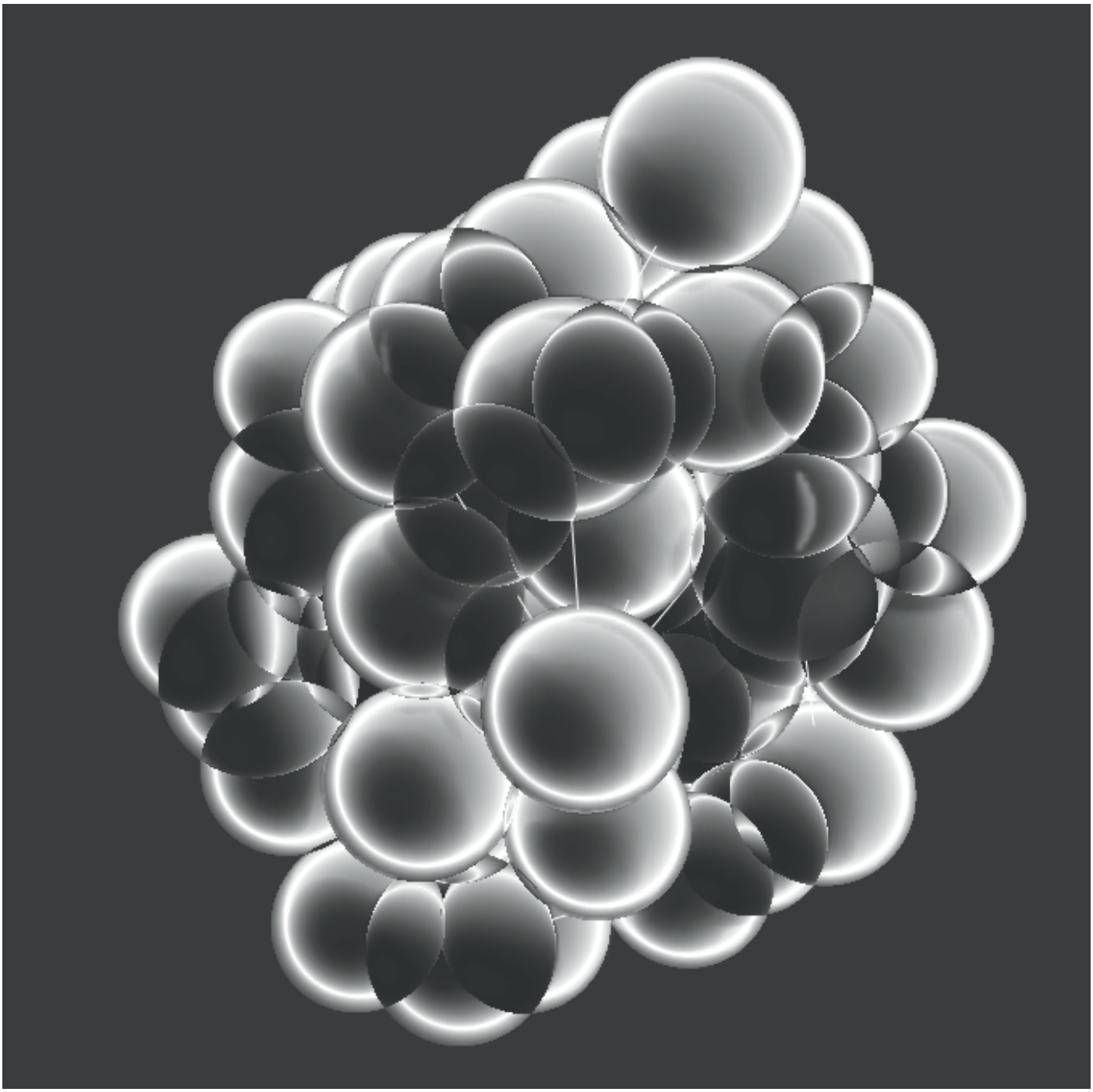
Cell Growth Simulation Program

User Manual



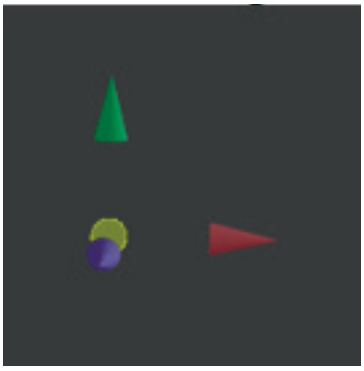
Introduction

The cell Growth Program is an interactive program that simulates three different types of particles that differentiate in the way that they grow. It is intended to create visually interesting forms and shapes inspired by naturally occurring cellular growth.
Some particles can be influenced by light that the user can control. Therefore, the user is able to influence the growth of the particles and create intriguing forms and reactions within the particles.
The project is a more experimental approach to cell growth, investigating new patterns and structures based on different circumstances.

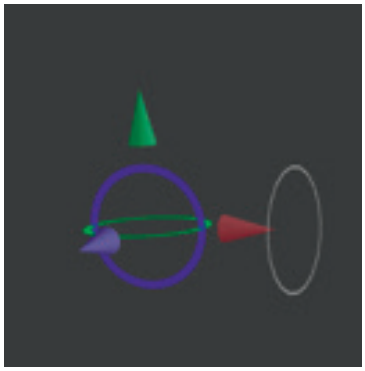
Getting started

By default the program will start with the 'Linked Particle' Type. The user can then change the particle type while the program is running.
The user can then influence the growth with the light provided. The light can be moved using the handles.

More alterations to the movement and form can be achieved using the options in the UI.
The program provides the user with two types of light. A point light in which the particles are attracted to, and a spot light to illuminate the scene.

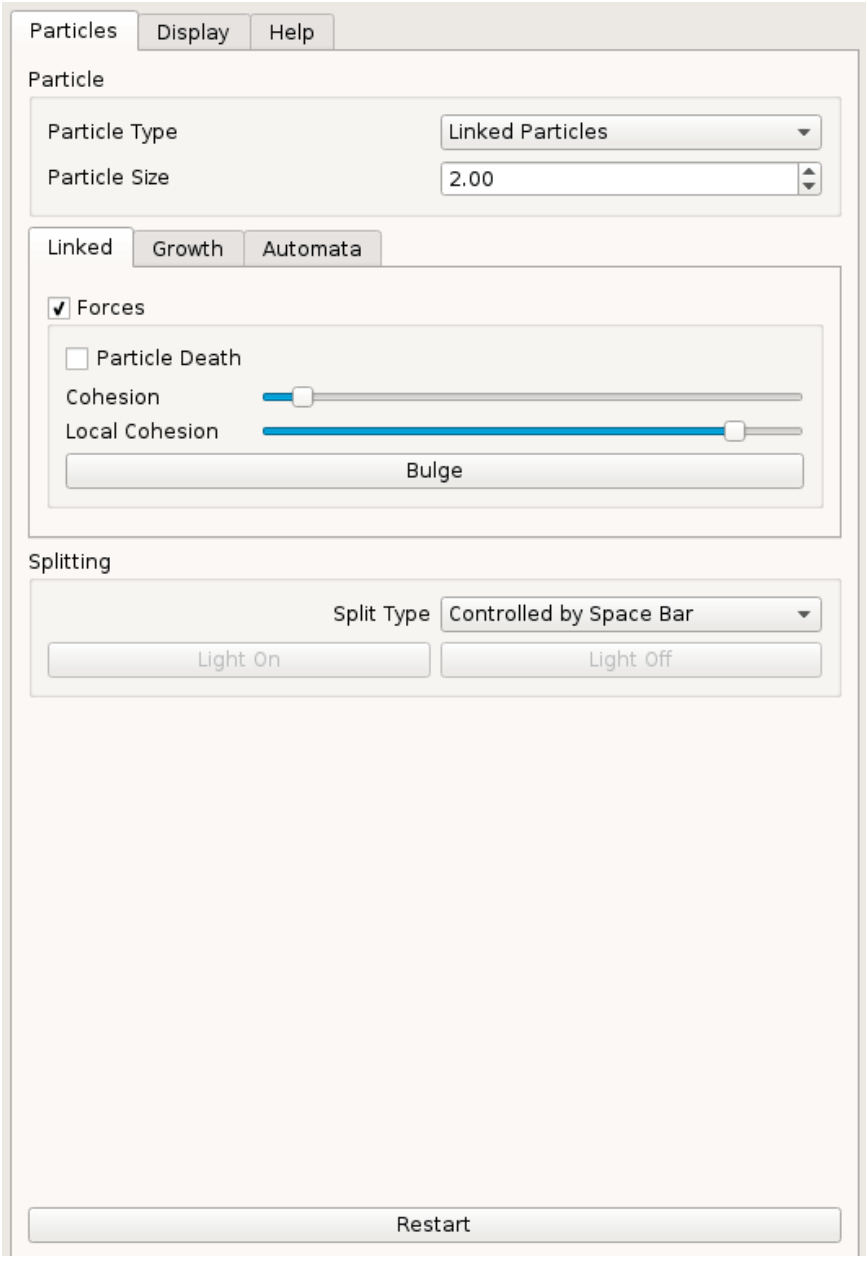


Point Light



Spot Light

UI: Particles



Particle Type

Linked Particle:
Linked particles are connected to each other by links. Each particle has at least 3 links to other particles. Through those links the particles create a membrane like mesh. The shape and tightness of that membrane is controlled by the particle specific forces in the 'Linked Particle' tab.

Growth Particles:
Growth particles are based on aggregation and grow towards the light like a plant. Their behaviour can be altered in the 'Growth Particle' tab.

Automata Particles:
Automata particles are based on the 'Conway's Game of Life' algorithm, using rules based on the number of neighbours to determine the life of the particles. Their behaviour can be altered in the 'Automata

Particle' tab.

Particle Size

'Particle Size' controls the radius of the individual particles. It will evaluate the calculations for each particle based on that value so that they do not collide.

Particle Specific Controls

Linked Particles

Forces:
Turning forces off will result in no movement in the particles as their movement is controlled by forces that are applied to them. This result may be desired if the user wants to observe a certain state or shape.

Cohesion:
The 'Cohesion' slider determines the strength of the cohesion to the centroid of the particles.

Local Cohesion:
The 'Local Cohesion' slider determines the strength of the local cohesion force acting on the particles. This will influence the particles towards the centroid of their directly linked neighbours.

Bulge:
The 'bulge' button will send the innermost particles outwards, hence driving all of the particles away from the centre point. This can produce interesting patterns as the particles are immediately drawn back in to the centre of the frame.

Growth Particles

Branches per particle:
Growth particles have a limit of children/branches per particle which allows the tree/plant like structure to be created by them. The higher the branch threshold, the less plant-like the structure becomes.

Branch Length:
The connections used in the linked particles to represent membrane constraints symbolize branches and connections for growth particles. Making the branch length longer will result in bigger gaps between the particles.

The program automatically increases the branch length if it does not find a position to place a new particle. However, that length will be reset after each split.

Grow towards Light:
Growth particles have the option to grow towards the light. Depending on how much influence the user wants on the shape of the structure this can be turned on or off.

Nearest Particle to Light:
When the particles grow towards the light, the user also has the option to always split the particle closest to the light which will result in a more vine like structure. By using a random splitting method the structure becomes more branch like.

Split Type

Controlled by Spacebar:
When the splitting is controlled by the space bar, particles will only split if the user presses the space bar. This can be useful if the user wants a controlled, slow splitting to understand the effect of one or several particles splitting.

Controlled by Light:
If the splitting is controlled by light and the light is turned on by the button below, the particles will constantly split under the influence of the light.

Automata Particles

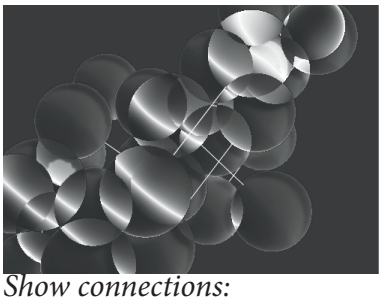
Radius:
The 'radius' slider determines the radius in which the automata particles will be created. Bringing the slider further towards the right will increase the radius in which the particles could be birthed.

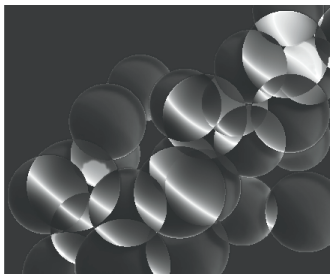
Time:
The 'time' slider determines the length of each generation for the automata particles. This means that the particles can be birthed more quickly or slowly, depending on the users choice.

UI: Display

Background:
Changes the background of the scene.

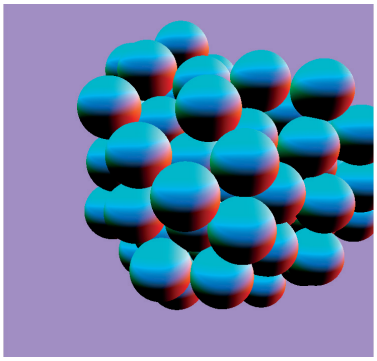
Blur Iterations:
Changes the blurriness og the background. Moving the slide to the left means little blur, moving it to the right means a lot.





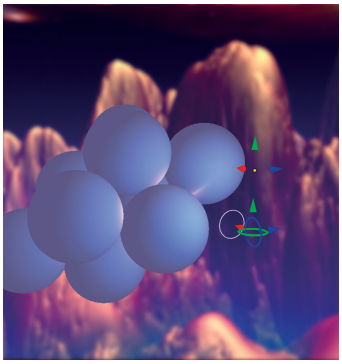
Show connections:
If this is ticked the program will display the connections between the particles, which, in the case of linked particles means that you can see the membrane constraints. In the case of growth particles this will display the branches between the particles. This cannot be toggled for automata particles, as they do not require links between cells.

AO:
The Ambient Occlusion pass will show the shadows of the particles. This pass can be manipulated even further with Radius & Bias.

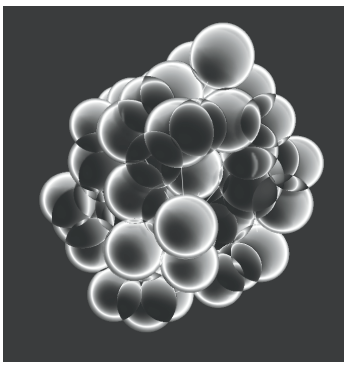


New Order:
This is an shading function inspired by Peter Saville to create «normal art».

Types of Shading



ASD:
The Ambient, Diffuse, Specular shading is a very simple, standard shader to show the particles. This render pass can be changed by the user.



X-Ray:
The particles will be shaded with the X-Ray method. This is the best way to see the intersection and connection between the particles. This render pass cannot be changed by the user.

Light Colour

Light Diffuse:
The R, G and B variables change the colour of the light. The value is set between 0-255. The actual RGB colour picked is also displayed in a rectangle next to the slides.

Light Ambient:
The ambient strength decides how much ambient light is set to the scene. The value is from 0-100 given in percentage. So a value of 40 means 40%.

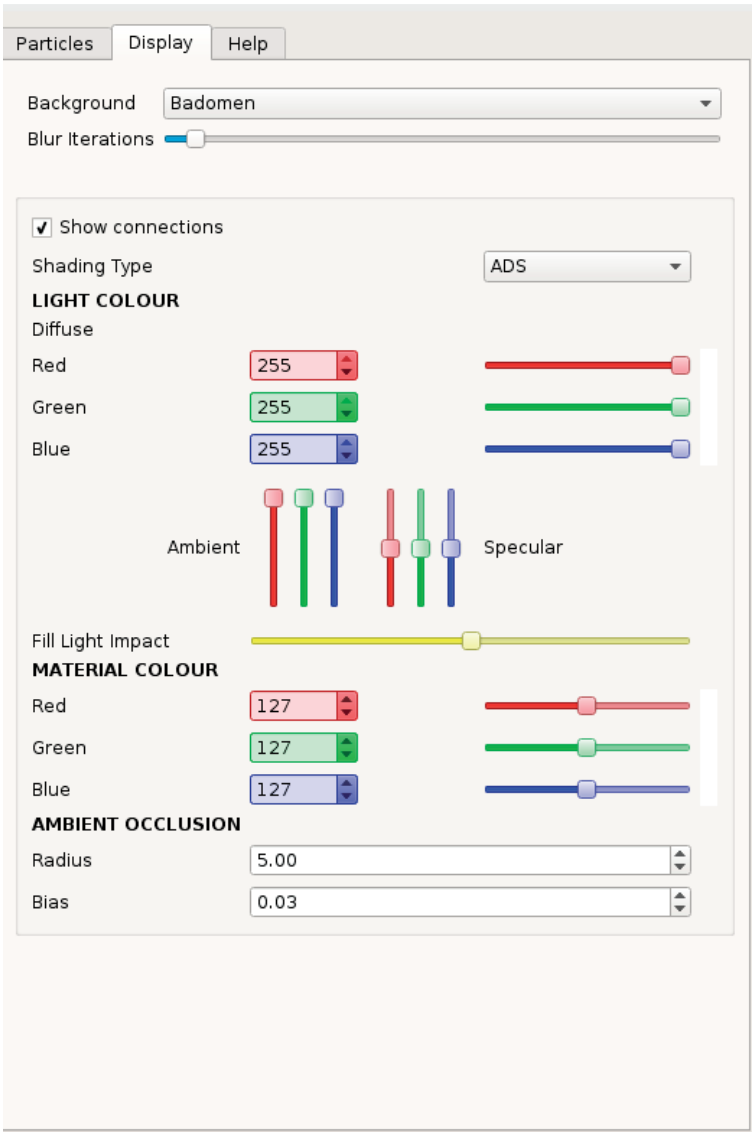
Light Specular:
The specularity controls appearance the specular reflections of the light. This is a value between 0-100 where the number is given in percentage.

Material Colour:
The R, G and B slide and spin box's decides the material diffuse and ambient colour of the particles. A colour rectangle is displayed on the side to better see what color is picket.

Ambient Occlusion

Radius:
The AO radius sets the brightness of the AO. The lower radius the more bright the scene will be.

bias:
The Bias is a relatively low value. The higher value the more clear the image will become, but it will also loose shadow information if the value is set too high.



UI: Help

This tab gives you a short description of the program and how it works.

Keyboard Shortcuts

1	*Ambient, Diffuse, Specular Shading*
2	*X-Ray shading*
3	*Ambient Occlusion Shading*
4	*New Order Shading*
alt + RM Click	*Rotating Camera*
W, A, S, D	*Move Camera Controls*
F	*Focus on the objects*