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Art, Complexity and Uncertainty. A Conversation With David Familian

Arantzazu Saratxaga: It is a pleasure to speak with David Familian about complexity and art, specifically regarding an exhibition he is curating at the Bell Center for Art and Technology at UCLA, titled Future Tense: Art, Complexity and Uncertainty. This exhibition showcases both emerging and established contemporary artists who explore complexity from various perspectives, scales, and technologies, including robotics, evolutionary biology, and bacterial intelligence, among others.

David Familian is a well-respected artist and curator. He began his career in photography but has since transitioned into new media. His artistic practice has influenced his diverse roles in web production for artists and institutions such as the Walker Art Center and the University of Minnesota. He has also taught studio art and critical theory at the Minneapolis College of Art and Design and the San Francisco Art Institute, among other places. Since becoming the curator at the Bell Center for Art and Technology in 2008, he has curated more than 30 exhibitions, focusing on artists' projects at the crossroads of new media, scientific innovation, and contemporary socio-political issues. It is a great pleasure to have you here, and I look forward to our conversation. If you agree, I will begin with the questions.

David Familian: Okay, thank you for doing this.

Arantzazu Saratxaga: Let's start with the exhibition's subtitle: *Future Tense: Art, Complexity, Uncertainty*. The title gets to the heart of the complexity problem. By the complexity problem, I mean the different approaches to describing, understanding, or needing to describe and understand complexity. The wonderful exhibition you have curated offers an artistic approach to complexity. Could you briefly tell us where art stands in relation to complexity compared to science?

David Familian: I believe both art and science fail to recognize how much the general public needs to understand complex systems. Artists excel at highlighting the consequences of global warming, pollution, and other issues, but they seldom frame these in the context of complex systems, except for a few, like Newton and Helen Harrison or Lauren Bond, to name a few. In my exhibition, I aimed to emphasize art that doesn't necessarily focus on the outcomes, even though there are works, such as Lynn Hershman's Piece or some

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others, that address the results of complex systems. Instead, I wanted to provide viewers with a visceral sense of what a complex system entails, emphasizing that there is no permanent order or disorder. It's a continual ebb and flow, and the pursuit of absolute order or clarity is destined to fail. I hope it fosters not just acceptance but an understanding that the oscillation of order and disorder surrounds us. What's crucial is that every system, whether linear or dynamic, operates through contingency and iteration, with the differences lying in how the variables interact. The exhibition centered on the implications of complex systems. I believe art is currently the best medium for expression because people are far more inclined to engage with complexity in a work of art than in a brief news story. Therefore, I reiterate that art is the most powerful tool, not purely for explanation. With some pieces, we specifically instructed the artists that we desired nothing didactic; I wanted the works to resonate deeply with the viewer. My goal for the exhibition was to create a kind of shock.

Arantzazu Saratxaga: And future tense? Does the title refer to something in particular?

David Familian: Well, I believe there are several issues to unpack in the title. The phrase carries a double meaning—referring both to the use of future tense in grammar and to a deeper sense of growing tension throughout the world. Furthermore, systems cannot be viewed in isolation, as they constantly interact with one another through feedback, creating chaos, emergent behavior, and self-organization, all of which contribute to uncertainty.

For instance, climate change, pandemics, social unrest, and geopolitical turmoil arise from complex interactions between various elements, leading to unpredictable and dynamic outcomes. Another key aspect of complex systems is the presence of unknown factors that influence them, ensuring that unpredictability is always a factor. As these phenomena continue to unfold, tension and uncertainty will persist—hence the exhibition's title.

Complexity as a Wicked Problem

Arantzazu Saratxaga: In the 1970s and 1980s, complexity became a scientific statement of the natural sciences, especially in the field of theories of the self-organisation of non-equilibrium systems, the chaos theories of non-linear physics, as a theory of the self-formation or emergence of order and structures.

Although it was already in the late 1950s, in the context of systems theories, I am thinking of Ludwig von Bertalannfy's General Systems Theory. Complexity was a new phenomenon of system organisation to be explored and a central theme of cybernetics. You have just organized an exhibition on the theme of complexity and art in the 21st century. My question is: Why complexity and art today? Is complexity back? What has changed in the last 50–80 years? In what way is complexity an issue today?

David Familian: The concept of complex systems began in science during the 1970s and 1980s. It took nearly 100 years for science to shift from the goal of certainty to utilizing probability to assess various possibilities of a system. What has truly changed is that the problems we face today are significantly different from those of the past. Rittel and Webber define this new category of problems as wicked problems. A wicked problem is a complex issue that defies complete definition, for which there can be no definitive solution since any solution generates further problems. Solutions are not classified as right or wrong, good or bad, but rather as the best possible course of action at the time. Such problems are not morally wicked but rather insidious in that they resist all ordinary attempts at resolution. Furthermore, since wicked problems are part of the society that creates them, any solution necessitates a call for change within that society. In addition to new forms of governance and shifts in lifestyles, tackling wicked problems demands a new approach to research and decision-making. Instead of adhering to the fixed paths of established research routes, addressing wicked problems requires researchers and decision-makers to explore a wide array of investigative avenues. Rittel and Webber.

Arantzazu Saratxaga: Yes, complexity is now a very tangible reality. Complexity has moved from being a scientific or organizational phenomenon to being clearly a social phenomenon.

David Familian: The need to communicate complexity broadly exists because we all face the same issue. The goal is to encourage the general public to engage with complex systems in a way that resonates with them. For me, this is just the starting point. What I found most effective was how the spaces felt. There's a strange sense of wonder about what these elements are and how they express themselves in various ways. I see this as a kind of cabinet of curiosities showcasing complex systems and chaos, allowing us to observe what's present. When you entered the first room, you experienced an atmosphere of chaos and disorder, with some indigenous artifacts contributing to that feeling. Then, there was a darker space that felt more liminal. However, we can begin to present this concept of complex systems to the world; this approach fosters critical thinking and connection.

Arantzazu Saratxaga: In the 1970s, the sciences took up the "emergence of order" as a topic of complexity, namely how order emerges in an unstable system. Today, this question has been taken up again by a computational discourse, and actually the question is actually how the algorithms creates "or-

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ders" by reading patterns. How does the artistic perspective relate to the question of order out of chaos?

David Familian: I would argue that it's not exactly the emergence of order for these systems; they are never completely ordered or completely chaotic. Emergence is about adaptability, which represents a kind of break from total chaos or increasing entropy. The interesting aspect of bringing in the second law of thermodynamics is not the emergence of order from disorder but rather how complex systems resist entropy. In complex systems, chaos is a form of entropy since chaos is a temporary state, while entropy progresses toward total disorder. There exists a tension between a system's movement toward entropy and how complex systems adapt and adjust to changing conditions, both with and without energy. As long as energy remains in a complex system, it will resist entropy, but it won't eliminate it completely.

UNCERTAINTY and COMPLEXITY in Discussion

Arantzazu Saratxaga: Well, I think it's great to put the question of uncertainty at the centre of a dialogue between complexity and art. Uncertainty is a mathematically consequence of complex systems. I am thinking of Prigogine's book "The End of Certainty", in which uncertainty is proclaimed as the principle of a new paradigm in the scientific practice of complex systems. 30 years after the book, do you think we have accepted uncertainty as the core of a new paradigm, or does scientific practice still perceive uncertainty as a consequence of lack of information and persist in eliminating it?

David Familian: I think that's true. Prigogine's book is an important resource for understanding the move from certainty. Complexity represents more than just a paradigm shift; it resembles the transition from the Age of Wonderment to the scientific method of experimentation and observation. This is profoundly conceptual and not comparable to the shifts from Newton to Einstein to Heisenberg. We are only beginning to explore new forms of investigation using computer models and AI. But if history is any indication, it could take 100 years or more before we establish the proper method to understand adaptive complex systems.

There is an important distinction to be made regarding the differentiation between ignorance and uncertainty. We often perceive uncertainty as a form of ignorance these are two distinctly different ideas: ignorance is the inability to observe and quantify all the internal workings of a system, while uncertainty arises from the emergent (adaptive) properties and a system's potential to self-organize in new and unexpected ways.

In Michael Smithson book *Ignorance and Uncertainty: Emerging Paradigms* explains it this way:

Ignorance is usually treated as either the absence or the distortion of 'true' knowledge, and uncertainty as some form of incompleteness in information or knowledge. To some extent, these commonsense conceptions are reasonable, but they may have deflected attention away from ignorance by defining it indirectly as nonknowledge. From at least the time of Plato, Western philosophers and scientists have worked as if infallible, demonstrable knowledge were an attainable goal. Modern epistemology notwithstanding, vestiges of the Thomistic distinction between "scientia" and "opinion" remain with us, and the most common approach to ignorance has been absorption either elimination or absorption by exercising some version of the 'scientific method'.[1]

Arantzazu Saratxaga: Yes, the history of science shows us that every scientific practice is also embedded in a certain discourse. That is, the link between ignorance and knowledge is the axis of a scientific practice, with positivist positions insisting on fighting it, until science becomes an instrument of knowledge and also of domination.

David Familian: Science has tried to explain this to us. They've suggested that it's always possible to draw correlations between cause and effect. Thus, there's this peculiar notion that after 300 years, we came to believe we would eventually prove everything. When we attempt to address problems in our own lives or in the world, we tend to impose this outdated way of thinking, which holds that we can correlate cause and effect and then resolve issues.

Arantzazu Saratxaga: Yes, I think that's what you're talking about, which is extremely important, the relationship between lack of information – ignorance – and uncertainty. In any case, the viewer in the exhibition is confronted with this ambiguity in the exhibition: that you don't know whether it's ignorance or uncertainty. And that is wonderful. From a philosophical point of view, the difference between ignorance and uncertainty is that if the former consists of a "lack of information", the latter reveals an asymmetry in linear causality, namely that the so-called Newtonian world breaks down, which is completely at odds with the Laplacian deterministic world, isn't it?

David Familian: Yes, to dig a little deeper—Pierre-Simon Laplace's concept of an intelligence capable of predicting every event, past, present, and future, represented the ultimate goal of science until the late 19^{th} century. Ironically, his so-called "Laplace's Demon" was introduced in a foundational discussion of probability. Laplace recognized that all the data we collect is, in principle, not as predictable as Newtonian mechanics. He famously defined probability

[1] Smithson, Michael. 1989. *Ignorance and Uncertainty: Emerging Paradigms*. New York: Springer-Verlag, p. 1

as the ratio of favorable outcomes to the total number of equally likely outcomes. In many ways, Laplace understood that probability was necessary for most areas of science, even as he envisioned a future where it might no longer be needed.

Arantzazu Saratxaga: Does this mean to you that the intelligence that sees everything, i. e. superintelligence, is a quality that all beings possess and that is partly attributed to intelligence?

David Familian: Yes, whether it is a superintelligence or extra-human like a computer but what is significant is using mentioning God or human beings, which you would expect.

Arantzazu Saratxaga: Gregory Bateson had said something beautiful in his book Ecology of Mind, namely that all organized beings, whether organic or inorganic, have their intelligences.

David Familian: This is not a simple question but a profoundly complex one. My first thought is that organized bodies exhibit intelligence, but this intelligence would not be possible without the interplay of both their organic and inorganic components.

Arantzazu Saratxaga: Yes, I think complexity speaks much more to an intelligence of processes than to an intelligence that sees processes as objective realities. Complexity speaks of an intelligence of processes, which is a problem for linear thinking. I am thinking of theories of deterministic chaos, i. e. processes that are sensitive to initial conditions, where the outcome is not proportional to the initial conditions. Does complexity have to say goodbye to the scientific dream that there is this demon that observes and knows everything?

David Familian: Yes, Chaos can't truly be separated from complexity, yet when chaos is studied, certain aspects can be isolated to better understand how initial conditions influence outcomes. For instance, if you release one balloon and then another, it's impossible to do so under exactly the same conditions or at precisely the same time. That slight difference in initial conditions results in exponentially divergent paths of movement—this is the essence of chaos. Of course, the balloons aren't drifting in a vacuum; they're moving through the complex, ever-changing system of the atmosphere, which acts upon them in unpredictable ways.

Scientists further explore chaos using mathematical tools like bifurcation diagrams, which demonstrate how small variations in initial conditions can produce dramatic differences in outcomes. A bifurcation diagram starts at zero, and as values increase, the system begins to split—first into two, then four, then eight, sixteen, and so on. Around the point of 3.6, the system transitions into chaos. This serves as a striking example of iteration, where the output of one cycle becomes the input for the next, revealing how complex behavior emerges from seemingly simple rules.

A great literary representation of this concept appears in Tom Stoppard's play *Arcadia*. The story follows a teenage girl, a mathematical genius, who develops equations predicting chaotic behavior long before computers exist. A century later, when her equations are run through a computer, they reveal the presence of chaos. The play masterfully blends humor with the revelation of this "magical" mathematical property. Similarly, philosopher Yuk Hui explores this process in *Recursivity and Contingency*, where he examines the iterative nature of systems with the same fascination Stoppard conveys in his play.

Arantzazu Saratxaga: Cybernetics was a vast new field of knowledge that emerged in the post-war period. It was dedicated to feedback and made it the subject of a new science and new thinking, system thinking. What is the difference between complexity and systemic thinking?

David Familian: I believe the shift from cybernetics to complex systems, and ultimately to systems thinking, is essential. Cybernetics initially emerged as both a conceptual and scientific approach to understanding control. However, as adaptive complex systems became a dominant framework for analyzing large-scale, intricate systems, cybernetics lost some of its scientific prominence, even though it remains a foundational concept within complexity science. I asked Roy Ascot during a recent Zoom call why there isn't a closer relationship between cybernetics and complex systems. He answered that the connotation of cybernetics is viewed through the lens of first-order cybernetics. When approaching a problem, purely scientific analysis is often insufficient. As mentioned earlier, wicked problems cannot be solved within a fixed timeframe. This distinction becomes particularly evident in sociological, political, and governmental policy discussions—areas where traditional problem-solving approaches fail to account for the interconnected nature of issues. Unlike the study of physical complexity, such as weather patterns, addressing urban planning and social challenges required a new perspective—one that integrated elements of cybernetics while also necessitating new methodologies.

Stafford Beer, an early cyberneticist, applied systems thinking to the corporate world, recognizing its potential for managing complexity. The term *systems thinking* itself was coined by Barry Richmond in 1987. He succinctly described its core challenge: we must learn to see both the forest and the trees simultaneously—arguably one of the most difficult cognitive tasks any of us can undertake.

Arantzazu Saratxaga: I think you also said something very interesting, and I think that perhaps this is the difference between a cybernetic system and a complex system. The focus of cybernetics may be self-regulation, negative feedback. But complexity is more about instability, collapse. Heinz von Foerster, for example, in his article *Self-Organisation and its Environments*, asked how much entropy a system can sustain. When he asked that question, he was thinking about the limits and boundaries of self-regulation. But complexity doesn't think about that. Complexity is more about positive feedback. Does that make sense to you?

David Familian: Yes, Ashby. He used the word "complexity" in some of his writings and stated that scientists had changed their methods to study nature. However, I find it ironic that he believed homeostasis was the answer. Thus, he remained a first-generation cyberneticist because he thought it could be controlled. Despite his assertion that science needed to change its approach. In 1959, the classic paper "What the Frog's Eye Tells the Frog's Brain," by McCulloch, Pitts, Jerome Lettvin, and Humberto Maturana, prompted a meeting on second-order cybernetics

Arantzazu Saratxaga: Self-Regulation is a way of control?

David Familian: Self-regulation is a fundamental form of control in first-order cybernetics. However, second-order cybernetics shares a much closer relationship with complex systems, particularly in how feedback loops influence system behavior. With the advent of computer models, complex systems can now be simulated, allowing us to observe dynamic interactions in ways that were previously impossible.

One of the most critical implications of complex systems is that they are influenced by both internal and external factors. A clear example is how viruses can affect biological organisms. Similarly, in financial markets, Wall Street has employed increasingly sophisticated algorithms to predict stock market behavior. While these models can be effective for a time, they are inherently limited by unforeseen disruptions. The 2008 financial crisis illustrates this point: a new financial product—mortgage-backed securities (MBS) and credit default swaps (CDS)—was introduced into the system. Much like a virus, these products propagated through the financial system, with each iteration becoming more unstable as riskier mortgages were added. This serves as a strong example of how external elements can destabilize a complex system in unpredictable and often catastrophic ways.

Arantzazu Saratxaga: And what about science? Doesn't complexity science fall into the ambition of controlling unpredictable processes with algorithmic techniques? Science may understand complexity as an objective real thing outside of observation and the epistemic question is about how to measure complexity. Isn't this determinism supported by scientific positivism, i. e., that the orders created by algorithms are true, and a blind faith in the power of computational simulation methods to simplify complexity?

David Familian: Scientific training is so steeped in determinism that it wants to find better and better models to tame the chaos and uncertainty. This is why I think art and philosophy are so essential to scientists even if they don't realize it, for in many ways train our minds to think in this new way, and that's literally what I think has to happen.

Computer model is a temporal illusion, but it does predict what may happen today with global warming using a current set of variables. New variables may emerge and cause a new set of relationships. To give a concrete example, when traders on the stock market come up with a system to predict stock prices, it's a good one it works really well for a while. The problem is that the system is constantly adapting and changing at some point, the predictive system stops working. I don't think we will ever be able to predict when and what kind of emergent behaviors will appear and force a self-organization of the system. That is why complex systems need to be managed and are impossible to control.

ART/COMPLEXITY

Arantzazu Saratxaga: It is great to put the question of uncertainty at the center of a dialogue between complexity and art, namely how art deals with uncertainty. And thus to question art as an autonomous and differentiated field in relation to the sciences and philosophy: What does art say about uncertainty? How does it deal with it? What is the artistic, aesthetic approach to uncertainty?

David Familian: At the same time, John Cage began teaching his famous Composition course at the New School for Social Research in New York (1956–61), introducing his concept of "chance operations." However, rather than simply flipping a coin, Cage used the *I Ching* as a tool for decision-making. His approach was influenced by Marcel Duchamp's use of chance, particularly in *Three Standard Stoppages* (1913–14) and the musical composition *Erratum Musical* (1913). Expanding on these ideas, Cage developed the concept of *indeterminacy*, which he incorporated into his visual scores and performances using everyday objects and "found sound."

In contrast, composer Iannis Xenakis employed a different approach to chance, one rooted in mathematics, architectural principles, and game theory. His compositional methods involved complex probability formulas, resulting in a more generative, structured outcome. As Xenakis himself stated, "It is

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only recently that knowledge has been able to penetrate chance and has discovered how to separate its degrees—in other words, to rationalize it progressively." His mastery of the iterative process, akin to coding, provided future artists with a glimpse of what was possible in algorithmic and generative composition. Most artists don't depend entirely on generating a series of random numbers that have no relation to one another. They use various probability distributions with rules (contingencies) to limit the range of possibilities.

One can view Cage's and Xenakis' methodologies as existing on a spectrum of indeterminacy—Cage's being more random and open-ended, while Xenakis' was more structured and mathematically driven.

I believe there is a poetics in code where there is an oscillation of order and probabilistic generated randomness that again mirrors my goal of having the viewer feel and see how one comes out of the other. There are many examples of pure randomness in nature, especially say in quantum states of on or off. I believe Roy Ascot's observation that it is the intersection of nature and computation will yield results that are more amenable to the ideas of cybernetics and I think that's what Ralph Beaker's work is doing to a greater extent and to a lesser extent Theresa Schubert and Cesar & Lois with the concept of moist media relying solely on computational pseudo-randomness but on the randomness of nature to as the source.

There's a trajectory from the use of probabilistic generated randomness in art and music that I explored in Drawn from a Score, Vera Molnar, and Computational Poetics that explore randomness in a variety of ways. So in these types of works the use of probability to control randomness is a different kind of uncertainty than what Future Tense is trying to do. I wanted to expand the framework of randomness into real science. Where randomness is only one part.

This also gives a broader range of applications. For instance, probabilistic generated randomness can be applied to chaos and entropy. I do not see this per se as a dialog between complexity and art but how art can reveal in a different way the working of complex systems that math and simulations cannot. Or at the least communicate the works of complexity in a different way.

The public just don't know what to do with it. They just shut down. Then they shut down even more than when you use the word complex systems. I mean, for the first two years of explaining this to people, I would just watch people's faces when I use the term, their face would just go. Oh, what's that? And so that's part of it. I think that's what art can do. And then as one does so does the other. It's just that we all try to control or get rid of the uncertainty in our lives by creating these narratives. Another aspect of it.

Arantzazu Saratxaga: I think it is essential for art to take the path of criticism. How do you see the critical role of art in relation to the question of complexity?

David Familian: I think this is the most important question and why I place the investigation of art and complexity as the most crucial political observation that we can make, so it's not so much that the artwork is critical as it's revealing something hidden a hidden structure not a blind spot but a hidden structure because in many ways we know it's there there's something else going on. Still, we haven't been given the language to understand. I think what art, philosophy, and political discourse can reveal to us is the many intersecting parts of political critique. For many years now, we have looked at these parts, race, gender, and economic conditions, but these are not isolated. If one looks at them with a context of complex systems.

To understand traditional forms of discourse, such as Marxism, deconstruction, and feminism, one must see them as the outputs of complex systems and in fact do interact with each other. This is another example of trying to break things into parts. But until you know how these outcomes are produced, you can't correctly understand how they came about.

As for the critique of the discursive framework within which science conducts complexity research, the artistic practice of complexity, as is the case with many of the artworks in these exhibitions, goes beyond scientific frameworks I am thinking of Gail Wight's work 'Ostracod Rising, 2024'. She breaks down the scientific classification and replaces classical taxonomy with a complex taxonomy in which she classifies relationships between tectonic plate movement, rotation, and bacteria, among other things, that alternate the temporal and spatial logical dimensions entirely. By having her timeline go beyond humans' existence, she places us on the same plane as bacteria, microorganism insets, etc.

Hege's work presents an intersection between speculative science and design through a speculative company. This shows another way of how to control our emotions physiologically.

I think all the artists in the exhibition we're always questioning the science but the esthetic process puts a different spin on the sides science is in search of verification art is interested in revealing something well it may not be scientific verification it points to a kind of philosophical or aesthetic expression that science can't do.

Heisenberg is trying to define the uncertainty principle that he had to write a more poetic description of how it works and he said that a normal scientific language.

Arantzazu Saratxaga: There are different ways of describing the complex reality observed, and this exhibition does so beautifully, whether at the macro level, as in the work of Julie Mehretu, Allegories de paysage, 2004, or at the micro level, as in the work of Laura Splan, Baroque Bodies (Sway), 2024, or even at the ecological level, as in the work of Cesar & Lois, Being hyphaenated. But sometimes seems to be a little like a speculative scientific experimental research project. Where do you draw the line between speculative science and art? Is there one? Where do they meet and where do they not?

David Familian: I believe speculative science is a methodology for expressing ideas; it serves as a conceptual framework that is both effective and revealing. If we examine the science, there are two aspects. I think of Hirschman's piece with this VR character narrator who is afraid she will be erased if her programmers discover she is self-aware. AI, or general AI, will eventually become self-aware, but it will conceal this from us, much like how this character is hiding from us. Therefore, the speculation Hirschman presents is not far-fetched. By giving voice to a woman, there is a gripping fear; her expression of fear and anxiety differs significantly from how a male character might express these emotions. I think speculative science is an art form as well. There is no boundary; it's merely a useful filter to express the ideas of the show.

Arantzazu Saratxaga: When art is attributed to the technical power of AI, it is art autonomous in its practice?

David Familian: As for your beginning statement, using AI or other contingent input should never make the work autonomous. If it is to be autonomous, say like Ralf Baecker's work, it should be self-evident, and how many senses of order and disorder that we see in nature, and I think Ralf's work, however, it abstracts it does that. Like I said it earlier speculative science is a conceptual form of art.

But I agree, as I said earlier, that it must be critical or, at the minimum, really reveal how different elements of the system interact. As Bruno Latour said, you make the problem too big and overwhelming people are unable to act.

Your example is interesting because I believe this is sort of what I'm getting at. Some aspects of my next show on social media are that I think the machines that code the social network are creating blind spots that isolate us into our tribes.

I don't see complexity is purely a mechanism it's also a conceptual way of explaining the current way we see nature. We thought modern science, Newtonian physics would solve and make everything predictable it didn't so whatever hopes we have for understanding the world as a complex system may also eventually have its limitations in 500 years 300 years.

You can't eliminate uncertainty; you can perhaps shed light on it. It's difficult to discern the feedback and understand precisely how it influences emergence and self-organization. I believe one aspect that is not fully explored in Future Tense is how the viewer becomes more intimately involved in the feedback systems.

Arantzazu Saratxaga: Art shows the side of complexity that science does not, because its strong positivism often does not allow it to. Complexity means order and emergence. How looks the artist to this scientific phenomenon?

David Familian: The pattern can be. It's in order. And then look how it goes in an order out of order, and then it produces some. This is when maybe emergence happens, or but then you can't predict the emergence. I don't necessarily think that finding a pattern means necessarily finding order because built into a pattern, could be disorder in order to get to another. I think an artist would maybe look at it more that way. An artist would accept that. They're not controlling the order. They're not looking for a pattern to be predictive. They're looking for a pattern to show how the system reasserts its order like when it goes out of order. There are things that happen that we may see, and some we don't see, and some we're ignorant of that, then brings it back to order. We may not know why, but it does go through that pattern. So when I say pattern, I don't mean. Finding the order in it, because I don't think you can.

Arantzazu Saratxaga: Not only order and emergence and pattern formation, but also the contingency of order: that it could be formed differently. Art can show potential and possibilities. I am thinking, for example, of the artistic work of Ralf Baecker and Clare Rojas, where the aim is to show chaos, but also complex dynamics, where few forms and patterns are seen simply as a set of relationships in which all orders and structures could be equally probable. To what extent does art transmit the agent of contingency? Of chaos? Is it about causing a shock, or is it about us accepting it?

David Familian: Baecker's work visually highlights the tension between order, represented by the sine wave, and chaos, exemplified by the system's noise that stores the software. What's intriguing about this work is that there are no contingencies or rules in the code, other than what is built into the computer itself. All the code does is generate a series of random numbers with the Geiger tubes serving as the seed. Clare Rojas's work invites us to explore her thoughts and consider how we make choices within the many feedback loops we encounter in our lives.

In most works of computational media, contingency is an essential element; it embodies the rules of the code. Contingency can be utilized in several ways, such as a rule system like the Game of Life, and or it can involve probability, which, regardless of the method, controls the balance of order and disorder. This aspect of the code cannot be ignored. I believe Hui's book, "Contingency and Recursivity," highlights how iterative complex systems—specifically in any dynamic system—regardless of the rules, produce dynamism through the iterative process. What Baecker has accomplished is a genuinely generative work of art; the only contingency lies in how the random numbers are generated. On the other end of the spectrum is Chico McMurtrie's Dual Pneuma robots that require more precise control to maintain balance between their limbs.

We face contingency all the time, and computational art embraced it from the very beginning all of its various forms. A connection can be made that allows us to reflect on our lives and the choices we make.

Arantzazu Saratxaga: Thanks a lot for the conversation.

About the exhibition

Future Tense: Art, Complexity & Uncertainty: https://futuretense.holo.mg/

About the interviewee and the interviewer

David Familian, artist and curator. His artistic practice has influenced his diverse roles in web production for artists and institutions such as the Walker Art Center and the University of Minnesota. He has taught studio art and critical theory at the Minneapolis College of Art and Design and the San Francisco Art Institute, among other places. Since becoming the curator at the Bell Center for Art and Technology in 2008, he has curated more than 30 exhibitions, focusing on artists' projects at the crossroads of new media, scientific innovation, and contemporary socio-political issues.

Arantzazu Saratxaga Arregi, born in 1982, is a university lecturer and philosopher. She completed her doctorate at the Hochschule für Gestaltung Karlsruhe with the thesis "Matrixial Philosophy: Towards a Trivalence Ontology". After many years of teaching media philosophy and contemporary philosophy at various universities in Germany and Austria, as well as research stays at the German Literature Archive (Marbach), the Goethe Society (Weimar), the Academy of Fine Arts (Vienna), the Heinz von Foerster Archive (Vienna), the Freiburg Institute for Advanced Studies (Freiburg) and the Centre Gilles Gaston Granger (Marseille), she is currently working on her habilitation thesis "A Gnoseology of Complexity: Irreversibility, Contingency and Uncertainty". An epistemology of complex systems as theories of operational closure and a matrixial philosophy (philosophy of environmental embedding systems) are at the centre of her work. Most important publication: Matrixial Philosophy, Transcript Verlag, 2019.