

Signal & Noise: Information

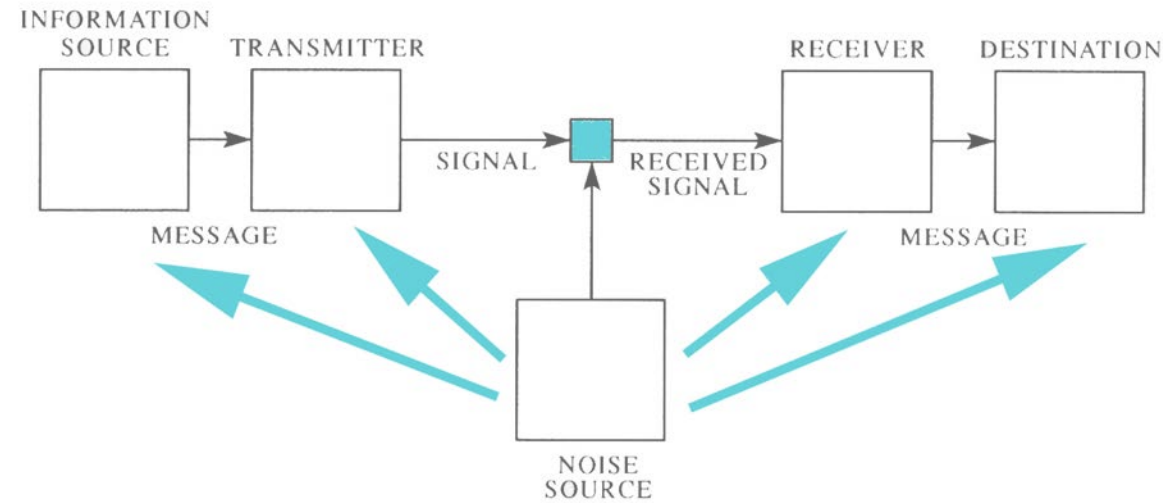
George Legrady © 2022

Experimental Visualization Lab

Media Arts & Technology

University of California, Santa Barbara

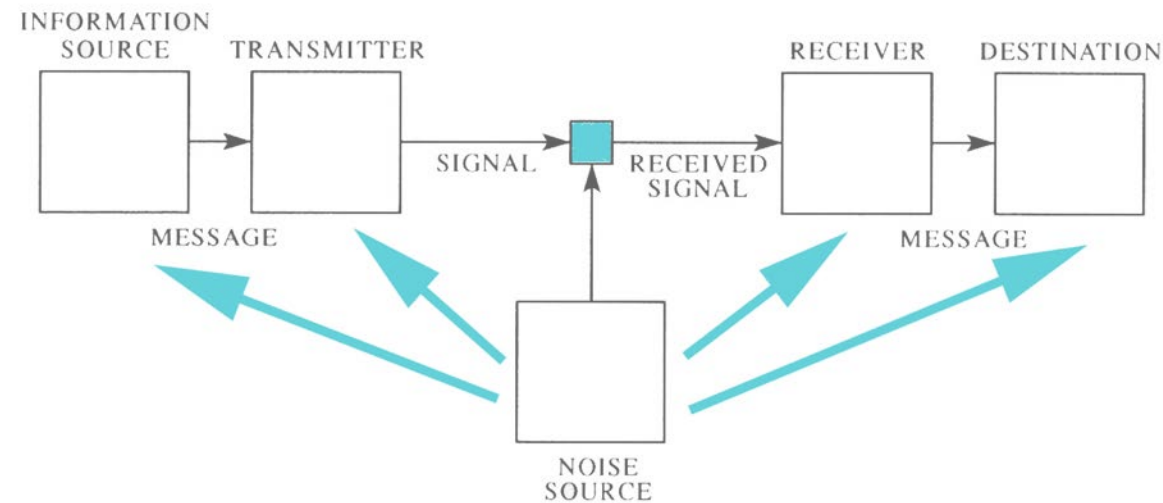
Claude Shannon's Information Theory of Signal & Noise (1949)



Shannon at Bell Labs developed the theory to get rid of noise from telephone communication

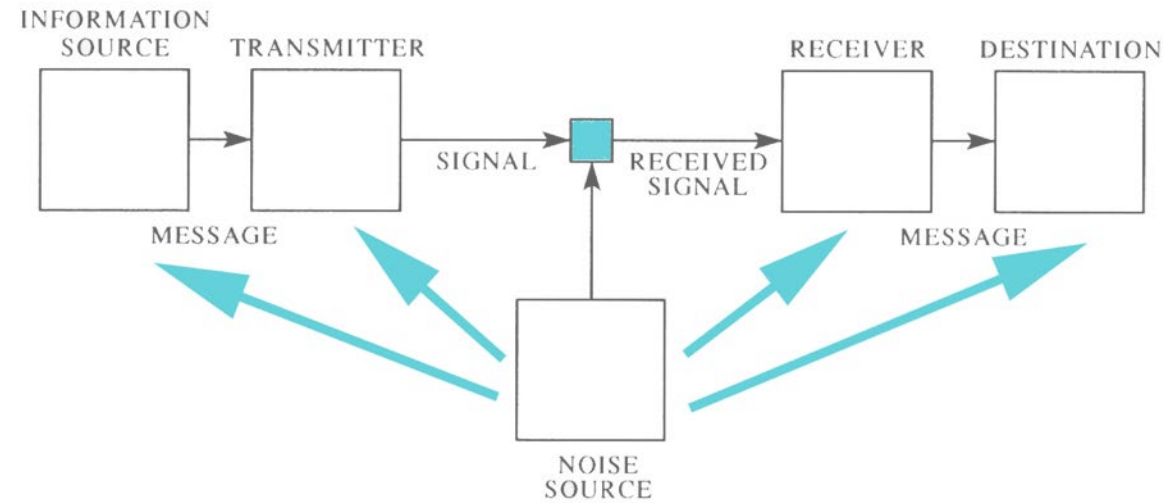
- **How to send a maximum amount of information**
- **How to measure the capacity of a channel to carry information**

Claude Shannon's Information Theory of Signal & Noise



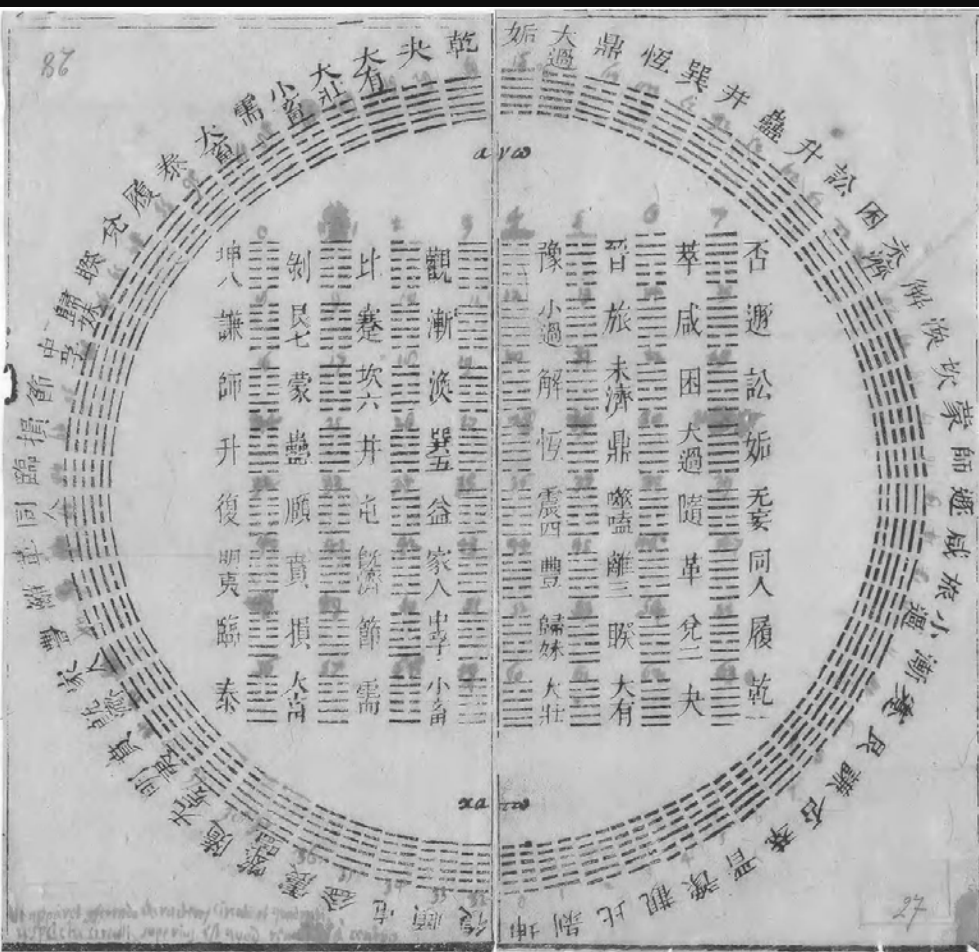
- **Signal**: Ordered information
- **Noise**: Unstructured, randomized information
- **Redundancy**: The measure of unnecessary, therefore “wasted” space. Functions to reduce errors
- **Entropy**: A measure of the average level of information, or uncertainty (noise) in a situation. How things result in relation to what is expected (probabilistic model)
- **Data compression**: Reduces the redundancy

Claude Shannon's Information Theory of Signal & Noise (1949)



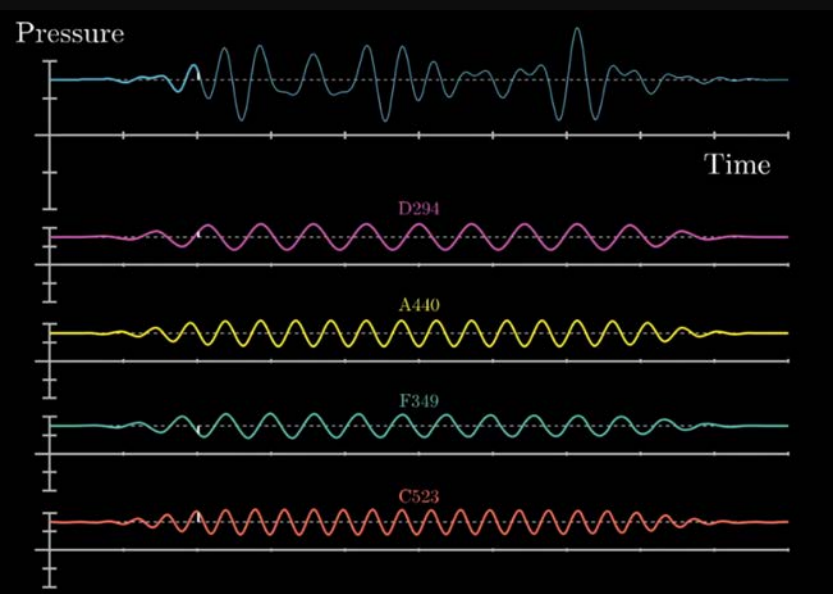
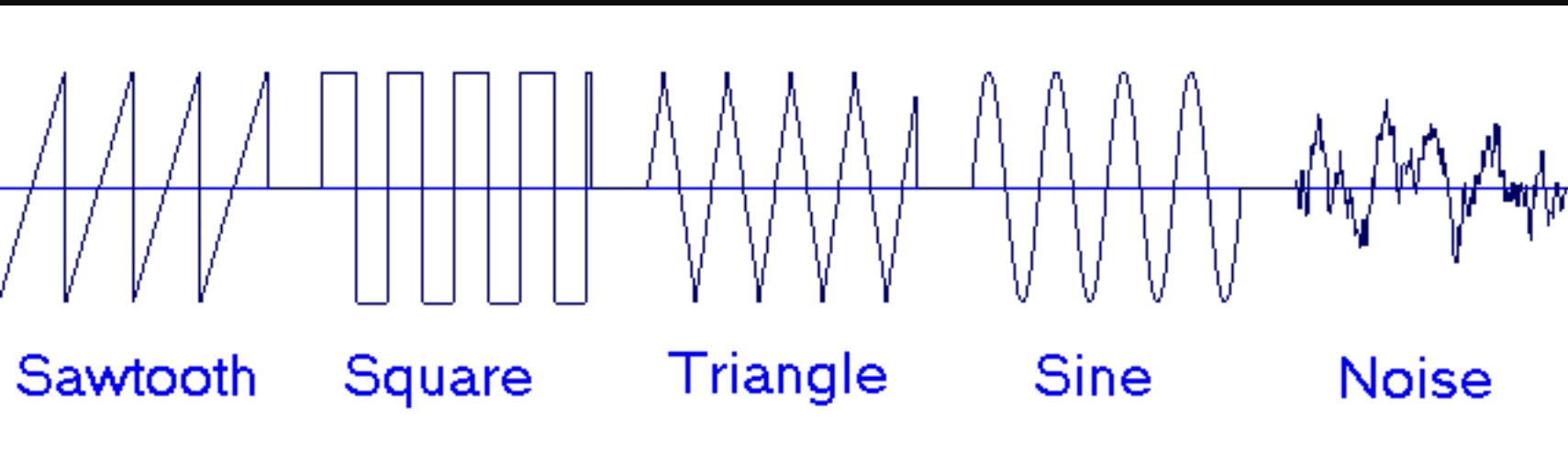
- **Noise is unintended, unplanned information that got into the signal**
- **Engineers want to reduce the noise**
- **But noise is useful to test systems, to increase the complexity**
- **Noise is also interesting as an aesthetic device**

I Ching to Binary System, Gottfried Wilhelm Leibniz (1701)



Hexadecimal	Binary	Decimal
0	0000	0
1	0001	1
2	0010	2
3	0011	3
4	0100	4
5	0101	5
6	0110	6
7	0111	7
8	1000	8
9	1001	9
A	1010	10
B	1011	11
C	1100	12
D	1101	13
E	1110	14
F	1111	15

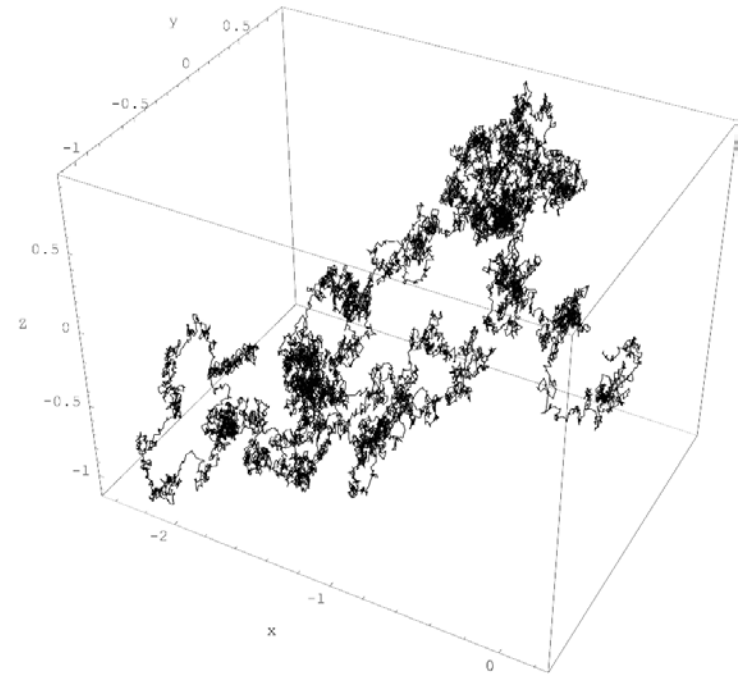
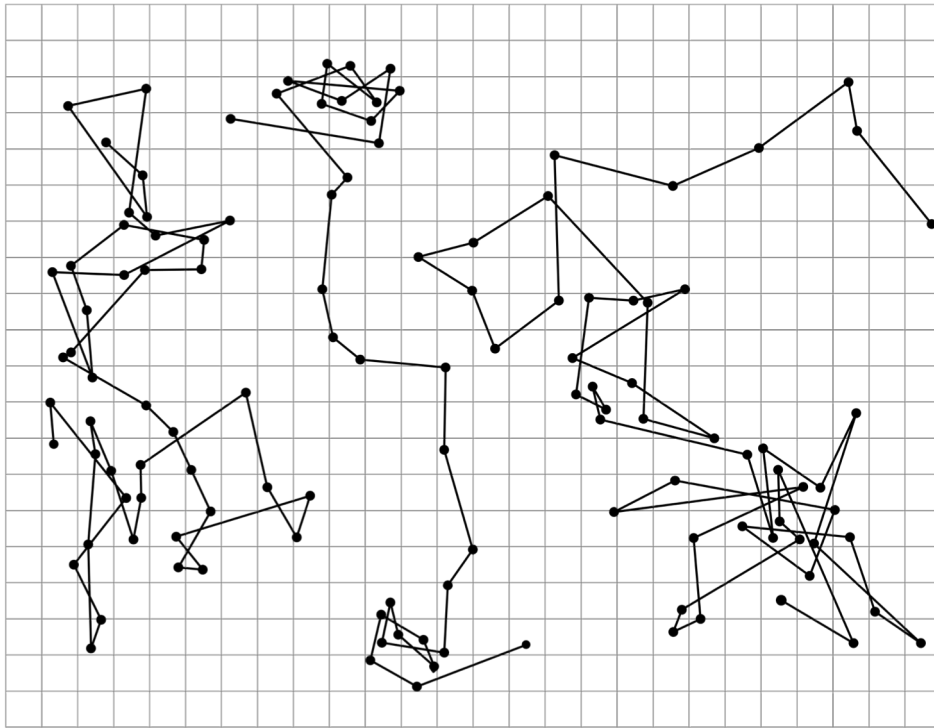
Analog Oscillators | Frequency Modulation | Fourier Transform



Frequency Modulation: Where one wave modulates another to get a complex signal

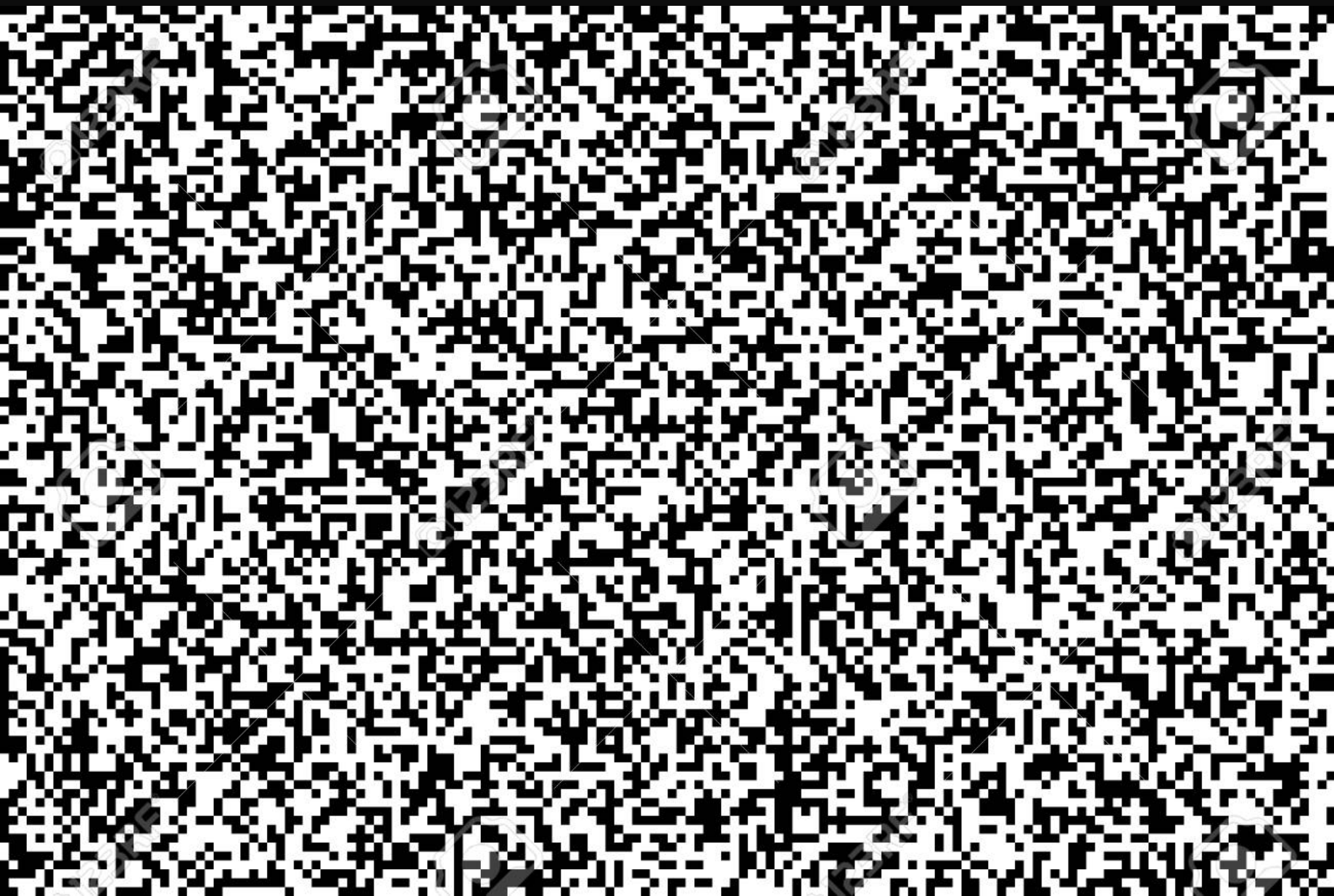
Fast Fourier Transform: A way to decompose a (complex) signal to its make-up of multiple basic frequencies

Brownian Noise | Random Walk

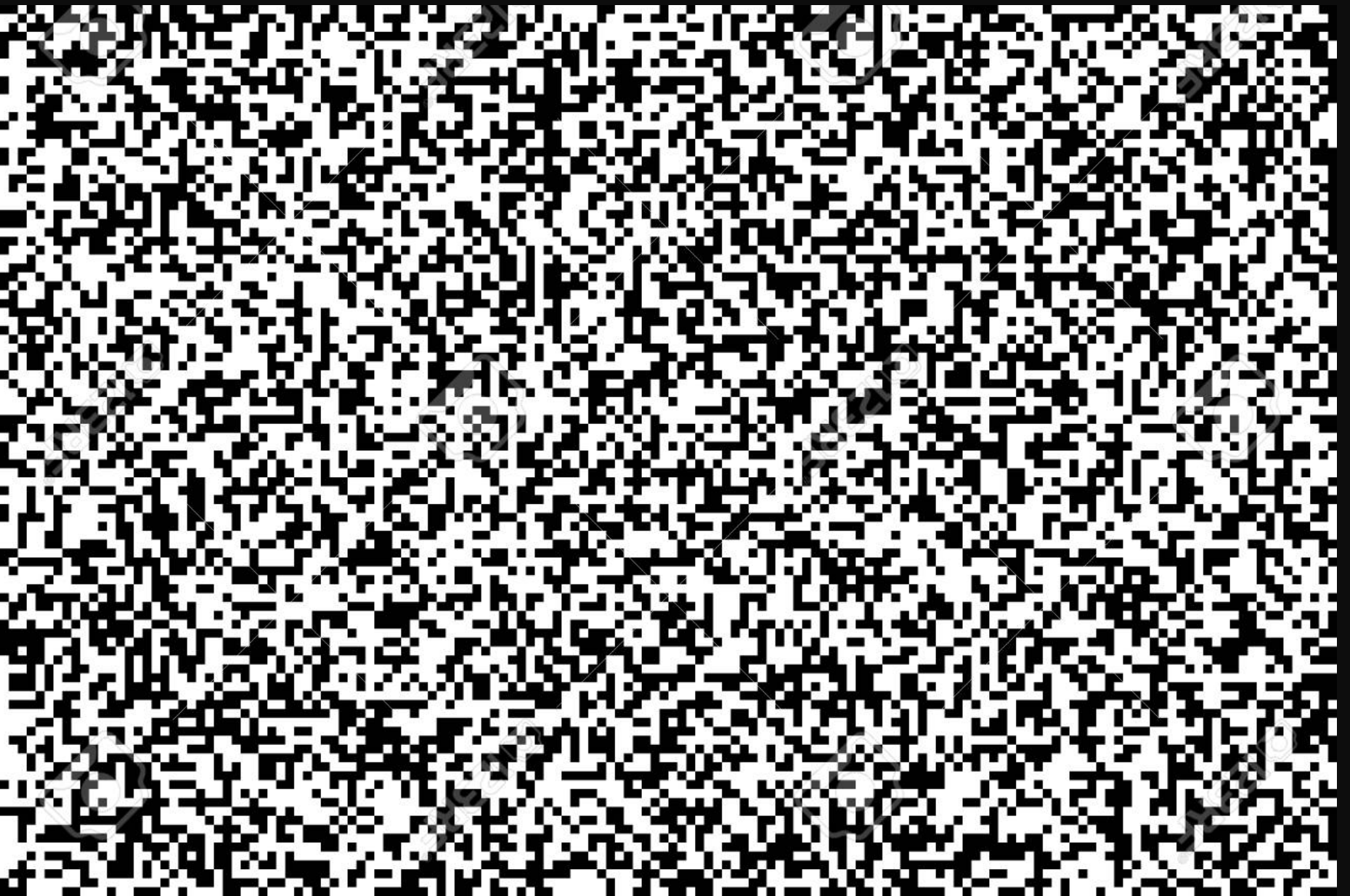


- **Brown (1827)** : Erratic motion of inanimate particles in water
- **Einstein (1905)** : Particles are moved/pushed by water molecules

Random sequence results in noise (in this case black or white cells)



Markov Chain: *What is the probability of the next state based on what has previously happened*



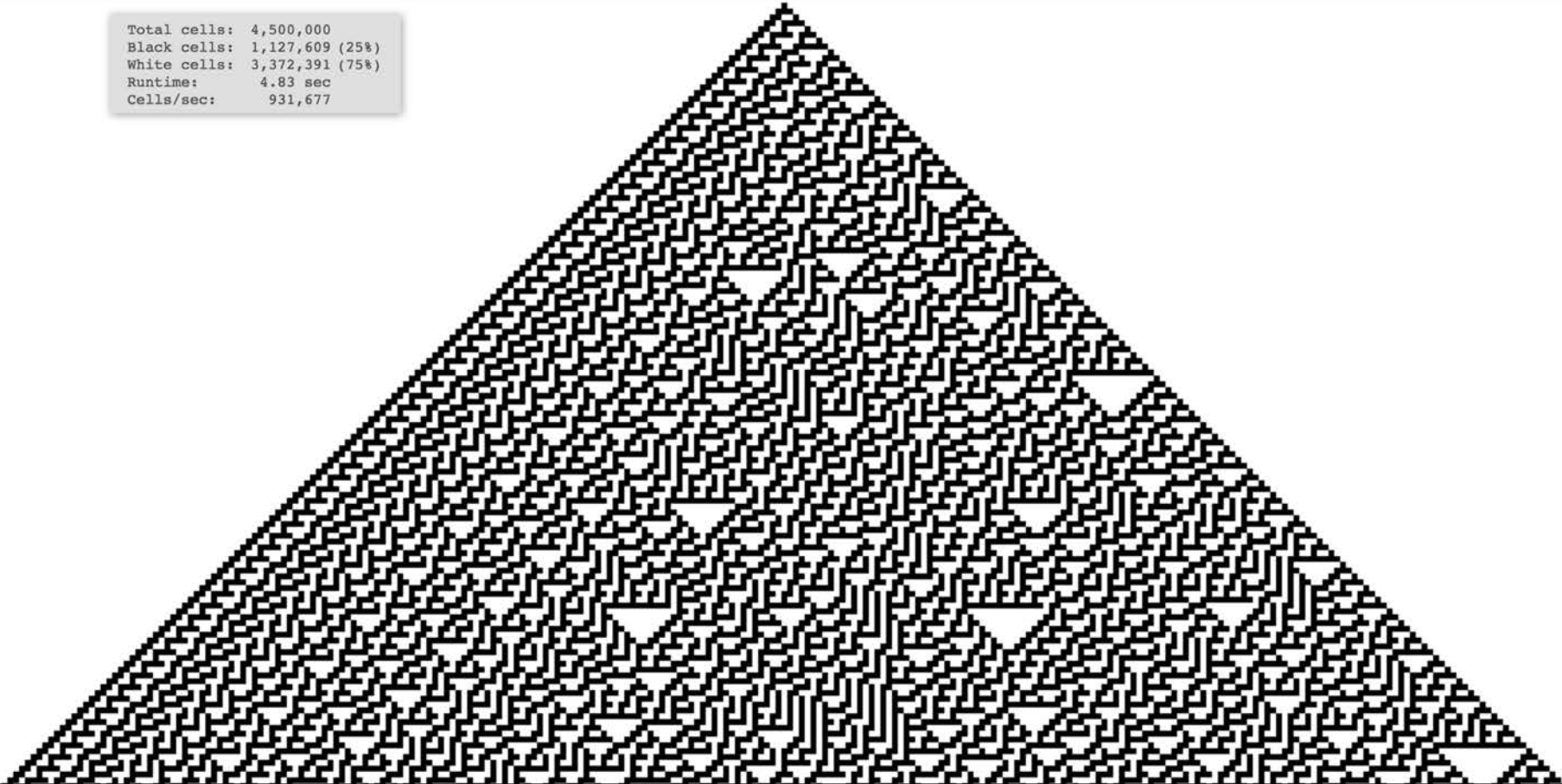
“Cellular Automata”, Stephen Wolfram

Elementary
Cellular
Automaton
Generator
by Kevin Lin

Rule 30 (chaotic)	n $n+1$								
binary		0	0	0	1	1	1	1	0

Rule
Steps
Cell size

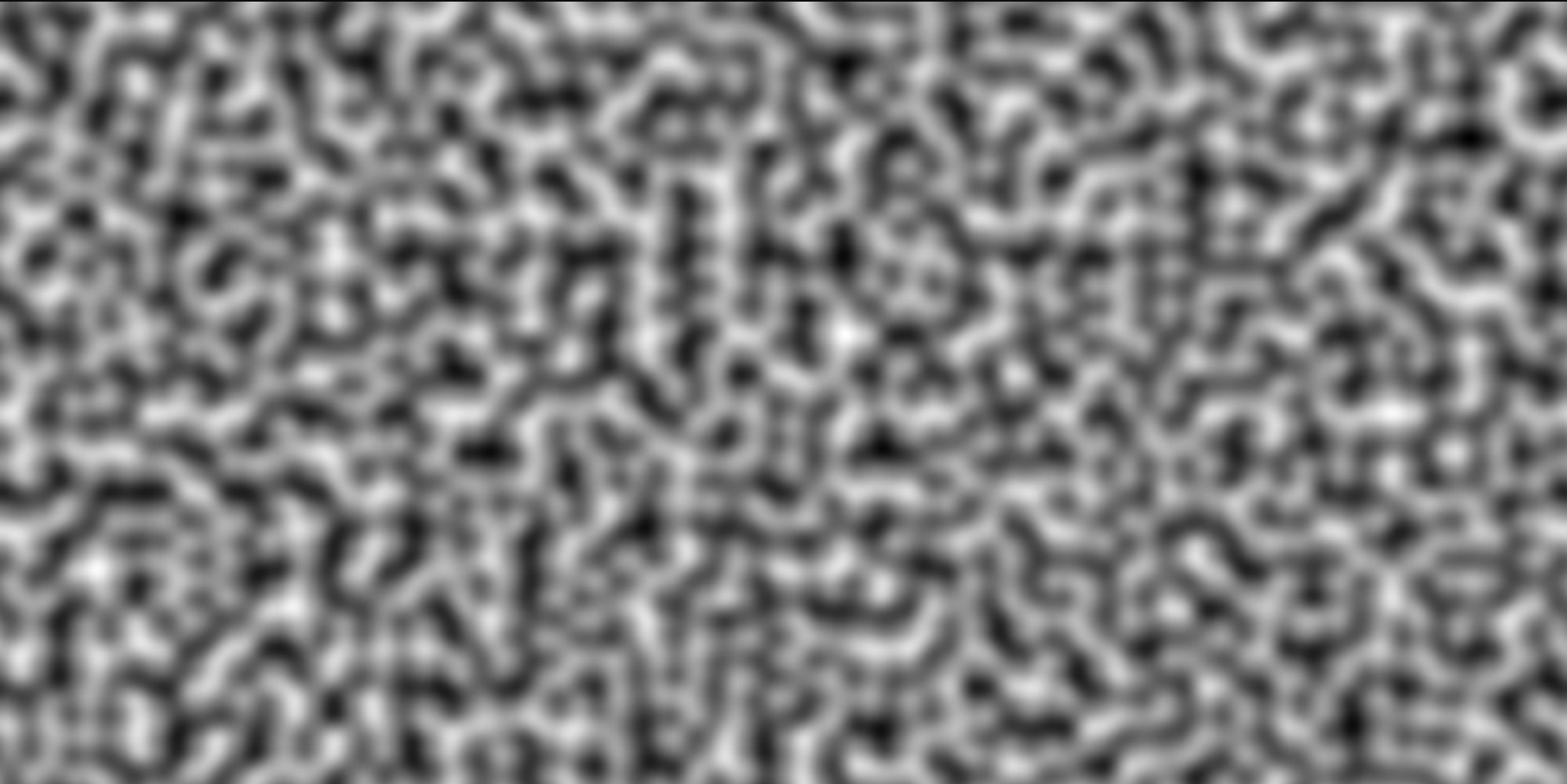
Total cells: 4,500,000
Black cells: 1,127,609 (25%)
White cells: 3,372,391 (75%)
Runtime: 4.83 sec
Cells/sec: 931,677



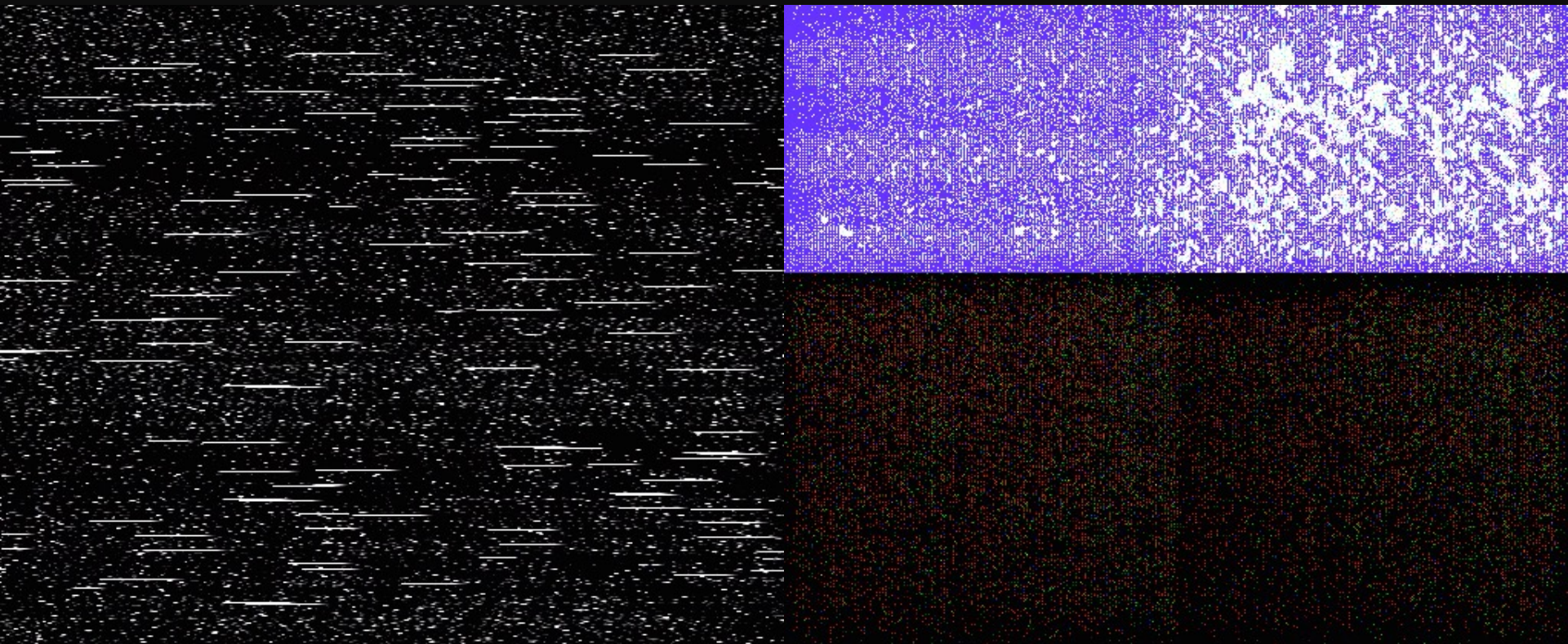
Photoshop Noise: Gaussian:100%, Uniform:100%

https://en.wikipedia.org/wiki/Gaussian_noise

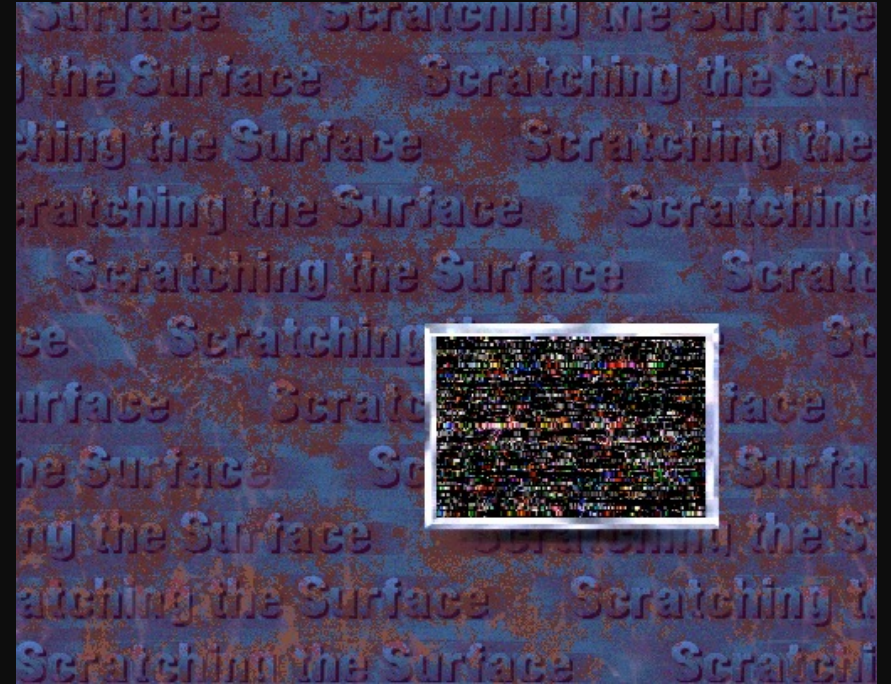
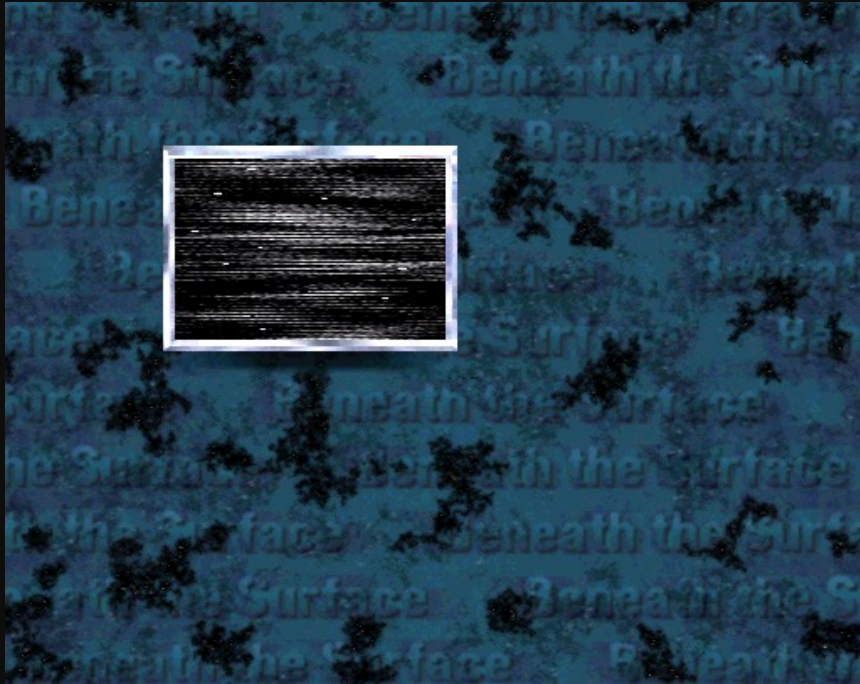
Perlin noise, a function to enhance noise texture, Ken Perlin (1983)



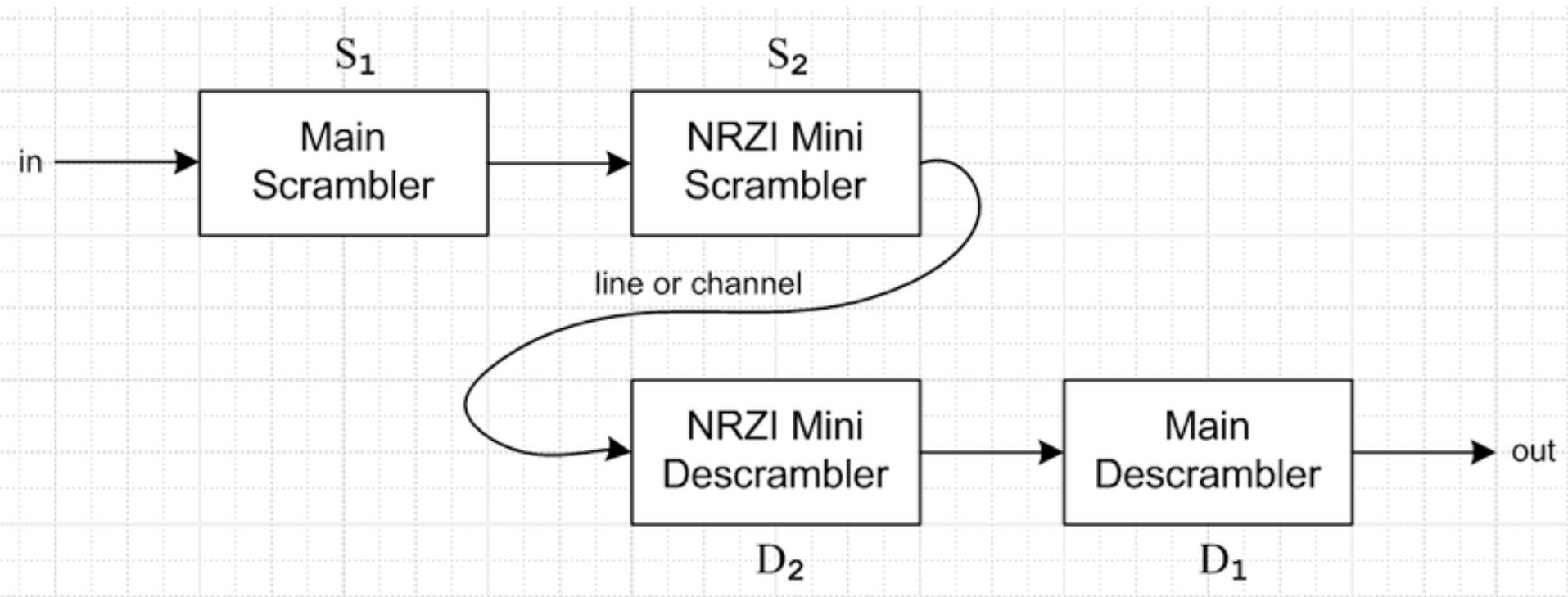
Analog TV noise (left), Digital Noise (right), George Legrady (1985)



“Beneath the Surface, Scratching the Surface”, George Legrady (1987)

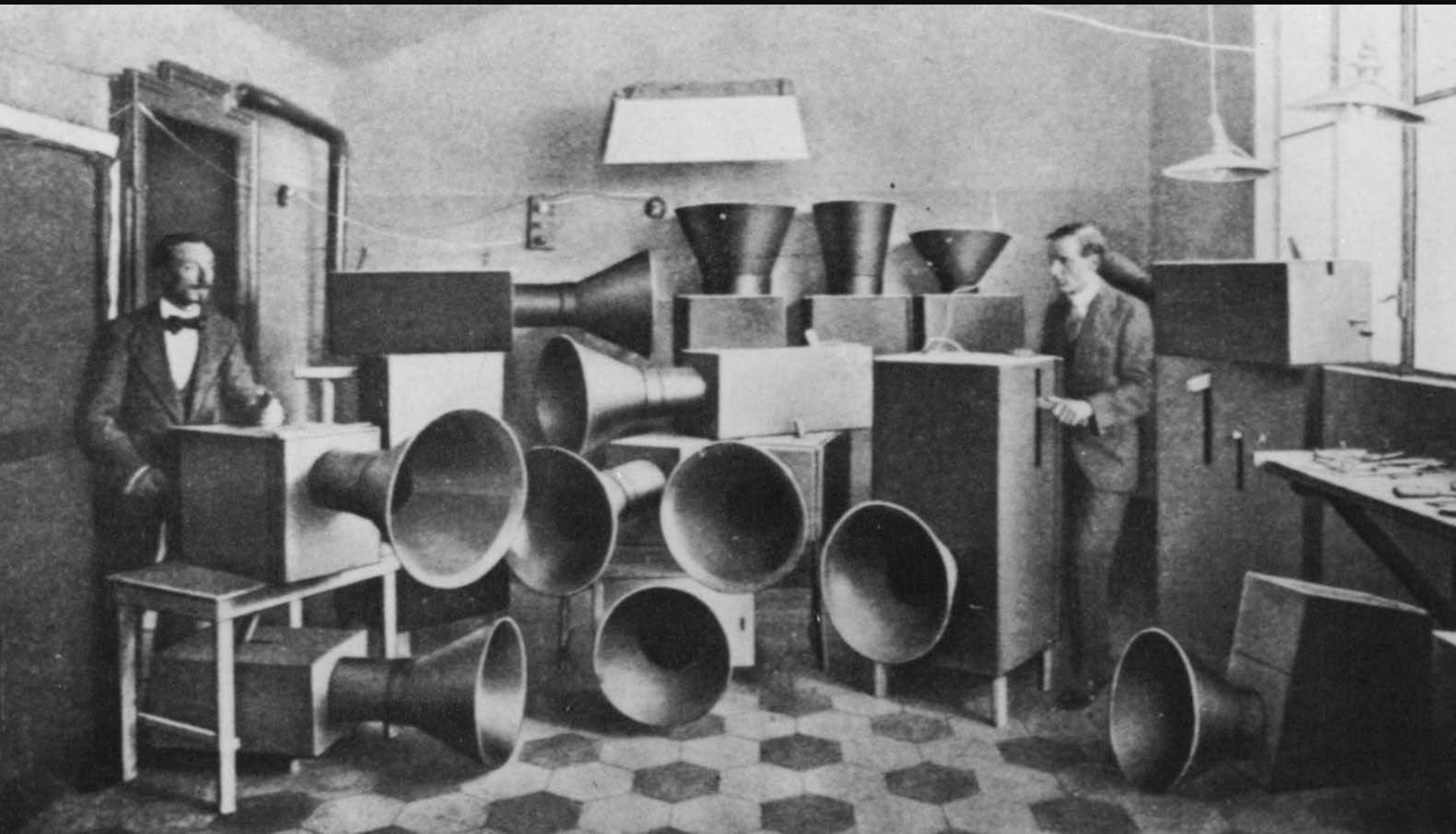


Telecommunication Scrambler



- A signal is scrambled based on a pattern turning it into noise – and the same pattern is used to descramble the data once it is received returning it to signal

“The Art of Noise: Futurist Manifesto”, Luigi Russolo (1914)



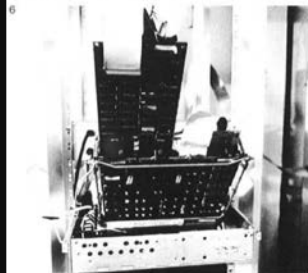
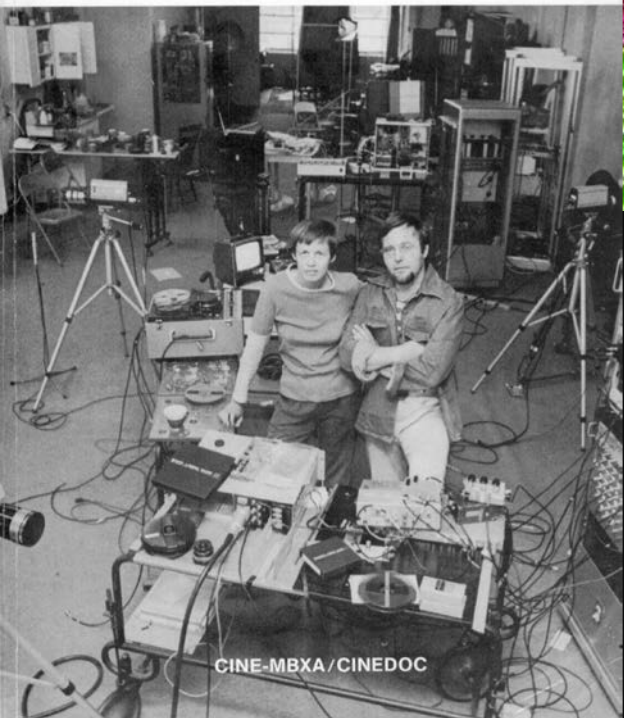
Speed! Technology! Destruction! The Italian Futurists (1909-1920)



Steina & Woody Vasulka (1932-2019, 1940-)

STEINA & WOODY VASULKA VIDÉASTES

1969-1984 : 15 ANNÉES D'IMAGES ÉLECTRONIQUES



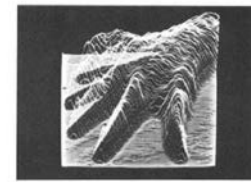
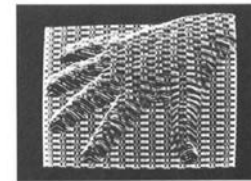
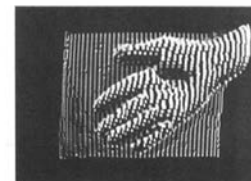
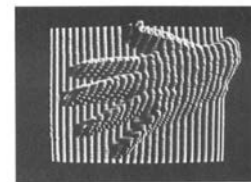
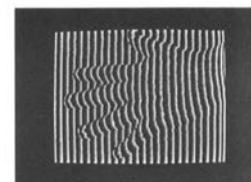
12. Le synthétiseur de son Putney.

13. A gauche : le prototype de l'incrustateur George Brown. À droite : la matrice à fiches.

14. La matrice de commutation à touches de George Brown.

15. Le programmeur digital de George Brown.

16. Le premier ordinateur des Vasulka (LSI-11).



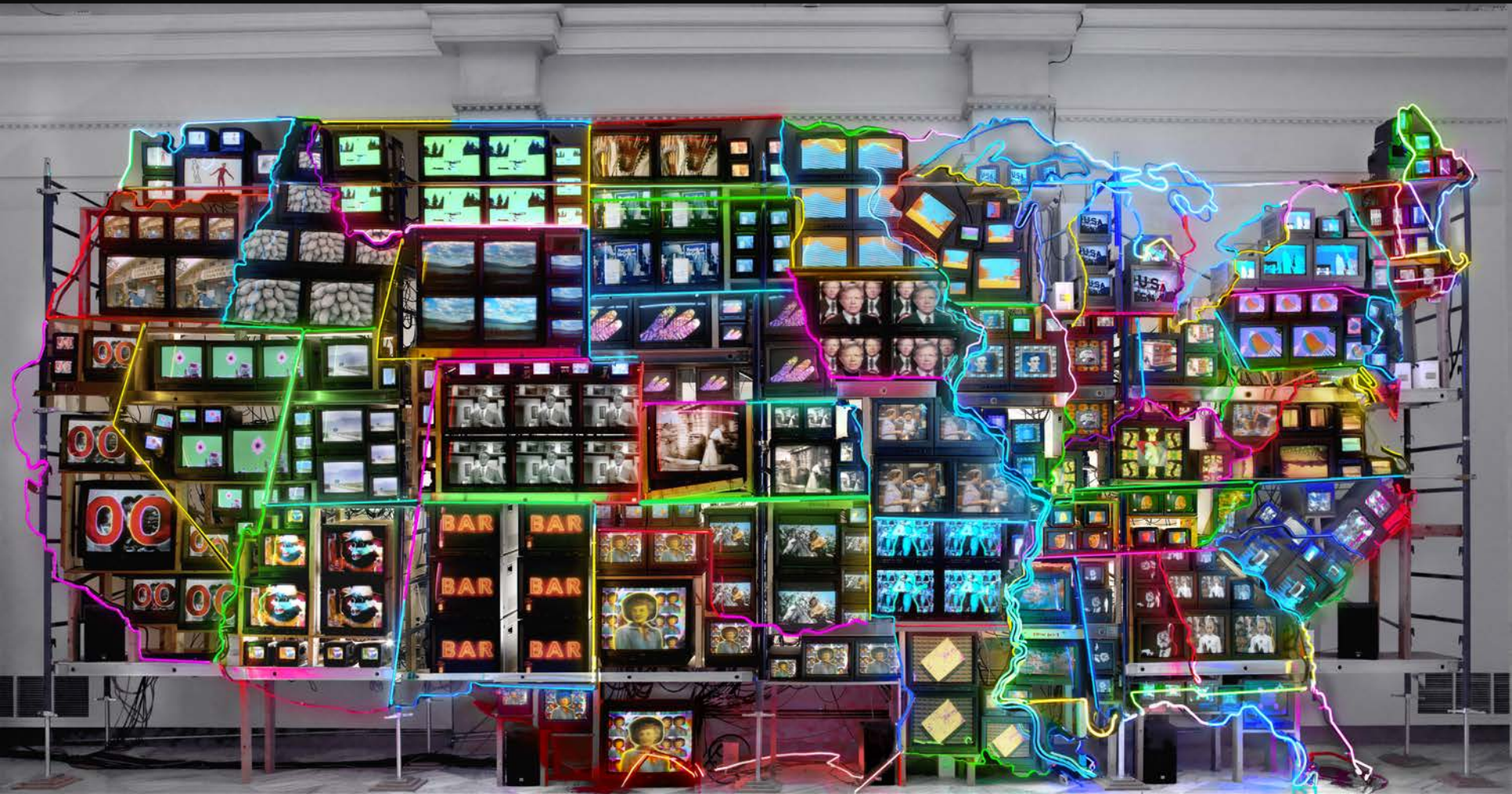
Ces codes de base : formes d'ondes sinusoïdales, triangulaires et carrées (111, N) ainsi que les fonctions Booléennes de l'Unité Arithmétique Logique d'un ordinateur digital (111, 0) sont souvent nommées CODE PRIMITIVE.

Ils constituent les bases minimales et essentielles à partir desquelles des codes supérieurs, analogues et digitaux, peuvent être synthétisés.

Outils spéciaux par : Jeffrey Schier - Digital Image Articulator, Rut/Etra - Scan Processor.

Woody Vasulka - Santa Fe, 17 juillet 1983

Nam June Paik (1932-2006)



“Equivalents II”, George Legrady (1992)

Shapes, as such, do not interest me unless they happen to be an
outer equivalent of something already taking form within me
Alfred Stieglitz

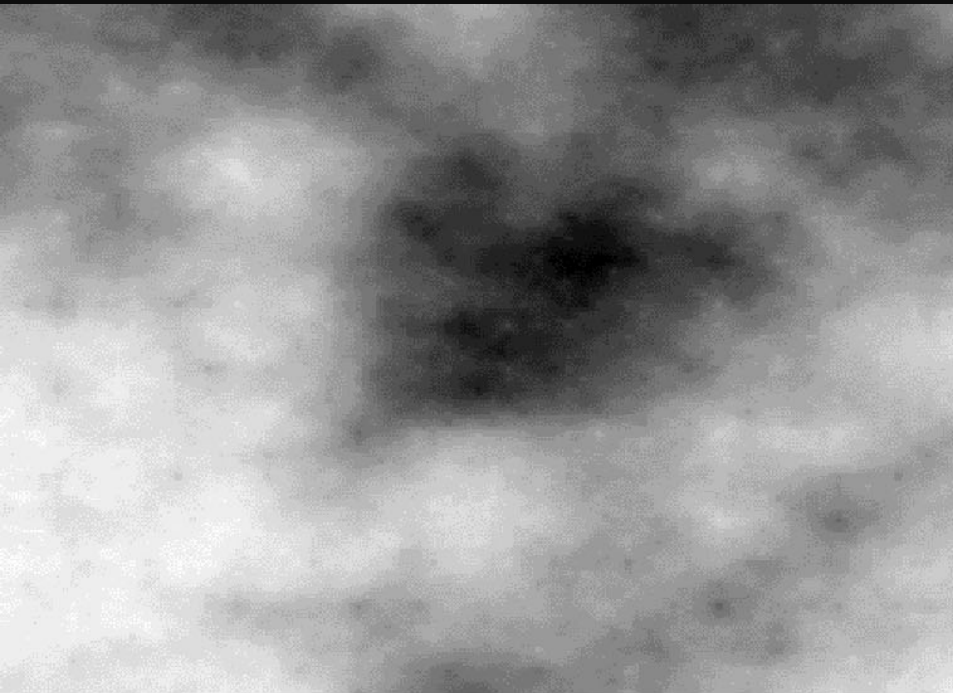
Noti...sential happens in the absence of noise
Jacques Attali



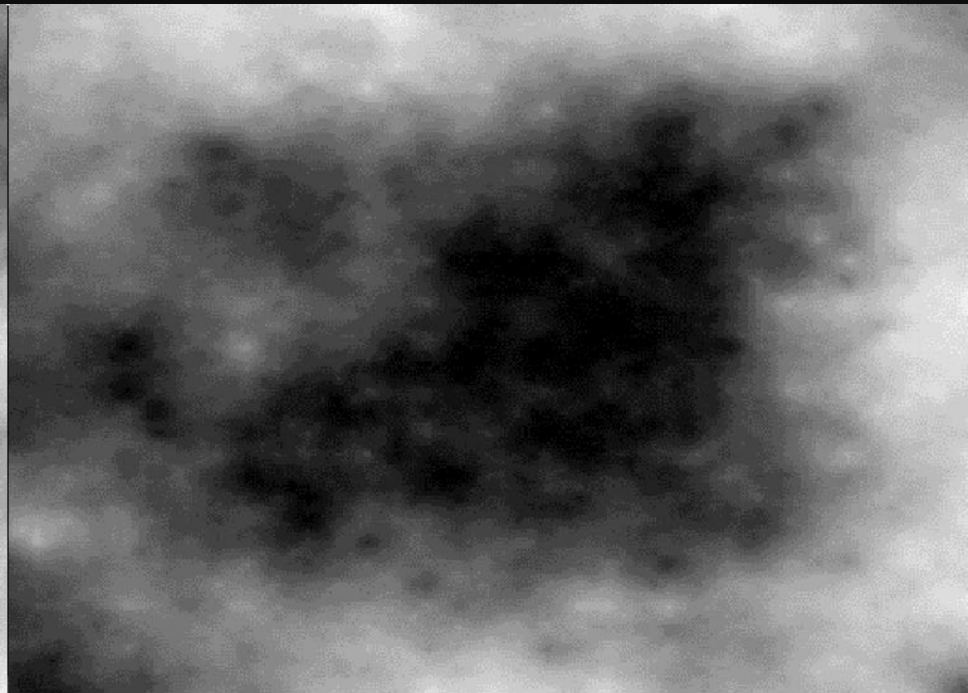
“Photography after photography”, Fotomuseum, Winthertur, Switzerland (1997)

“Equivalents II”, George Legrady (1992)

College Art Association (1990)

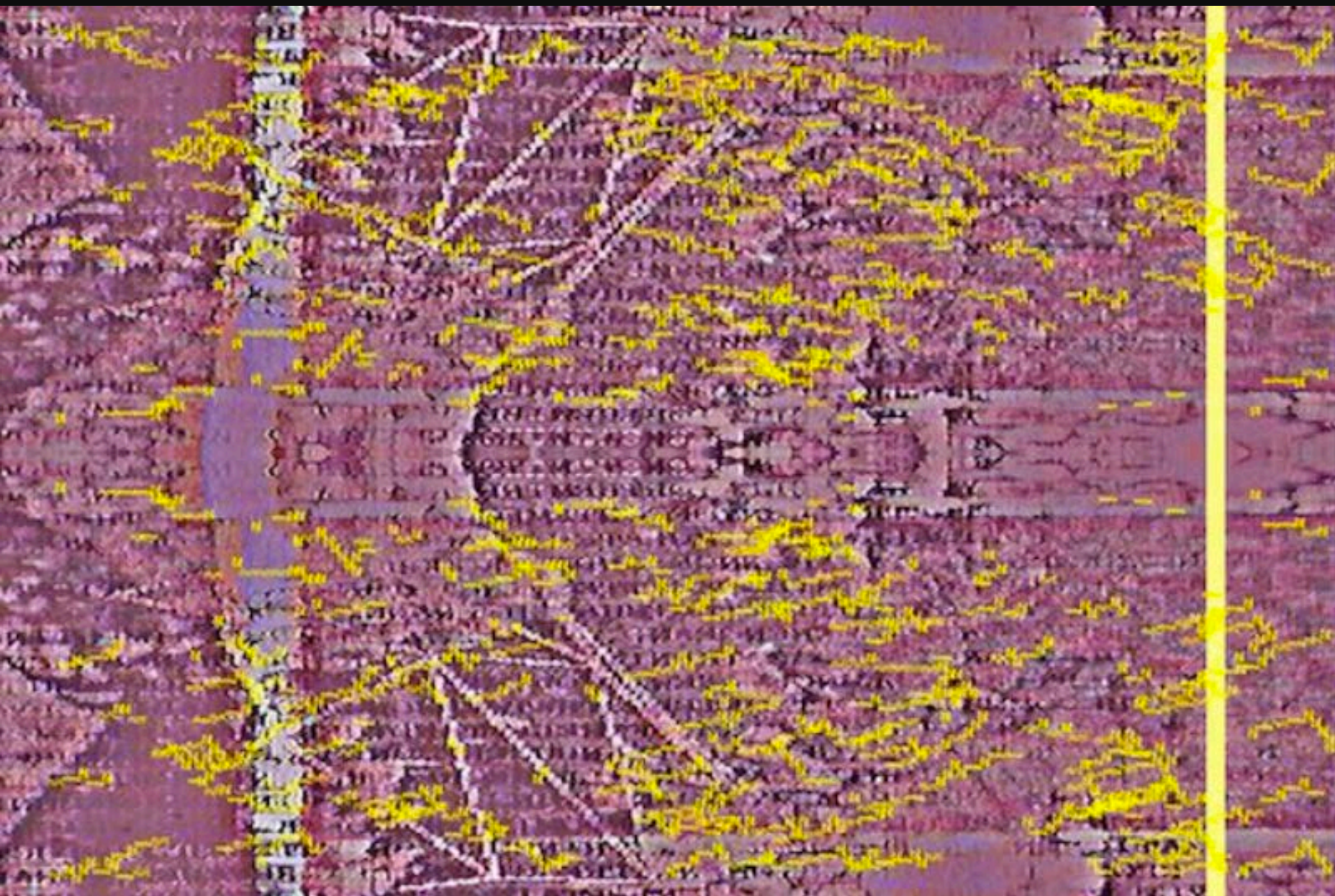


The siren song of Western consumerism is echoed by Kodak's presence in Hanoi.



Amy Rink of Novato, Calif., throwing out her latest batch of junk mail.

“Viral Attack Transmission”, Joseph Nechvatal (1993)



<https://www.vice.com/en/article/wnpgwb/artist-paints-with-artificial-life-and-computer-viruses>

Glitch Art, Rosa Menkman (2010)



<http://transferyallery.com/rosa-menkman/>



**The
Glitch
Moment(um)**

ROSA MENKMAN

Network⁰⁴
Notebooks

CONTENTS

ACKNOWLEDGEMENTS	5
INTRODUCTION	7
GLITCH STUDIES MANIFESTO	11
A TECHNOLOGICAL APPROACH TO NOISE	12
Linear Progression and the Myth of Perfect Transmission	12
Noise Artifacts	15
Encoding And Decoding: Compression Artifacts	15
A Vernacular Of File Formats	17
Orderly Chaos: Feedback Artifacts	26
The <i>Other</i> Noise Artifact: Glitch	26
THE PERCEPTION OF GLITCH	28
The Meaning Of Noise	28
The Glitch Moment(um): A Void In Techno-Culture	29
Technorealism And the Accident Of Art	31
A PHENOMENOLOGY OF GLITCH ART	33
The Predicaments Of Defining Glitch Art	33
Categorical Precursors: A Binary Approach To Glitch Art?	35
From Passive Appropriation Or 'Pure Glitch Art' To Active, 'Post-Procedural Glitch Art'	36
Post-procedural Glitch Art Or the Intentional Faux Pas	37
The Concept And Technique Of Ruin	40
Creating the 'Perfect Glitch' Using Critical Media Aesthetics	43
The Tipping Point of Cool: Critical Media Aesthetics' Becoming Commodities	44
FROM ARTIFACT TO COMMODITY	46
From Circuitbending to Simulation	46
From Databending to Transcoding	49
From Enchanting Affect To Filtered Effect	53
The Glitch Art Genre: Between the Void And Commoditized Form	55
The Genre Paradox	57
ORGANIZING GLITCH SPHERES	59
Glitch Art Networked	62
Glitch Sphere Relations	63
Some Final Reflections On The Glitch Spheres	64
THE EMANCIPATION OF DISSONANCE GLITCH	65
BIBLIOGRAPHY	67

The Perception Of Glitch

*Our taverns and our metropolitan streets, our offices and furnished rooms, our railroad stations and our factories appeared to have us locked up hopelessly. Then came the film and burst this prison-world asunder by the dynamite of the tenth of the second, so that now, in the midst of its far-flung ruins and debris, we calmly and adventurously go traveling.*⁰¹

- WALTER BENJAMIN

THE MEANING OF NOISE

To develop a categorization of noise for contemporary audio-visual media theory, I have used Claude Shannon's mathematical theory of communication. In his definition of informational noise, Shannon conveniently focused on the transfer of information between machines, leaving human elements and context out of the equation. Drawing on Shannon's model, I was able to divide digital noise into three basic categories of noise artifacts: *encoding/decoding artifacts* (which are most often referred to as compression artifacts), *feedback artifacts* and the 'other' corruptions known as *glitch artifacts* – artifacts for which the causes are not (yet) known. It is important to realize that the difference between each of these artifacts is not rigid, as the description of a glitch artifact can be understood as a de/compression or feedback artifact (and visa versa), depending on the viewer's knowledge of the technology. In the context of human-computer communication, I also deviate from Shannon and Weaver and believe that the concept of noise becomes more complex as it connotes meaning and translation. Consequently, human-computer definitions of noise must also include social parameters and become more complex, inevitably negotiating questions of context, perception and aesthetics.

The etymological definition of noise refers to states of aggression, alarm and powerful sound phenomena in nature (*'rauschen'*)⁰². When the concept of noise is approached within a social context, noise does not exist independently, but only in relation to what it is not. However complex or inclusive noise appears as a signifier, it is always a kind of negativity: it stands for unaccepted sound, not music, invalid information or the absence of a message. Noise is unwanted, other and unordered. Accordingly, there is also no unequivocal cultural definition of noise, because in the end, what noise is and what noise is not, is a social matter. As James Brady Cranfield-Rose writes, 'noise is a "cipher", a question mark, forever eluding fixed definitions'.⁰³ Furthermore, whichever way noise is defined, its negative orientation also has positive, critical dimensions. Noise tends to reflexively stage a reconsideration or re-view its opposite – the world of meaning, norms and regulations, goodness, or beauty.⁰⁴

01 | Walter Benjamin, 'The Work of Art in the Age of Mechanical Reproduction', in Hannah Arendt (ed.) *Illuminations*, New York: Schocken, 1968, pp. 219-254, p. 236.

02 | Torben Sangild, *The Aesthetics of Noise*, Copenhagen: Datanom, 2002. www.ubu.com/papers/noise, p. 5-8.

03 | James Brady Cranfield-Rose, *Tick-tick-tick-tick-tick... Oval, the glitch and the utopian politics of noise*, unpublished master thesis, Burnaby, Canada: Simon Fraser University, 2004, p. 13, <http://lib.ublib.sfu.ca/handle/1892/8961>.

04 | Paul Hegarty, *Noise/Music: A History*, London and New York: Continuum, 2007, p. 5.

A Phenomenology Of Glitch Art

*"Failure" has become a prominent aesthetic in many of the arts in the late 20th century, reminding us that our control of technology is an illusion, and revealing digital tools to be only as perfect, precise, and efficient as the humans who build them.*⁰¹

- KIM CASCOE

THE PREDICAMENTS OF DEFINING GLITCH ART

Artists often find themselves on a frontline, reflecting on the cultures, politics and technologies of their time. Over the last decades, audiovisual media and computers have gradually gained more and more importance in an art field that is still fundamentally ruled by classical media forms and genres. Noise itself is of course not new; similarly, contemporary glitch art relates to a long history of noise art and artists battling in different ways against media forms and their flows and conventions, including especially what I have outlined as the convention of transparent immediacy.

While not being new, noise art arises unpredictably in new forms across different technologies and cultural scenes. Over time, noise artists have migrated from exploring the grain, the scratching and burning of celluloid (for example, *A COLOUR BOX* by Len Lye, 1937) to the magnetic distortion and scanning lines of the cathode ray tube (a significant work being Nam June Paik in *MAGNET TV* in 1965). Subsequently, glitch artists wandered the planes of phosphor burn-in, as Cory Arcangel did in *PANASONIC TH-42PWD8UK PLASMA SCREEN BURN*, in 2007. With the arrival of LCD (liquid crystal display) technologies, dead pixels were rubbed, bugs were trapped between liquid crystals or plastic displays and violent screen cracking LCD performances took place (of which my favorite is %SCR2, by Jodi, under the Pseudonym *webcrash2800* in 2009).

To some artists, myself included, it has become a personal matter to break the assured informatic flows of media. While normally, transparent media screens generate conventional impressions of immediacy, there is a desire to force the viewer to think beyond his comfort zones. Glitch artists make use of the accident to 'disfigure' flow, image and information, or they exploit the void – a lack of information that creates space for deciphering or interpreting the process of creating (new kinds of) meaning. Through these tactics, glitch artists reveal the machine's techné and enable critical sensory experience to take place around materials, ideologies and (aesthetic) structures. Their destructive or disfiguring processes have no technological name, definition or explanation (yet). For this reason, it is necessary to not only define and categorize glitch at technological levels, but also to look closely at how specific media are exploited on a more complex techno-cultural level. The artists I discuss here include Ant Scott, 5VOLT CORE Gijs Gieskes and Jodi. Of course many other artists whose practices are invested in the moment(um) or culture of glitch could have been included here. An actual historiography would for instance also include signal processing artists like Karl Klomp, Lovid, Morgan Higby-Flowers and Max Capacity, aesthetic glitch-tricksters like Jon Satrom, jonCates, fabric artist Melissa Baron, and databend generative artists such as stAllio!, glitch-irion Pixelnoizz and Hellocatfood. This historiography is still unwritten (partly because it is still in progress).

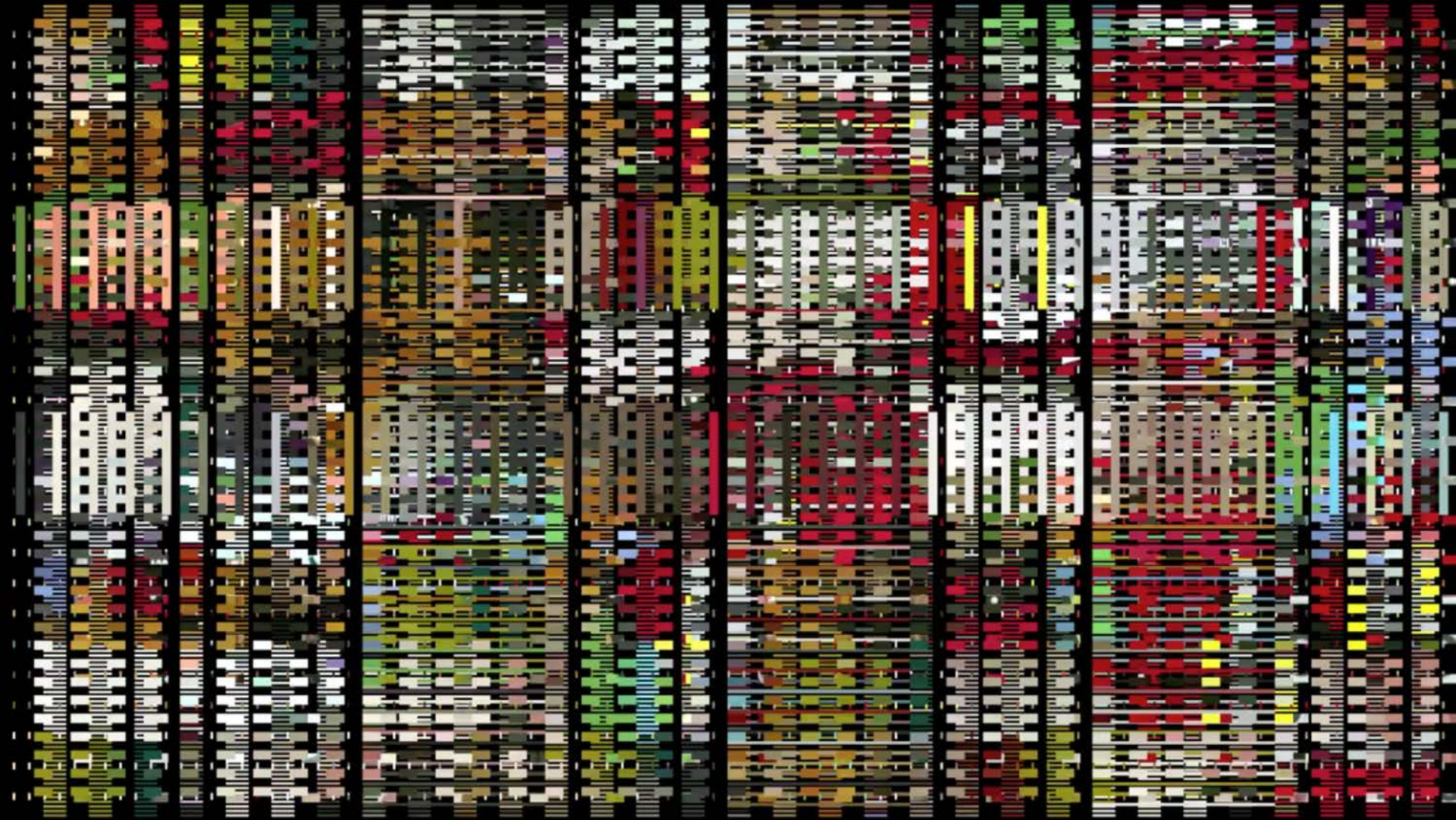
01 | Kim Cascoe, 'The Aesthetics of Failure: Post-Digital Tendencies in Contemporary Computer Music', *Computer Music Journal* 24.4 (Winter 2000): p. 13.

“Mathematical Theory of Communication”, Casey Reas (2014)

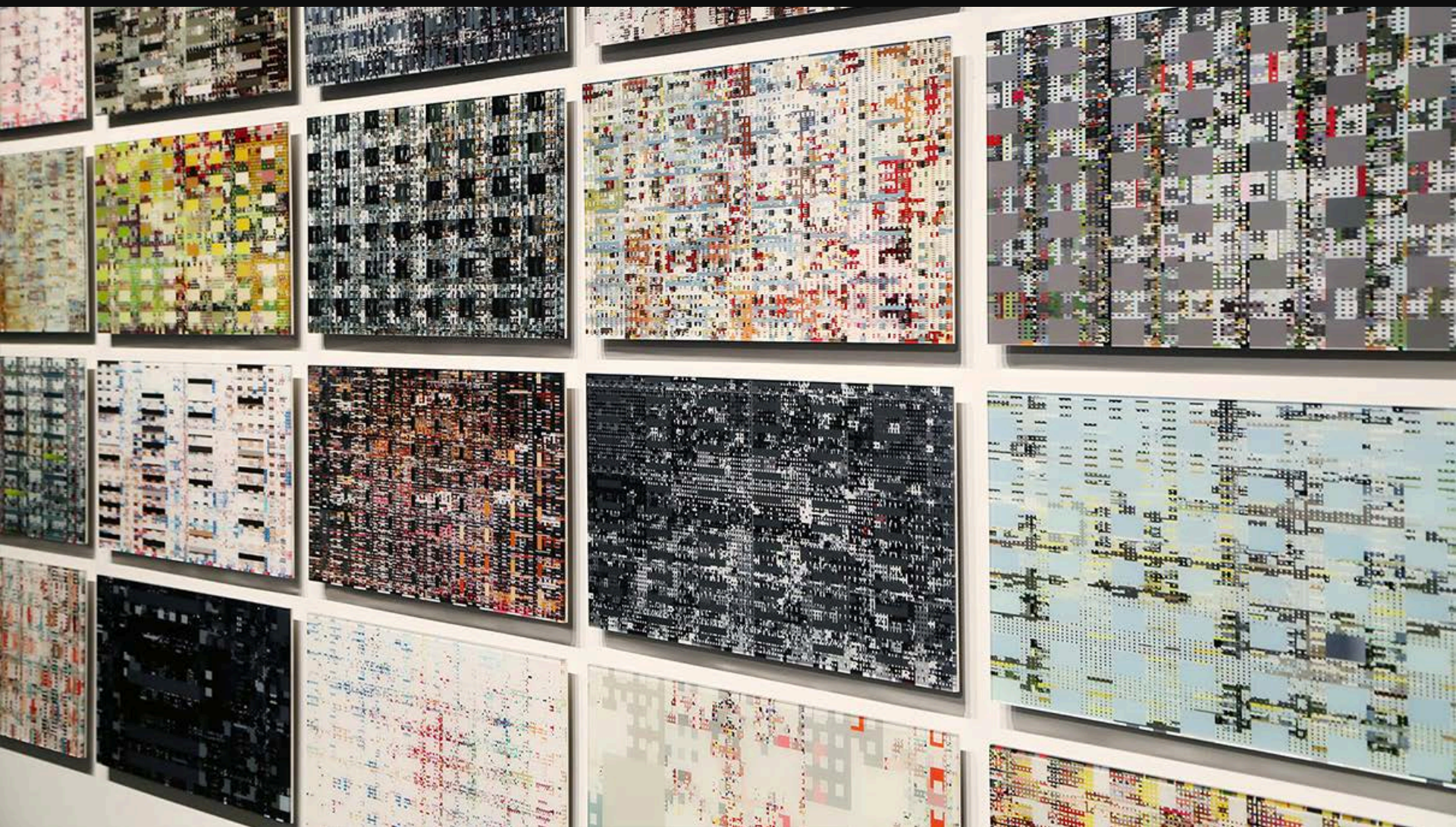


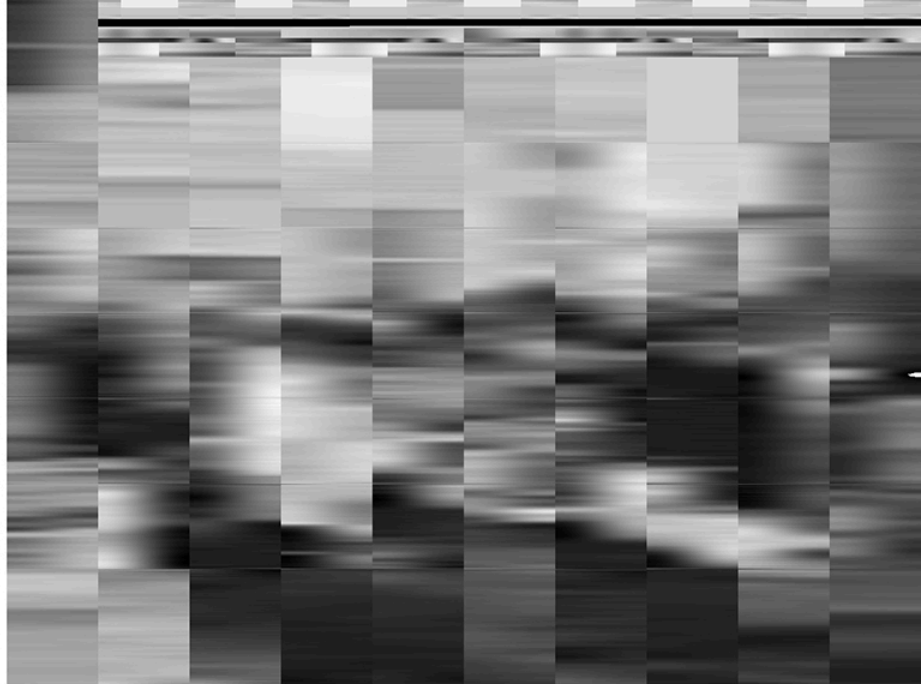
https://reas.com/mathematical_theory/

“Signal to Noise”, Casey Reas (2012)



“Control Room (You Haven’t Won)”, Casey Reas (2013)





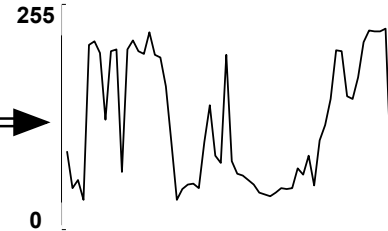
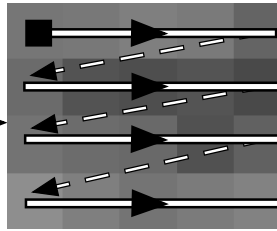


Sound Synthesis

Select Image Region

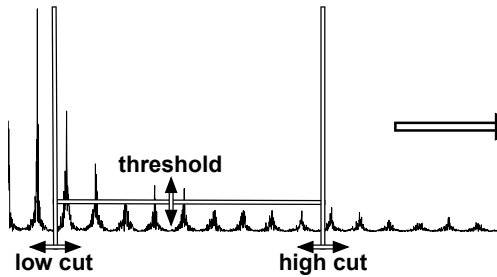


Raster Scan Pixel Values

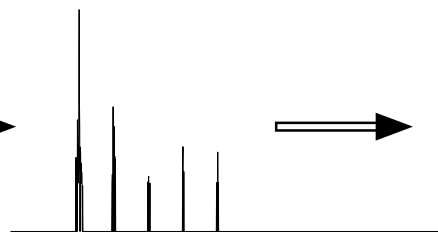


FFT

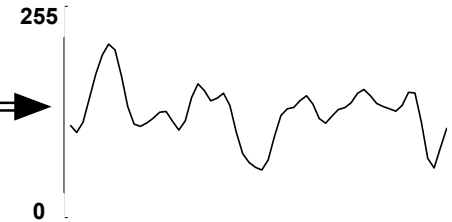
Apply Filters



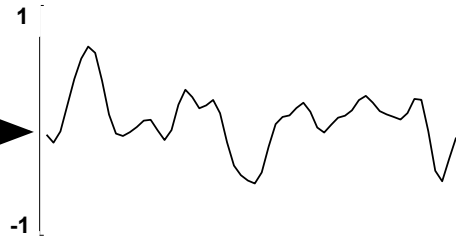
Filtered Spectrum



IFFT



Audio Wavetable



Rescale

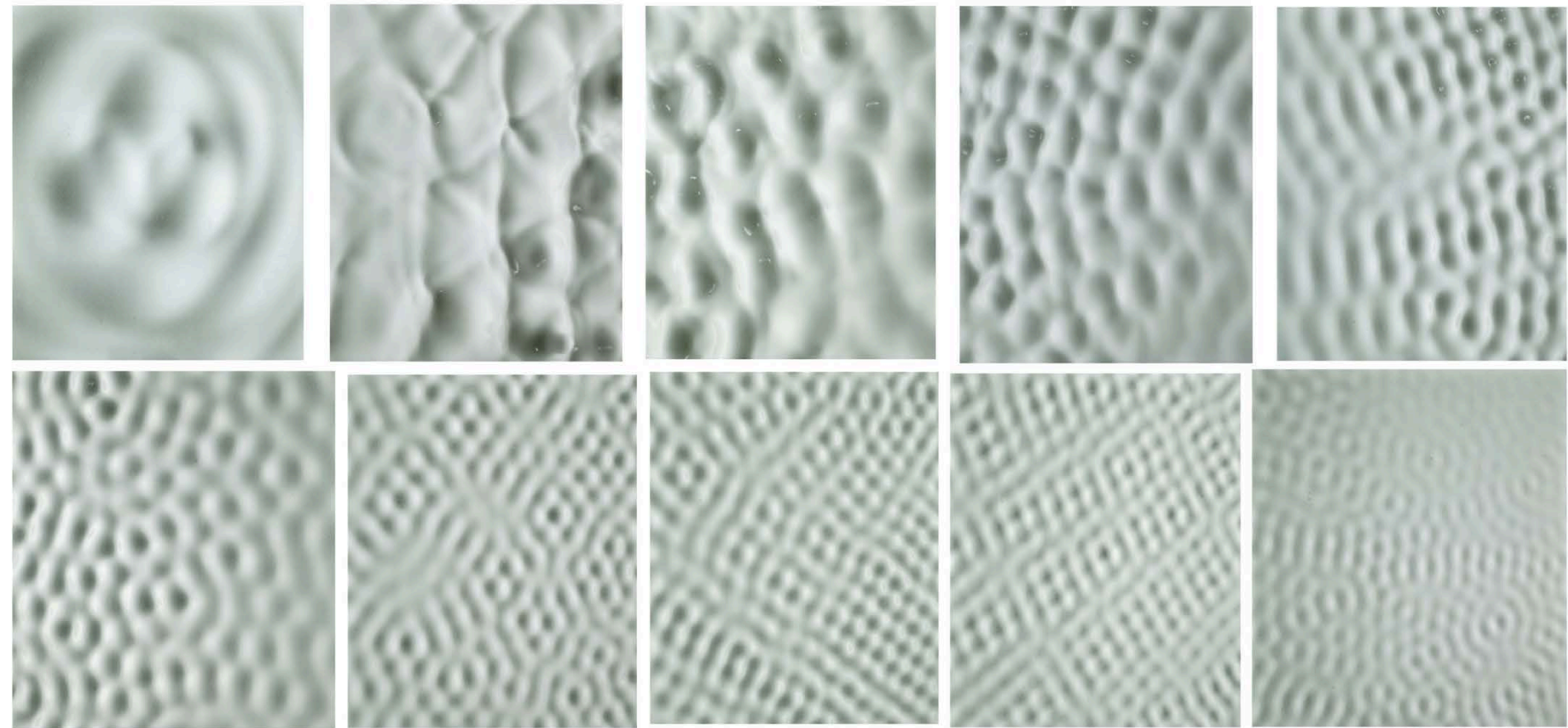
Spatialize

Multi-Channel Sound

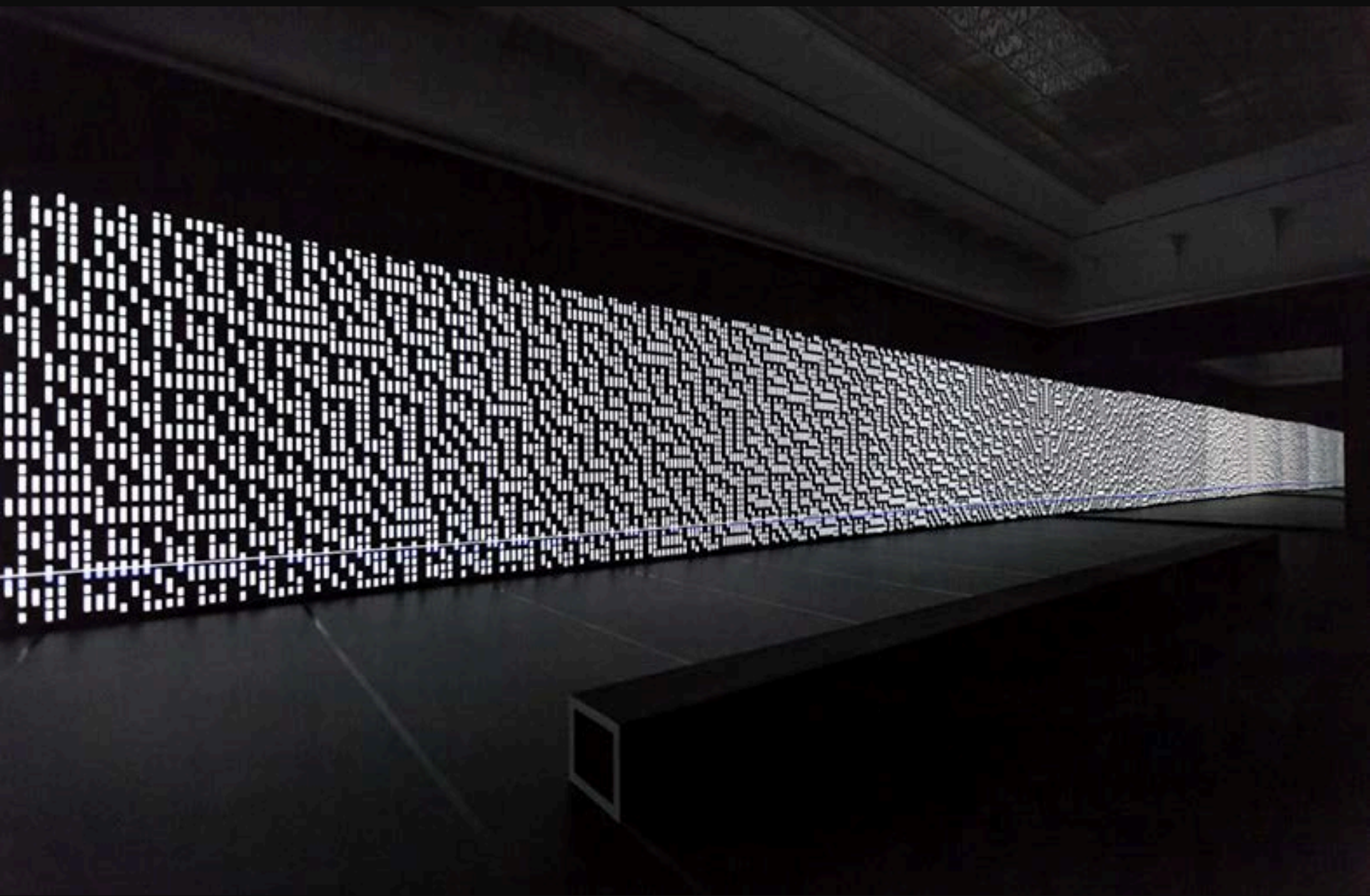
Final Sound and Image



“Milch, 10 Hz, 20 Hz, 25 Hz, 40 Hz, 95 Hz, 110 Hz”, Carsten Nicolai (2000)



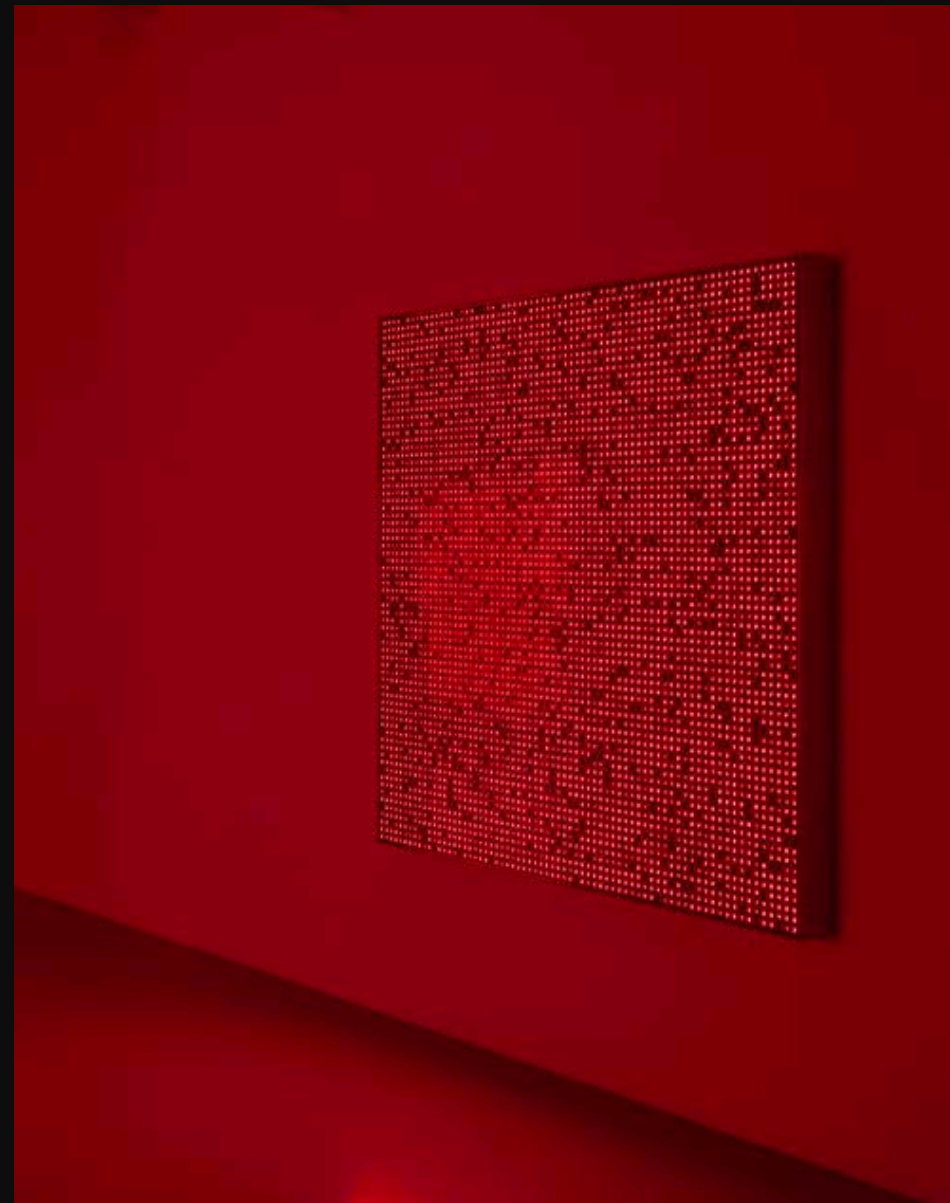
“Unitape”, Carsten Nicolai (2015)



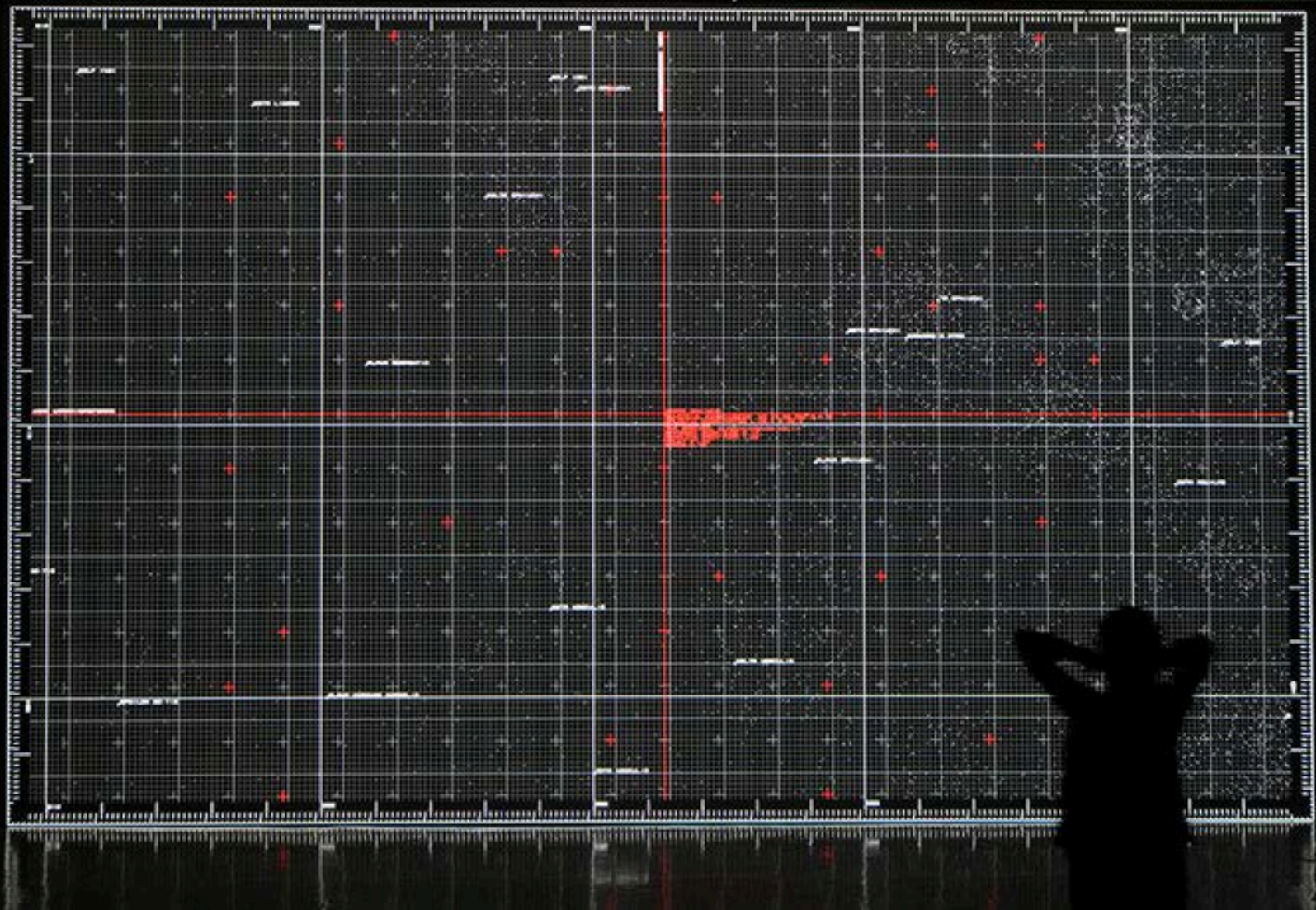
“Mega Death”, Tatsuo Miyajima (1995)



“Innumerable Life / Buddha”, Tatsuo Miyajima (2019)



“data.tron” (WUXGA version) , ryoji ikeda (2011)



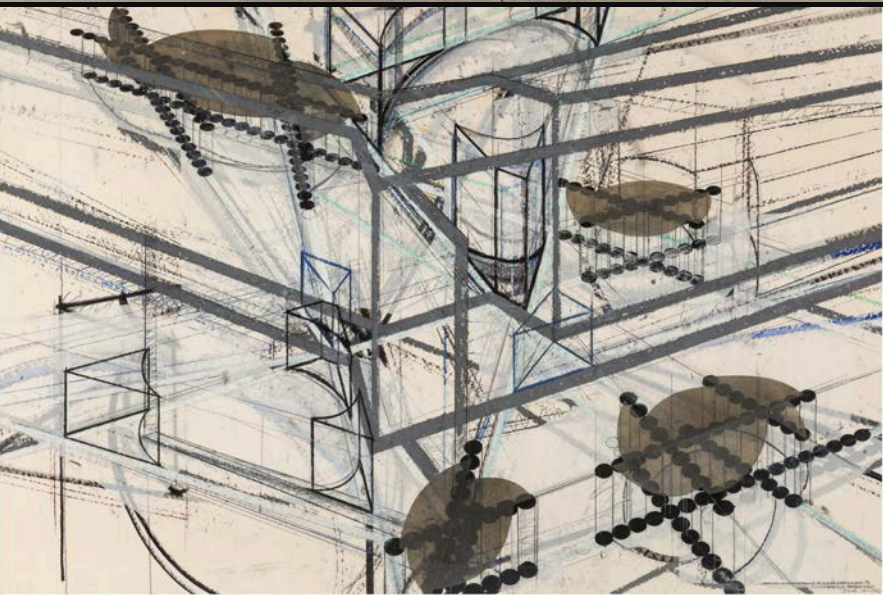
“data.flux” (12 XGA version) , ryoji ikeda (2017)



“data.tron” (3 SXGA+ version), ryoji ikeda (2009)



Barry le Va (1941-2021)



Videos

Brownian Motion in Nature: <https://www.youtube.com/watch?v=89LP5pHWxM8>

Stephen Wolfram: [A New Kind of Science](#)

Vasulka: [Transformations](#) | [Digital Images](#) | [Artifacts](#)

Casey Reas: <https://vimeo.com/144161213>

Voice of Sisyphus: <https://vimeo.com/239322215>

Carsten Nicolai: [a \[alpha\] pulse](#)

Tatsuo Miyajima, Australia: <https://www.mca.com.au/artists-works/exhibitions/tatsuo-miyajima-connecting-with-everything/>

Rioji Ikeda: [Data-verse](#) | [data.matrix](#) | [code.verse](#)

Barry le Va: <https://www.davidnolangallery.com/artists/barry-le-va>

To be continued...