

STARTS Residency Public Report

Residency “Immersive Minimalism” by Theresa Schubert

at the **Poznan Supercomputing and Networking Centre (PSNC)** in Poland.

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1. Introduction

The result of my residency under the title 'Immersive Minimalism' was the production of a 10 minute digital film 'Always Dead and Alive' in 8K and 4K resolution with 5.1 surround sound. The project investigates modes of perception through creating minimalistic video scenarios that challenge our awareness of time and space. By adapting Cellular Automata, a set of rules often used for simulations of patterns in nature and physical behaviours, I combined my research on the evolution of patterns in nature and self-organisation of forms with generative video. Surprisingly complex behaviours appear when all 33 Mio. pixels on screen become alive as individual interacting agents within a set network.

I. Artwork

Always Dead and Alive (2019) is an 8K video environment working with cellular automata (CA). In a coded architecture of abstract geometries, a sequence of self-generative patterns plays out, completed and enhanced by an abstract soundscape. It is an immersive and sensorial work intended to make a digital space experienceable in an organic audiovisual flow of light, color and sound, based on the mathematics of nature.

While the basic shape and framework of a pattern is defined by the artist, its actual appearance, motion and morphing are created by the cells or pixels themselves in the ongoing process. They constantly compute anew and adapt to the neighboring ones, leading to their systematic organization and thereby creating visible patterns.

Abstract geometries emerge, blend, morph, disintegrate, fade out and reemerge in a constant flow. The shapes are organically irregular; however, they always adhere to a geometric grid or another type of systematic structure like circles or lines. The visual dimension is enhanced by an abstract ambient soundscape, which creates a mysterious, primordial, extraterrestrial atmosphere. Just like the visuals do, the sound, composed by Jan Skorupa, oscillates between organic and inorganic characteristics. At times, it appears like foaming liquid, bubbling water, trickling sand, cracking wood, rustling foliage, human breathing and secretive whispering, fluidly blending with bell-like chimes and resonant strings, shifting mass, metallic machinery moving through infinity, vastness made audible with minimal elements, an open emptiness interchanging with pixelated density. This ever-

transforming soundscape acoustically describes the visual plane with pixels behaving like cells, like organic life breathing and evolving in a digital environment.

a. [Artist's reflection and development process](#)

After an initial phase of research in terms of literature and other existing artworks, I decided to advance on theories of color perception, movements of shapes and changes of geometries based on algorithms. Connecting this to theories of immersion, which is always based on a somatic experience, I wanted to create a large spatial environment. My initial plan in the residency was to first work with generative visual content (code-based) to understand better the impact of size, color, shapes and movement in such an immersive setting. This was originally planned as a study. I found the aesthetic outcome so promising that I decided to focus on this part to make an exhibitable film out of it. My idea to work with micro(scopic) biological materials to film was not realizable due to the fact that it was not possible to set up a weeks long time-lapses at the institute as well as health and safety risks. Further, we did some experiments and plannings for timelapses of growth processes in plants and fungi.

After several visits to PSNC and also after having seen their infrastructure, I started to be fascinated by their large server rooms. The huge concrete halls with server racks, blinking LEDs and deafening noise create a very specific atmosphere and I decided to address this space. I developed a concept for a ~25-min. film (working title 'The Cave') that juxtaposes images of their real Server Spaces, that hold the Supercomputer, but also obsolete server technology. The story unfolds based on visual metaphors of computer networks discussed via a real supercomputer server space and the forest as a superorganism. The film is told from a female first-person perspective via different text-to-speech programs. Produced by the PSNC-team in native 8K and 4K respectively it uses newest film technologies in combination with 3D laser scans and computer-generated visuals. This film currently in the final stage of postproduction and will be an additional outcome of the residency.

b. [Conceptual and technical background](#)

At the very beginning of the residency, I came across the mathematical model of cellular automata and I decided that this group or rules was ideal to combine my interest in biology and phenomena of nature with the task to produce a video for an immersion ultra-high resolution space.

Cellular Automata (CA) are a set of logical rules to model discrete dynamic systems. They consist of a regular grid of cells in a two- or three-dimensional space whereas the development of an individual cell in time depends on the states of its surrounding neighbourhood cells. John von Neumann was the first to consider such a model and include it into his universal constructor, a self-replicating machine in a cellular automaton environment to test an abstract simulation of a physical universal assembler, with which he wanted to show “not self-reproduction per se, but the evolutionary growth of complexity”(mutation).¹ He was interested in finding a way to describe complex systems like neural networks with logical language and made a comparison between artificial and natural automata.² Since then CA have been studied to understand and simulate many physical, chemical and biological phenomena.³

CA can produce interesting and extremely complex patterns based on iterations of simple preconditions. In 1989 Rudy Rucker stated that the current greatest task for scientists today was to build “living machines: intelligent artificial life”, and compared it as an equally important work than the building of the Nôtre Dame cathedral in Paris for medieval artisans.⁴ This comparison stuck into my head, even more after the sad coincidence of seeing Nôtre Dame partially burning down in April 2019, days after our STARTS residency days at Centre Pompidou.

With CA it is surprising to see how a simple set of rules always leads to new formations and complex patterns. They self-organise in a network, an implementation of a massively parallel computing system. Rucker also described CA as the bottom up approach to creating a-life as opposed to the top/down approach coming from artificial intelligence. CA was the ‘matter’ on which AI could evolve: “If AI is the surfer, CA is the sea”.⁵

Stephen Wolfram claims that the universe has a digital core and follows fundamental laws that can be described with simple programs.⁶ Following this line of thought, CA are thus a powerful way to describe nature, better than traditional mathematics.

¹ McMullin, B. (2000), John von Neumann and the Evolutionary Growth of Complexity, *Artificial Life*, 6 (4) (link from Wikipedia)

² Von, Neumann J., & In Burks, A. W. (1966). *Theory of self-reproducing automata*. Urbana: University of Illinois Press. Pg. 19

³ Rule73 CaseStudyClass4 PDF

⁴ https://www.fourmilab.ch/autofile/e5/chapter2_75.html [29.05.2019]

⁵ Ebd.

⁶ A New Kind Of Science

What fascinates me about cellular automata is its simultaneity, because like in nature, the world is happening in many different places at once, and CA are offering a very aesthetic experience of that. Events don't happen at an isolated spot, they happen in parallel and often connected. This intertwindness and the fact that the future depends on the present are fundamental rules of CA but also of our reality. Although it is a very specific, simplified model, every computation is a visual process. It incorporates space, time and colours leading to ever changing, evolving abstract forms.

Looking at CA from the last decades, one usually has a somewhat pixelated appearance in mind. This is due to the fact that most CA were not going much larger than a 1000x1000 px grid. The other method was to assign clusters of pixels for one cell, making the grid resolution much smaller but the inside cells larger. For my project "Immersive Minimalism", I am dealing with a UHD environment of 7.680 x 4.320 pixel. These 33 million pixels are individual cells in my CA system and are recalculated at every step. Given a large enough display and distance to the screen the pixel become invisible and merge to larger color areas and gradients.

About the rules

The first rule I chose is based on the so-called Voter Modell (the election for the European Parliament were just days ahead at that time). According to mathematician Stephen Wolfram, the voter model shows, "how the views of neighbours can influence a neighbourhood. On a given day, several voters will abandon their current views and assume the position of one of their four neighbours. When run, strong groupings appear almost immediately, with conflict at the borders." Put quite simply it means, the model can simulate how people influence the opinion of individuals in their neighbourhood. Although the main reason I chose this rule is the capacity for abstract colour formations and noise, I do find the hidden political message in the seemingly chaotic surface extremely interesting. Other rules are based amongst others on Amoeba, Life without Death, Assimilation, or Maze.

Toffoli, Tommaso & Margolus, Norman. (1987). Cellular Automata Machines. Complex Systems. 1. 967.
Rucker, Rudy. (2005). The Lifebox, the Seashell, and the Soul: What Gnarly Computation Taught Me About Ultimate Reality, The Meaning of Life, And How to Be Happy.

c. Tech / Co-Creation Process

For implementing the chosen CA rules, I collaborated with a programmer from Berlin. Before writing the code with Jörg Reisig, I chose the CA based on how capable they are of self-organization, i.e. at recognizing the state of the neighboring cell, adapting and shape-shifting accordingly. He implemented the rules in Unity and made a simple interface to generate the CA's and export as PNGs. The interface allowed it to select rules, modify colors, timings and choose starting conditions as geometric shapes.

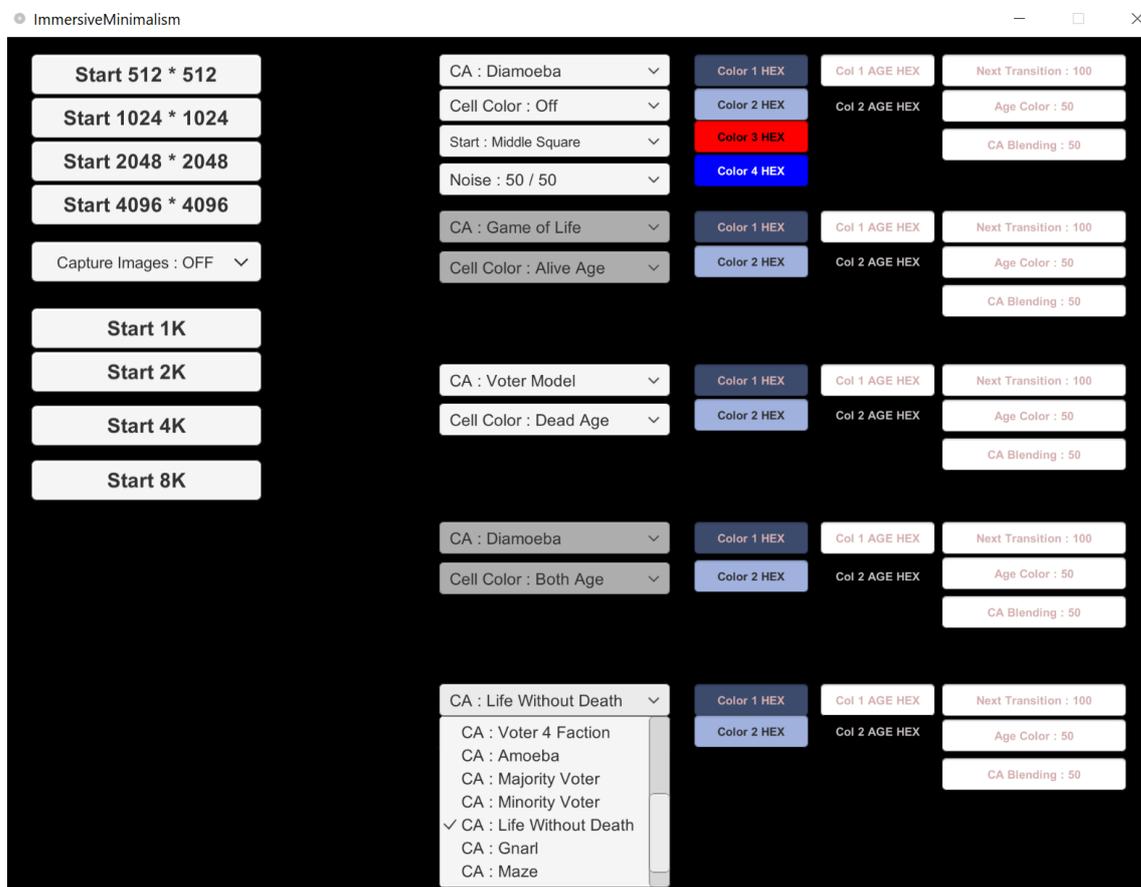


Figure 1 Screenshot from CA interface in Unity

Due to the fact that it was a massive computation task it was impossible for us to develop this as a real-time application (at least within the timeframe and this budget) so we exported PNGs that were then combined in Davinci Resolve to a video sequence.

In collaboration with the PSNC team, I tested the video appearance during several visits at PSNC on their 8K monitor and the large video projection wall. Based on this experience adjustments and improvements were made.

To develop a soundscape for the video I exchanged with Jan Skorupa from PSNC about my idea and imagination for it. He then composed a 5.1 surround soundtrack for the video that complements the atmosphere of the piece very well.



Figure 2 Sound production studio with Jan Skorupa

The final video edit and export to uncompressed DPX-files I produced at Spin Digital in Berlin. Spin Digital is a partner in the Immersify-project and the kindly agreed to host me between July and August. They provided me with a fast editing computer, software and codecs. There with the team we tested several configurations of their self-developed encoder. Due to the difficult, abstract nature of the video material, it posed an extremely difficult task to encode as a video file. Standard encoders create many artefacts when they are faced with abstract content, additionally there is hardly any around for 8K content. Therefore, a special version of the encoding dev software was made by Spin Digital to be able to encode the video in highest-quality, yet still have a manageable data-size and mbit rate. The uncompressed files were then encoded by PSNC and matched together with the final audiotrack.

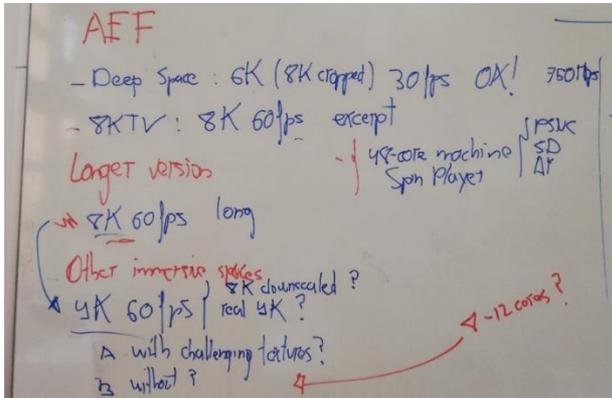


Figure 3 Notes from discussion at Spin Digital Berlin

II. Impact

d. Research and Artistic Impact

My research contributes to the fields of art history, sound studies, cultural theory and aesthetics. Further, this work contributes to leading, innovative media art especially in the field of audiovisual installation, computational art and sound composition. Additionally it made a good case study to experiment with modes of perception on large screens and in immersive environments.

Exemplary visitor feedback from Ars Electronica Deep Space 8K screening, 05.09.2019:

#01 "Experiencing the 'immersive minimalism video' made time stand still - I was at once transfixed by the immersive and dynamic energy of the environment while at the same time being acutely engaged, curiously investigating the forms seemingly growing around me as they blossomed and resonated in vibrant and unexpected ways."

#02 "Colours and shapes are combined with nice sounds in this visual show. What I saw in Schubert's video was some kind of an artificial entity that was evolving like a biological organism."

e. Dissemination

To enhance public exposure I developed a dissemination strategy that was supported by tools such as the official Vertigo residency blog, my personal website, a brochure, newsletters, social media posts and a public exhibition + screening, as well as talks.

- Ars Electronica Festival 2019: Screening, exhibition and talk

- Interview with Platon TV at PSNC, published on youtube Nov 2019:
<https://www.youtube.com/watch?v=RyTyiZer9GM&feature=youtu.be>
- Immersify - documentation from Ars Electronica Festival:
<https://www.youtube.com/watch?v=7LfRuiP6c-8>
- Talk at Futurium Museum Berlin, Dec 5 2019
- Screening at final STARTS event Paris Feb 27 – March 1 2020



Figure 4 Brochures and Flyers by Theresa Schubert and PSNC ----- Interview setup by Platon TV



Figure 5 Talk at the Immersify-Panel during Ars Electronica Festival 2019, Postcity 5.9.2019. Foto: Vanessa Graf

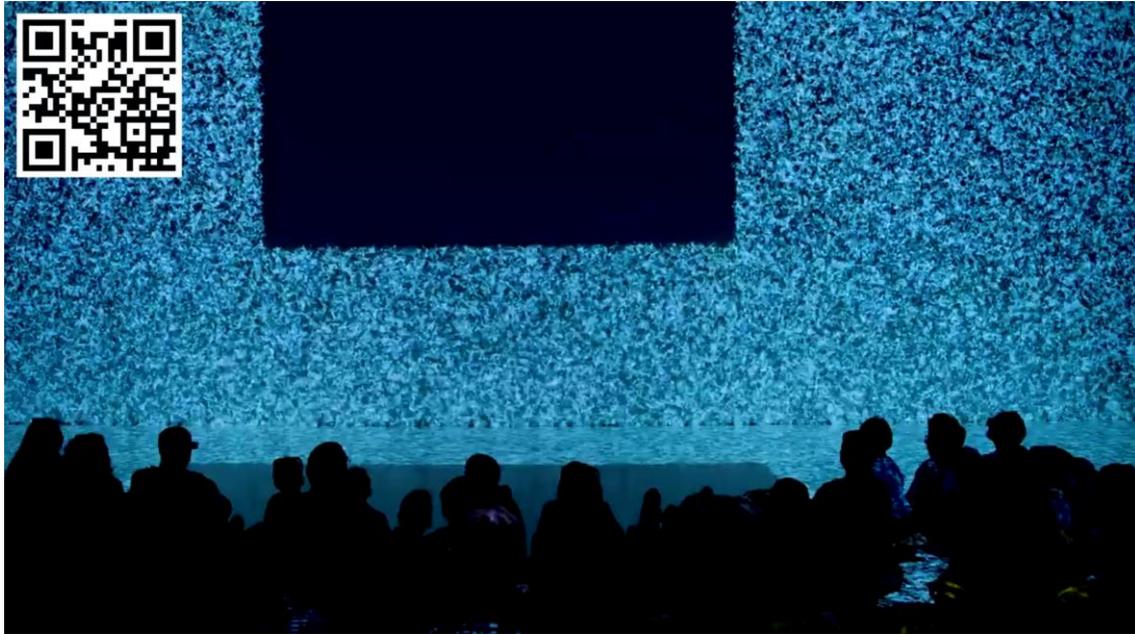


Figure 6 Video still from Immersify-project documentation at Ars Electronica Festival. c Futurelab

III. Art-Science Inter-Relationships

In Always Dead and Alive, organic processes unfold within a digital structure. Aspects of living matter (the cell) are applied to hitherto lifeless code (the pixel). The work is an artistic exploration of the interface between life and technology. It applies processual powers of biologic self-organization to intangible mathematical code, describable in zeros and ones, demonstrating the similarities and the possible interconnectedness of the organic and the digital. It uses most innovative technologies to create an immersive environment where not the technology but the human and the aesthetic experience are in the center of the investigation.

Overall, I am extremely happy about the residency and its outcomes.

I think it is very important that artists get the opportunity to meet makers of our future's technology and get the chance to work with it creatively. Because an artist looks at the process differently than a scientist or engineer would, it opens up many interesting possibilities for research and encourages us to explore things that we might not have otherwise considered.

I hope there will be a next edition of the STARTS residencies. In this case I would advise that also the tech partner will receive some funding for hosting the artist and that there is a budget that would also allow the tech partner to visit the artist's exhibition or home studio to foster a deeper exchange and a collaboration that can work even better in both directions.