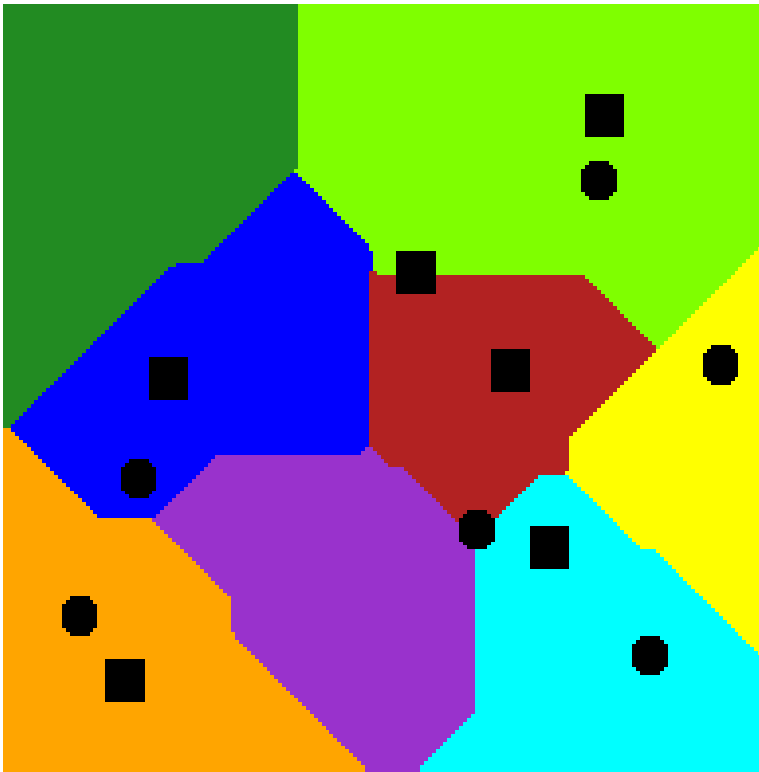
We can define Amount, size, and one of two types of inclusions(square, or circle). We can add inclusions before(image 4, image 5) and after grain growth(image 6). On screen I presenting inclusions before and after grain growth.



*Image 4 Microstructure after simulation, Square and circle inclusions added before simulation*



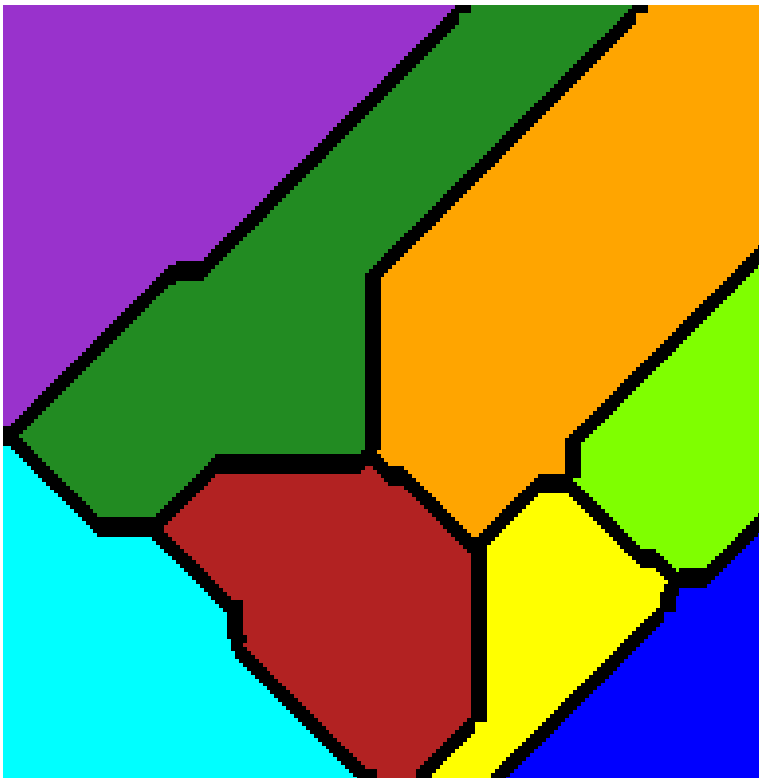
*Image 5 Inclusions without simulation*



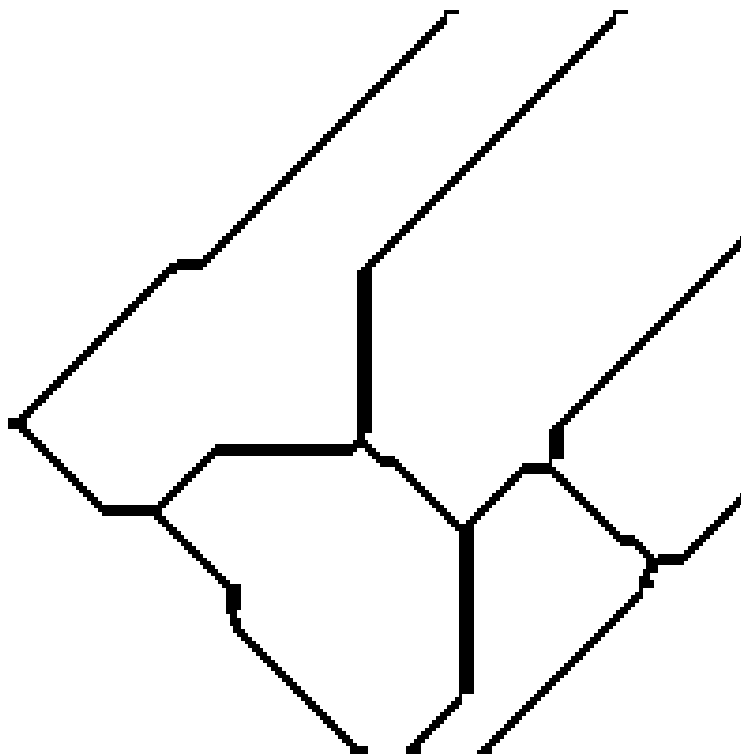
*Image 6 Inclusions added after simulation*

### **5. Grain boundaries**

After simulation we can add the boundaries to all grains(image 7, image 8), or one grain(image 9, image 10). We can clear space without boundaries, and see only boundaries without colours(image 8, image 10) that's marks the grains,



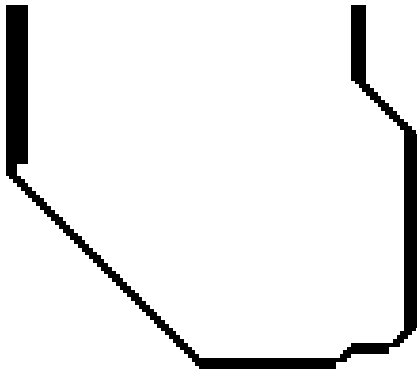
*Image 7 Boundaries of all grains*



*Image 8 Boundaries after clear space*

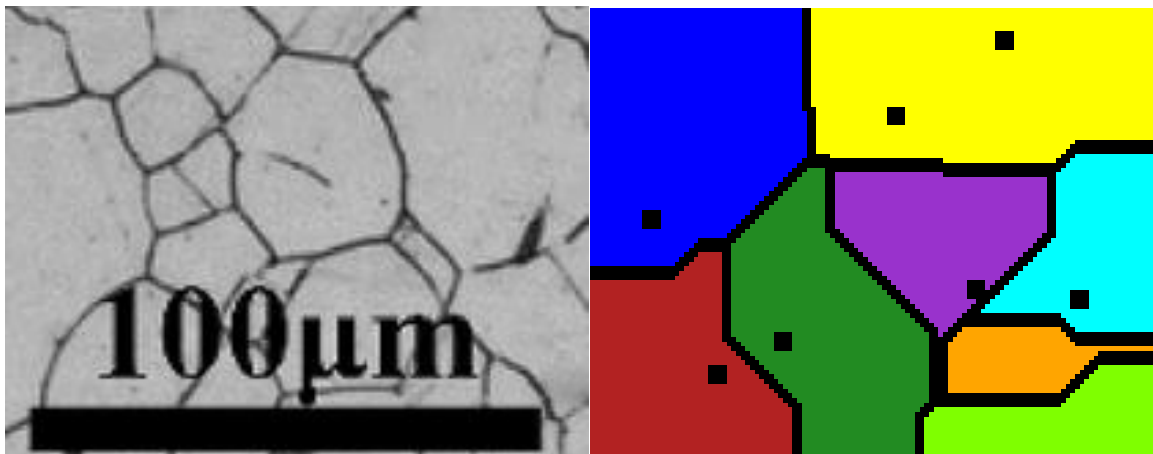


*Image 9 Boundary of one of grain*



*Image 10 Boundary of one of grain after clear space*

#### Comparison with real microstructure



*Image 11 Comparison of real microstructure, and simple grain growth*

## 2. Technology and Installation process

- Application was written on C# language.
- For GUI I used Windows Forms, because is simple to usage.
- To write application I used Visual Studio IDE, because it's the best dev tools and services make app development easy for any platform and language

### 3. Conclusion

I am crated application to simulate grain growth. The application can generate o lot of different grain growth, with different configuration. It's generate grain growth similar to real microstructure.

**Sources:**

1.[https://www.researchgate.net/profile/Xiaolin\\_Li28/publication/305922578/figure/fig1/AS:614028862836738@1523407297976/The-microstructure-of-the-solution-treated-as-received-austenitic-stainless-steel.png](https://www.researchgate.net/profile/Xiaolin_Li28/publication/305922578/figure/fig1/AS:614028862836738@1523407297976/The-microstructure-of-the-solution-treated-as-received-austenitic-stainless-steel.png)