Procedural Growth

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Abstract

The connection between the biological growth process of natural organisms and their respective physical forms has been a subject of scientific interest for over a century. By using various biological growth processes as a means for generative art-making, computational artists create artificial organic forms through computer simulations. Our experimental art project, however, intends to explore non-biological procedural means for creating unseen organic forms.

Biological Growth

D'Arcy Thompson's seminal work *On Growth and Form* (Thompson 1942) was first published in 1917. The postulation of how biological forms are defined by the growth mechanism and external forces describes the mathematical principle of many natural generative processes. The enduring impacts of Thompson's work go far beyond its intended audience, and its artistic influence is particularly timeless (Jarron 2016).

The father of modern computing, Alan Turing, is also a follower of Thompson's vision; his one single biology-related publication (Turing 1952) describes a precise mathematical structure that governs the morphogenetic process of many visual patterns found in nature. This mathematical formulation suggested by Turing is commonly known as the reaction-diffusion system; it remains an essential pattern synthesis method used by many computational artists.

The continuous advancement of computer hardware performance in the last few decades has allowed artists to explore various biological growth processes at a very large scale and hence producing much more sophisticated visual outcomes such as the aggregation based work by Andy Lomas (Lomas 2005), and the work by Sage Jensen (Jensen 2019) that used Physarum transport network simulation (Jones 2010).

Procedural Growth

The renderings or 3D models created by the mentioned artists using various biological growth processes are extremely inspiring. However, instead of creating forms with a known growth mechanism or framework, we are more interested to explore non-biological growth processes for unseen organic forms generation.

The first work produced in our project is titled *Simplexity 01* (Wong 2020). It features an unseen semi-organic structure that was generated by a simple space-filling algorithm in a voxelized 3D space (fig. 1). The algorithm targets to visit every single voxel without repetition in a random yet continuous manner.

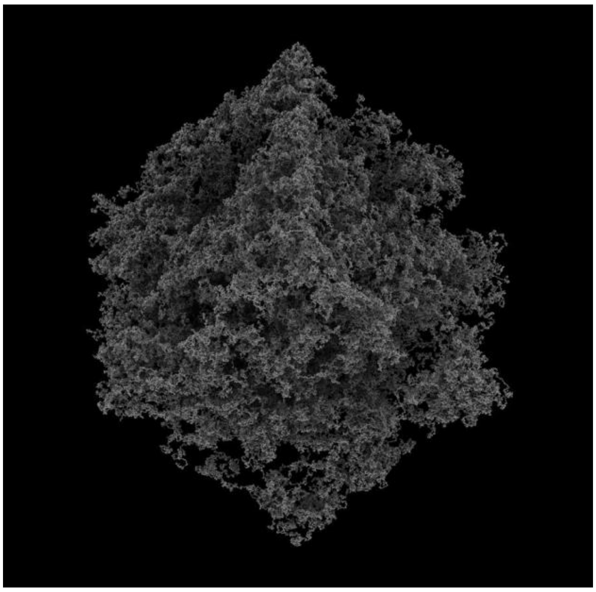

Fig. 1. *Simplexity 01*, 2020. Kin-Ming Wong. Digital Image.

At the very beginning, we found that the generated forms were highly geometrical and there was apparently no organic quality in them.

Until we decided to voxelize the space aggressively, we started to see interesting results. As this simple procedural growth algorithm targets to form a continuous pattern, so the early portion of the growth will leave a lot of individual voxels unvisited. These voxels together form a very fine-fragmented visual (fig. 2) which has a contrasting quality compared with the semi-organic structure as featured in *Simplexity 01* (Wong 2020).

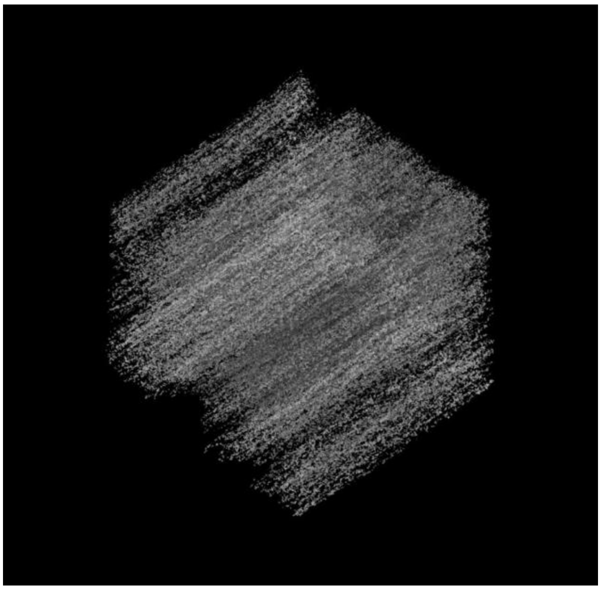

Fig. 2. Untitled, 2020. Kin-Ming Wong. Digital Image.

We are going to produce a collection of prints based on this simple procedural growth and we plan to extend our experiments with fluid simulation-based mechanisms such as Lattice Boltzmann methods which are designed for discretized volumetric space.

References

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Biography

Kin-Ming Wong is a computational media artist and technologist with a strong focus on algorithmic and generative image synthesis. He is currently an Associate Professor at the School of Creative Media, City University of Hong Kong. His artistic and technical works have been presented internationally in SIGGRAPH, SIGGRAPH Asia, Computer Graphics International, Pacific Graphics, and IBC etc. He was also an award-winning visual effects pioneer of the Hong Kong movie industry. He maintains an active connection with the industry via artixels, his commercial visual effects software and consultancy practice.