Gradient Topologies: Perpetual Tuning of AI Systems as Artistic Performance

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Abstract

In this paper the author discuss factors of artificial intelligence (AI) that affect approaches to the creative process in general and how these influence the relationships between creators, technologies, and the resulting works. This paper is an inquiry into how AI can serve as framework for practice in the arts as well as to explore some of the properties creative AI exhibited through its use in the author's audio-visual performance artworks. Specifically, this paper will ask the question, what is the language of AI in the artist's own creative practice. I will explore this question as it relates to the artwork *432Hz*, a live, generative sound scape performance that utilizes the act of training artificial neural networks (ANN) to generate various soundwaves that evolve over time and fluctuate between the harmonic and the discordant. *432Hz* is performed with a custom audio synthesizer is also a custom-built neural network that the performers train throughout the performance to learn to generate a combination of various sine wave frequencies. In this artwork, the AI model used serves as a model or framework for the aesthetics and structures of creative processes through the act of training or neuroevolution.

Keywords

Artificial Intelligence, Audio Synthesis, Cognitive Systems, Audio-Visual Performance, Artificial Neural Networks.

Introduction

Computation and computational media have a rich history in the meandering march of the arts and artworld. Computational technologies have long been ubiquitous within our daily experience, and they are now deeply embedded within all avenues of culture. They have become tools of our intelligence and at the same time, computational technologies, through extension, have increased the powers of our intelligence. Like all technologies, they have increased our abilities to manipulate our environment and understand it simultaneously. One has only to consider the Large Hadron Colldier at CERN or the Voyager 1 probe to get a glimpse at examples of how these particular tools have expanded our capacities to touch, smell, taste, see, and hear our reality(ies). We are profoundly affected by this new extension of ourselves. Therefore, due to the nature of the work of an artist, even if an artist only works with analogue or non-computational/ traditional media, the artwork is informed by and influenced heavily by computational media. I am focused now more broadly on computational media because it is the foundation on which artificial intelligence (AI) rests. AI is at least an enhancement of computational systems, technologies, and processes, and at the most represents the goal, of which the development of computational media is the stepping-stone, on the road to developing an extension of human intelligence.

Friedrich Kittler states that once our reality and the technical media through which we experience the world has been transcoded into a perpetual flow of digital data, "With numbers nothing is impossible…a total connection of all media on a digital base erases the notion of the medium itself." And in this continuous, evolving data flow that instead of hooking up technologies to people, absolute knowledge can run as an endless loop [1]. Topologies in mathematics and in networking is the description of a structure or object in space made from points that have an underlying logic. However, this logic and structure is highly variable and contingent. When exploring this field, and looking at these topological objects and spaces, it becomes apparent how these spaces are a construct, that can be easily morphed, stretched, pulled, enlarged, squashed, and expanded—or in other words, these objects and spaces are tested and highly contingent and to a certain extent, they represent not unique, modular possibilities much like in contemporary architecture and the built spaces we occupy where "cookie cutter" homes and apartments serve as our spaces for existing. For example, consider building projects like the Hudson Yards project with modular, climbable sculpture 'The Vessel' in Manhattan. If we apply these concepts of topological properties of constructed space to examples in visual arts, we can use the example of Sol LeWitt's artworks such as his wall drawings or sculptures. Through my practice, I am interested in these morphologies and contingencies. In my own art making where I utilize AI and data as media, I explore how nature and our artificial extensions of nature are expressed and transformed through numerical data and mathematical expressions. At its core, an artificial neural network or deep learning model is nothing more than a huge array of numbers being computed repeatedly. It is this "digital base" which becomes a starting point of which I propose as a lens in considering what are the properties or language of computational media and subsequently, the language of creative AI.

The convergence of technical media, that is evident by Kittler's statement of the "total connection of all media on a digital base," comes to fruition through the translation of computational systems to simulate our own cognitive systems – this is Artificial Intelligence. This scaffolding is realized at its core through the application of mathematics a means for the control of nature (and natural processes) as exhibited primarily through the harnessing of the electromagnetic spectrum and electrical current to compute bits in the form of electrical pulses in a CPU or across a circuit (i.e. through computation or which is down to its core frequencies of electrical pulses). Put more simply, in the context of this text, what is the language of Artificial Intelligence (AI) in creative practice? Finally, in pondering this question, I will use theories of embodied cognition and nonconscious cognitive systems to provide a model for creative practice as the creation of enacted, embodied meaning or aesthetic experience through numbers as exemplified in the performance piece *432Hz* (see Figure 1.).

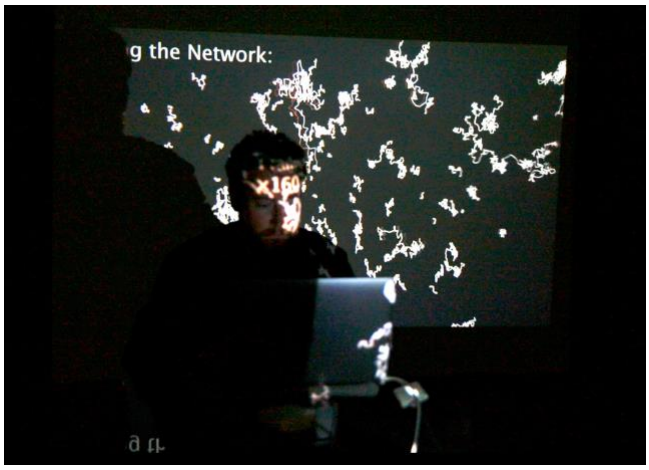

Figure 1. During a performance of *432Hz*. Custom software, custom neural network, sound. 2021. © Copyright by Johnny DiBlasi.

Through this piece, our practice, and the making of aesthetic experience, numbers are expressed through sound frequencies and are then 'tuned' by the machine (AI) over time by way of playing or performing the machine (as instrument or medium). I will use *432Hz* as a model for a contingent and embodied experience of feed-back loop between artist and machine, and through this case, numbers (or AI) become the medium for an aesthetic object or experience. Through the work, the artist's playing of the AI instrument is an exchange that generates an aesthetic experience, an exchange between artist and audience, and thus the work arises out of two cognitive systems exchanging sensorimotor feedback and operations.

The AI model used in creative practice is our own stepping-stone to think about the aesthetics and structures of creative processes in working on projects such as *432Hz* and *Transcoded Ecologies*, as well as how these projects highlight a framework for a foundational language of creative AI which affects these approaches to the creative process and the relationships between creators, technologies, and the resulting works. This paper is an inquiry into how AI has altered our theoretical framework in the arts as well as to explore the properties or the language of creative AI.

Through creative practice, I explore the language of creative AI through artistic experimentation and processes of building and interfacing with artificial neural networks and generative deep learning models. Namely via the proposed audio-visual performance piece titled *432Hz* that is an experiment in building deep artificial neural networks to calculate, train, and tune numerical expressions of computer-generated sound waves. This project represents an iterative process that explores one way in which AI can be embedded in creative practice. This project, and other projects like *Transcoded Ecologies*, not covered here, as well as others in the field offer a look at unique aspects to creative practice where AI is embedded as a medium for making or where the AI system becomes the art object. First, I will cover some broad areas of background and history in reference to media and technology before taking a more targeted look at the history of machine learning (ML) developments and artists that use this technology, as they relate to creative fields. Then I will address AI in creative practice more specifically, and I will draft a proposal for a framework for a language of creative AI through the discussed artwork *432Hz*. Finally, I will conclude by exploring ideas relevant to cognitive systems more broadly before returning to the questions raised by the confluence of AI and creative practice.

Background and Histories

As I previously mentioned, the long history of the development of media is a history of the development of the expansion or the extension of our capacities for seeing and hearing (as well as our other three main senses) through technical means. This history or development does include not only the advancement of technical media, but also includes, and is represented by, the development of how we (human actors) produce knowledge (and our perception of our own brains, bodies, and selves) more broadly. In this section, I will first outline this broader history of the development of media technologies and computation as it relates to shifts in art. This is followed by some examples of performance based methodologies in creative practice before outlining the recent history of the developments in AI as it relates to the technology's specific linkages to creativity and artistic practice.

As Siegfried Zielinski states in his comprehensive archeological unearthing of technical development, the history of our technical media (and production of knowledge) can be compared to geological deep time [2]. Against Zielinski's urgings, I like to compare this history to a root system of a tree (sort of a flipped family tree of media) where the farther back one looks, the more diversity in technology one will see. Zielinski uses the history of

geology and the evolution of the Earth as a starting point to begin to think about a concept of deep time for technical media. Using this example of "geological deep time," Zielinski applies these concepts more broadly to think about the history of the human species and its progress through technology. He urges us to draw a different picture of progress, and that from a paleontological perspective, a picture or metaphor of progress represented with models of "simple to complex" or tree structures should be rescinded [2]. Rather, from this deep paleontological position, Zielinski reminds us of the branching diversity found as we look back on nature's and our own technical progress. He states "From this deep perspective, looking back over the time that nature has taken to evolve on Earth…if we make a horizontal cut across such events when represented as a tree structure, for example, branching diversity will be far greater below the cut—that is, in the Earth's more distant past—than above [2]. Therefore, the technical progress within our history embodies a convergence of media and technology, rather than a diversification.

The bit comes from the "ons" and "offs" of electrical current pulses—and from that we get computation. We have this convergence of mathematics, physics, electrical engineering, and so on to bring us to computation. Computation also represents a convergence of media—or a convergence of media by which we hear and see through a technical means. However, because it is a convergence of this media, computation is also heterogenous in the sense it represents all of our media or mediums. Like the invention of photography, the development of computation was the next inevitable or determined step in the convergence of our technologies and thus a post-medium condition in the arts. The evolution of the arts into its post-medium condition was informed by a computational perspective in culture and assisted by the adoption of the technology itself. In Rosalind Krauss's analysis, it was the introduction of the complex system of the Portapack (video) as a medium of art, which shattered the Modernist dream—like a Benjaminesque moment, where we crossed a threshold into a "post-medium condition" [3].

Computation has an important history in the visual and performing arts, and there are many examples of artists working in the area of computation, both directly through the use of computation as a tool to make the work as well as a conceptual framework or approach to making work. And much like the development of AI that was running in parallel to the discoveries and advances in computation more basically, artists who were working with computation, were also integrating AI into their practices, engaging with the technology and its implications conceptually, and who were also in the room with AI scientists and figures at some of the first research centers. As the pioneer of Conceptual Art, Sol le Witt's created works such as *Proposal for a Wall Drawing* where the artist emphasized the process of making art as one that is inherently computational or a set of operations to be carried out [4]. The exhibition at The Jewish Museum in 1970 aptly titled *Software* is yet another example of artists and the field exploring ideas surrounding cybernetics and structures of information and communication through their works and practices [5]. Frieder Nake is another good example of one of the pioneers of appropriating computational devices as a tool for making artworks. In the text, Computers and Creativity, Nake details several narratives of his peers who utilize computational technologies to make work in the mid to late 1960s [6]. Nake used the process of computation to create drawings that were generated by algorithms and drawn by the machine. One of many examples of such work is Nake's print titled *Felder mit Rechteckschraffuren Nr. 6 (02/09/19659* [6].

Now I will dive more specifically into practices and processes within the arts that employ approaches that utilize computation within the context of composition and performance. I point to two examples, one past and one present. John Cage developed the concept of 'chance operations' over many years in producing compositions and performances such as the *Music of Changes*. Where Cage creates a system of composing that is based on the same set of operations found in the I Ching text. By utilizing this process into his composition, Cage is setting up an approach that yields to concepts of emergence, and thus where complexity and emergence share the same space with a predictable determinism [7]. Ryoji Ikeda serves as a good contemporary example of an artist and composer that utilizes real-time computation and data processing into performative works. In Ikeda's performance titled *superposition*, the artist employs "other performers appear on stage as operator / conductor / observer / examinee to complement a wide range of video images and other innovative technologies," and "real-time program computations and data scanning/processing to create a further abstraction." [8]. Both of these artists and composers give a context for the framework and approach I take in the performance piece *432Hz* which foregrounds processes of emergence and complexity through real-time computation as performance.

Artist and performer Susan Kozel is another specific example of a performance artist working at the unique area of computation in performance. In her text, Kozel uses a phenomenological approach to examine and investigate computational performance processes and artwork. She was analyzing a performance that utilizes cameras to track body movement and custom software to respond with a generated visual in real-time. Although Kozel considered this system as 'not intelligent,' she did believe it was a sufficient system in its responsiveness and its ability in making her, the performer, to feel as if the interactive system was a 'quasi-autonomous' and a somewhat aggressive being [9]. Kozel goes on to draw upon the Varela, Thompson, and Rosch text on embodied experience, as well as utilizing Maurice Merleau-Ponty to create a phenomenological approach to her performance-art-research. She goes on with her experiment through learning how to perform and interact with the responsive computational system that generates outputs based on her dances and movements. Through this approach, Kozel builds a framework for her computational

performance that is propped up by an ontological foundation that represents a sense of embodied and interconnected experience with the system. Ultimately this framework is built upon a process of interaction and exchange with the virtual, computational system which reveals a concept of a sort of folding over or an intermingling between the interacting systems of performer, the mind-body, and the computational or virtual machine systems. Thus, in her "phenomenological" approach, Kozel explicates the virtual in a "material ontology" where the virtual exists through experience and is inherently spatial and corporeal by nature [9]. Through my work, I propose to expand this "material ontology" of the virtual with AI systems. Through the sensorimotor, material cognitive systems of AI, artist, and audience, a framework appears where these cognitive structures become interwoven systems tuning each other over time and folded into one another evolving contingent topologies. I will expand upon this idea later in this paper as I discuss this idea of embodied experience and intermingling cognitive systems through my own research and the performance piece *432Hz*.

In the last eight years, there have been rapid advances in the machine learning branch of artificial intelligence. Particularly this past year has seen even more leaps in the innovation of the generative models (via Large Language Models). Specifically, a more powerful machine learning system has moved forward significantly – the type of deep learning called generative modeling. This machine learning model is distinct from its counterpart discriminatory modeling, in that this technology doesn't stop at just being able to classify data belonging to certain labels. Generative modeling has to infer patterns and structures in the data in order to be able to generate or create novel outputs [10]. It is truly a creative AI, and this raises very important ethical issues. In a time when data and information is constantly and simultaneously weaponized or under attack, the prospect of generative modeling raises issues between what data is accurate and what is generated by AI. At the same time, this new technology offers us a unique ability to really question and probe ML and AI itself. Because of how generative modeling must function in order to complete its tasks, it offers a lens into really understanding where the data comes from, how AI works to understand it, and what is the inherent structure of the data.

Eight years ago, Google published a story about a technique they were developing called "Inceptionism" where the engineers were trying to understand "...what exactly goes on at each layer [within a Neural Network]" [11]. Specifically, the idea is to understand what is really going on with each layer in NN, why and how it works, and what are the properties that drive a model to be a success or a failure. As they were taking this closer look, the engineers came to "one surprise: neural networks that were trained to discriminate between different kinds of images have quite a bit of the in- formation needed to generate images too." [11] The model was aptly named DeepDream, and by looking at the properties of the images, one can see the mathematical logic behind their creation: a mash-up of repeating, self-similar, and modular forms. What are the ramifications of a machine or AI as creative agent? The idea of what is an artist and what does it mean to be creative has a long history of development and has been debated throughout our history of culture and art. One could argue that this idea of machine as artist is simply another extension of this ongoing debate surrounding the artist or author. Rather than these questions, I propose that the more relevant questions are those surrounding how best to leverage these technologies within the creative act and how do these technologies inform our perceptions of the world and understanding of cognition. Can these applications for AI reveal new frameworks for aesthetic experience and the agency of makers to create such experiences? In addition to the evolving debate around author-artist, artists have been using machines as a tool for making art objects and aesthetic experiences throughout the history of cultures. Were these machines also being creative? What is different about the AI machine's creativity?

AI offers artists new applications and opportunities to explore systems of creative expression and aesthetic experiences. Memo Atken's work *Learning to See, Hello World* is an example of how artists are using AI to build intelligence systems in order to investigate these systems as basis for creative expression. In this work, the artist starts with a blank Neural Network which is then trained in real-time as a performative action [12]. In this particular work, the artist uses an Artificial Neural Network (or Deep Neural Network) that is trained in real-time on a live video feed as its input. The neural network learns over time how to recognize and ultimately create video frames. One unique feature of this software and resulting artwork is that the user or performer can adjust various parameters of the neural network which controls and manipulates the machine's ability to learn during the performance and execution. This work is an example of an AI agent's process of training its computer vision as artistic experimentation and expression.

As I stated previously, artificial intelligence (AI) has developed alongside computation and could even be seen as end by which computation is the means. In this context, it makes sense that AI was mostly theoretical up until only the recent past few decades—computation had to get ironed out first. In the last six years or so there have been rapid advances in this machine learning branch of artificial intelligence. As a result of these advances in deep learning and deep generative modeling, these machines are now able to generate novel, creative output such as a musical score, an image, or a piece of text. There are countless examples of artists using this technology in all sorts of interesting ways, but I am not going to get into too much more details regarding these examples. Rather, I want to consider a specific type of use of AI in our creative practice—through performing AI. In this usage of the machine, the AI is one cognitive system, and the individual artist, is another.

Performing AI: Tuning Custom Neural Networks in Audio-Visual Performance Works

The project *432Hz*, seen in Fig. 2, is an experiment in building artificial neural networks to calculate, train, and tune numerical expressions that are transcoded into computer-generated sound waves. *432Hz* is a live, generative soundscape performance that utilizes the act of training neural networks to generate various soundwaves that evolve over time and fluctuate between the harmonic and the discordant. The piece explores the aesthetics of sound and movement expressed as data in order to create an experience of this information into generative imagery and computer-generated sound waves.

In the past, tuning pitches tended to vary widely before tuning was standardized and based on the 440 Hz frequency. Before this standardization, this pitch was expressed in lower frequencies, and for a time, composers promoted a scientific pitch based on 256 Hz or 432Hz. 432Hz is an exploration of these tuning frequencies and how sound is expressed through these numerical relationships. The multimedia performance consists of generative imagery that evolves over time and mapped to computer-generated sound waves. Various soundwaves or oscillators expressed by the computer through assignment of these numerical values are layered and altered throughout the performance by a custom digital synthesizer created by the artist. The synthesizer is also a custom-built neural network that the performer trains throughout the performance to learn to generate a combination of various sine wave frequencies.

Inspired by the emergent relationships between naturally occurring and artificially generated oscillations, and the evolving relationship over time between the audience and machine (AI) agent and experience of the auditory output, *432Hz* involves a performance of a generative audio-visual experience. The development and the performance of the artwork take the form of a live computer-generated set of evolving projection and sound.

The performance *432Hz* is an exploration of these tuning frequencies and how sound is expressed through these numerical relationships. The multimedia performance consists of generative imagery that evolves over time and mapped to computer- generated sound waves. Various soundwaves or oscillators generated by the computer through assignment of these numerical values are layered and altered through performance and a custom digital synthesizer created by the artist. The audio synthesizer was built using Java and Processing sound libraries or sound Application Programming Interfaces (APIs), and where the artist/I hand coded the audio digital synthesizers and patches (which are then patched to the sound buffer on the computer). Using object oriented programming methods, the artist set out to build a custom Artificial Neural Network by writing a custom program (or series of program Classes via Object Oriented Programming) in Java that is comprised

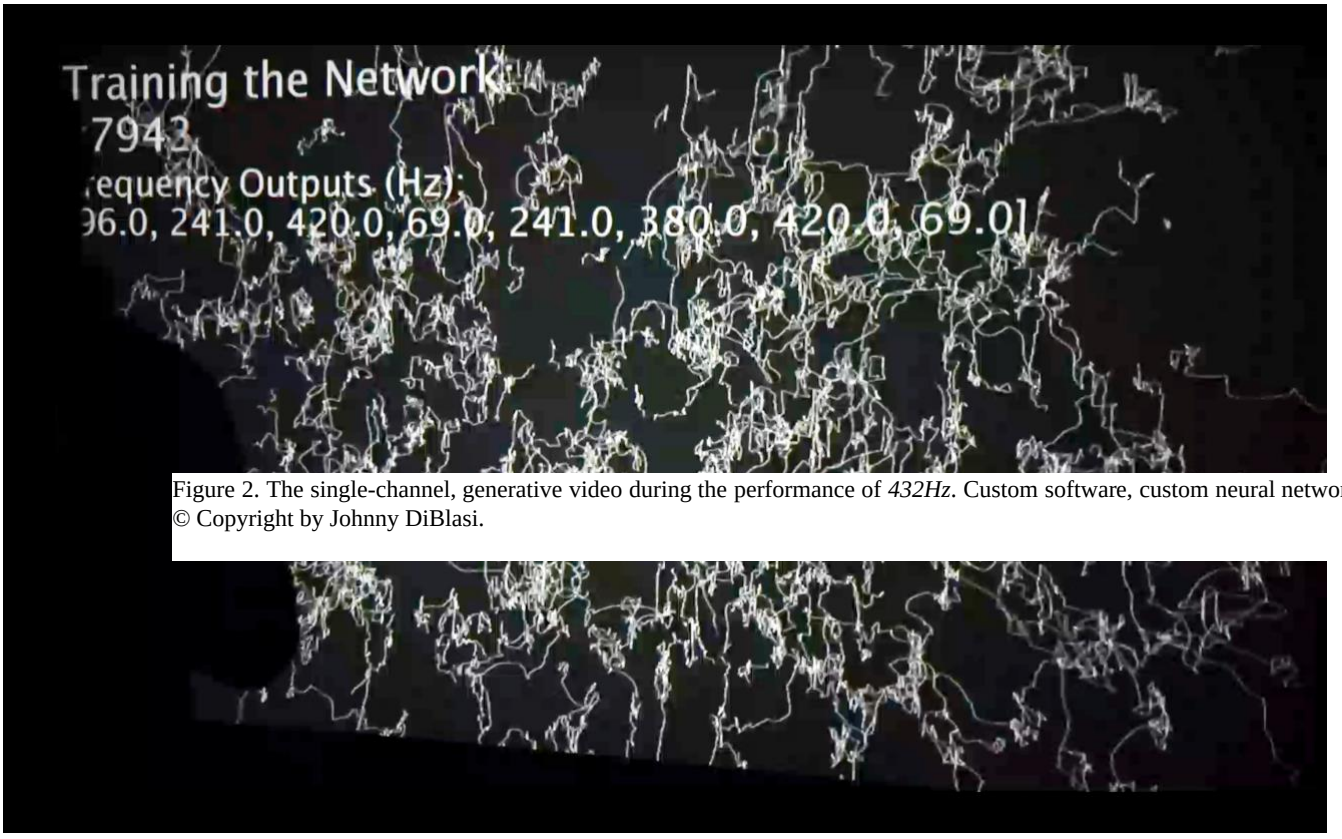

Figure 2. The single-channel, generative video during the performance of *432Hz*. Custom software, custom neural network, sound. 2021. © Copyright by Johnny DiBlasi.

of a series of classes. Specifically the artist wrote a program for the Neurons as well as the program for the entire Network using the Java based Processing language and IDE. Every "Neuron" in a Neural Network is connected through a series of weights and biases. And so inputs are passed through the network where each neuron, which is more or less a matrix or table of numbers, calculates outputs by way of specific algorithms (or activation functions). In this case, the artist uses the sigmoid function: $y = 1 / (1 + e^{-x})$ as it compresses all the values into the range between 0 and 1. The custom neural network is then using backpropogation, where the inputs are trigger computations and send the result to the next connected neuron. An error is calculated and the backpropogation process begins where the weights (computations) are adjusted and updated to learn to predict a more correct answer [13, 14] Certain frequencies were chosen in order to make certain chords of sound, where each frequency translates into a specific note and octave (i.e. 432Hz set to the output will produce a 'A' note). Based on the 'A' note, a series of other notes are selected by the artist to produce various harmonic chords. The sound synthesizer is an eight channel audio synthesizer rendered by the machine entirely as an array of audio outputs generated by the Java sound library. The different note soundwaves occupy the various different output channels. Different filters and effects are applied to the soundwaves, and some of the channels are broken up by way of granular synthesis. In granular synthesis, the channel of sound or the sine wave is chopped up into single grains of sound.

The synthesizer is also a custom-built neural network that the performer trains through-out the performance to learn to generate a combination of various sine wave frequencies. The machine "learns" and tries different emerging patterns of combined oscillators. The Artificial Neural Network (ANN) is created through the artist's hand coding of a fully connected, neural network that uses backpropogation (rather than unsupervised learning). Each 'neuron' in the network is actually literally an instance of a Matrix object that is called from the custom-built Matrix class that the artist developed This class includes the crucial algorithms and matrix mathematics which are all needed for the processes that a neural network uses to execute, to learn, and to calculate an error. The soundwave frequencies start out as being somewhat random and discordant, and throughout the course of the performance, I train the neural network while I control (or play) the audio synth. While training, the network is tuned to learn new patterns and combinations of harmonic soundwave frequencies, as well as learning to generate the values for the controls of the filters, effects, and sound grain parameters. The visual aspect of the piece is a representation of the neural network nodes and, by extension, the sound being generated. These nodes are represented visually by a swarm of agents whose movement is dictated by the various parameters of sound. The outcome is an audio-visual performance piece that can have different durations around half or three quarters of an hour and one where the artist plays the synthesizer and tunes the ANN to evolve the sound and visuals over time.

So with this project, I explore AI and the generative neural network as itself the media for artistic output as well as the resulting art object. So rather than having the AI create something for the artist—or program the AI to generate the novel aesthetic object (i.e., to make something under the guidance of the artist)—the performance becomes a conversation between the performer and the AI as it is being trained. Through the performance of this system, *432Hz* explores the idea of the performer as simultaneously the builder and trainer of artificial intelligence through the construction of a neural network as itself the media of production. This media outputs an evolving aesthetic experience of sound and imagery that represents the generation of training over time but can also reveal the state of the learning AI at any moment in time.

I proposed as a model to elucidate a series of properties or principles for the use of AI for creative means. First of all, the neural network, or AI itself, becomes the created object—the aesthetic object to experience, rather than the AI's generated output. Secondly, throughout the work, the AI represents a cognitive system, or technical nonconscious cognitive system, with which the artist, another cognitive system, engages in a conversation or dialogue with the AI system through the process of tuning—or training of the AI. Lastly, I want to consider a certain model postulated within the fields of architecture and experience design. In Richard Coyne's text *The Tuning of Place*, he proposes what he calls a metaphor of "tuning" when constructing a theory of how we construct and manage experience within our places and spaces which we can think of in the context of nonconscious cognitive systems. Therefore, our places are cognitive systems that are made up of physical space as well as embedded, integrated, and pervasive digital media, and we tune these systems as we experience and interact with them. He writes that his examination of tuning is a framework for ways designers and users engage with the materiality of digital media. Furthermore, his concept of tuning "provides a richer metaphor for the interconnected digital age than Mum-ford's trope of synchronization" [15]. This is what happens throughout the performance of the piece: the artist's cognitive system tunes or trains the AI's cognitive system over time. This is also an integral and unique aspect of the AI system. AI is trained over time where the connections between nodes in the network are tuned to be stronger or weaker based on the relationship between the inputs and the desired outcome. The piece and the experience are contingent as the two systems tune and morph over time based on different sensorimotor actions taken in response to the machine's generated light waves and sound oscillations.

Through projects such as *432Hz*, I explore the idea of artificial intelligence—and its training or tuning over time—as a medium for creative expression. As a medium for aesthetic experience in itself—the act of training is an act of tuning simulated "neurons"—which at its core are data expressed as a number occupying a space of memory within the larger interconnected network. Using the new research in the field of cognitive science—that of embodied cognition or enaction—as a lens to under- stand the

relationship between myself, as an artist, in the act of creating, but also as the interplay between myself—a cognitive system—interacting or exchanging with another cognitive system. But wouldn't that make the two parts simply one cognitive system? And what of the audience who is also connected to the work through their own aesthetic experience of the piece which generates various levels of meaning reflected in the work of art or aesthetic experience?

Another helpful concept to help us explain the proposed framework or model for these systems of languages and aesthetic experience are laid out by cognitive scientists such as Francisco Varela. Varela and his co-authors propose a current theory of cognitive science which is centered around the concepts of embodied cognition and their theory of "enaction." The current state of the field of cognitive science (referred by some as Post-Cognitive era) puts forth new ideas about how cognitive systems, consciousness, and the mind works through the theory of enaction or embodied cognition. In the text by Francisco Varela, Evan Thompson, and Eleanor Rosch, after a survey of the past theories of mind that guided the field, the authors define and present a kind of 'none' but 'all of the above' theory through their idea of the mind as experiencing reality through a process of enaction. What is key to these ideas of enaction, is actually there is no such thing as a separation between the two entities of mind and body, but actually the mind-body is part of one cognitive system that experiences and takes actions in the world [16]. So we see that the mind and sensorimotor system that is our body is actually a part of one cognitive system that experiences the world through a process of enaction where there is a constant feedback loop between this cognitive system and its environment through its sensorimotor functions it takes actions in the environment through a complex back and forth of tuning the environment and tuning its own reaction to the environment as it gathers information and takes subsequent action. This model of the brain or cognition (and consciousness) is built on top of the previous connectionist strategy to model cognition/brains. This is a similar concept to the ideas surrounding Everywhen which describes an idea that all time co-habits the same state of presence. Additionally, like the concept of Everywhen, this approach and framework expands upon that which was discussed above in Kozel's research approach to performance arts practice.

In these various ways, variable and hybrid nonconscious (and conscious) cognitive assemblages are generated and enacted in an embedded aesthetic experience. This idea has always been at the core of my interest in the landscape as an artist and my exploration of concepts surrounding the landscape in my work. How we move through our environment which is changing, as we alter it with technologies, etc., and we change to adjust to new alterations to the surroundings. I'm interested in this feedback loop between sensorimotor data, our navigation through the landscape's infrastructure, learning its features, and then designing alterations to the constructed and experienced landscape. It's truly inspiring how I'm engaged in a feedback loop between all of these biological, technological, and cultural systems that make up the environment and that make up myself as an embodied mind–body system.'

Conclusion

In conclusion, I aim to highlight and propose a model for thinking about AI in creative practice by generating properties or the so-called syntax of the language of creative AI. As the paper's title suggests, I wanted to explore the formal and structural relationship between overlapping, contingent, and fluctuating cognitive systems that collaborate, or more aptly, tune each other and bring about changed states in each system.

In this current moment at the culmination of the interwoven histories of computation, AI and art, I seek to define the properties and structures of the language of creative AI which, I argue, can be seen as a culmination of a variety of languages rooted in aesthetics, artistic practice, and cognitive science. The framework created here is elucidated by a dialogue between various cognitive systems which use this language to create aesthetic experiences and which represent a collaboration between various creative actors and agents involved in this conversation. I investigated the histories of computation and AI and how these technologies have affected the language of the arts as both areas of culture developed and grew.

As I've laid out previously, the current state of the field of cognitive science puts forth new ideas about how cognitive systems work through the theory of enaction or embodied cognition. In *The Embodied Mind*, the authors define the theory of the mind as experiencing reality through a process of enaction [16]. In the model of embodied cognition, the mind–body or the entire cognitive system and its environment arise together through enaction within this embodied experience. Varela, Thompson, and Rosch explain their model of cognitive science by defining their theory of "embodied action." The authors do this by focusing on explaining what "embodied" means in relation to cognition, and they high-light the first point "that cognition depends upon the kinds of experience that come from having a body with various sensorimotor capacities" [16]. Secondly, the authors point out that they use the term "embodied" because "these individual sensorimotor capacities are themselves embedded in a more encompassing biological, psychological, and cultural context" [16].

When considering theories of cognitive systems, we see their relation to concepts espoused above in embodied cognition. Cognitive systems are enactors that are embodied or embedded within a milieu or context where they are constantly receiving information coming into a sensorimotor system and make a conscious/unconscious/nonconscious enaction (reaction) and/or feeding forward new meaning. Following these examples, Katherine Hayles outlines a "tripartite framework" specific to human cognition but also used to conceptualize how these various levels interact and also how

these ecologies or systems can include biological systems and technical systems. Specifically referring to human or self-aware cognitive systems, she developed a “tripartite framework” the various layers of cognitive systems that include consciousness, unconsciousness, and nonconscious cognition [17]. This tripartite framework highlights the inner workings of the various aspects of the interwoven cognitive assemblages, and we can see how other nonconscious cognitive systems (biological or technical) are embedded within the environment and exact changes within these assemblages with “material processes.”

Through using these lenses and theories of embodied cognition and enaction, I propose a collaboration or generative feedback loop that arises between various cognitive systems or assemblages. Finally, I used the concepts of enaction, aesthetic experience, and the sensorimotor cognitive system (or cognitive assemblages) to describe the relationship between various levels of aesthetic experience and artistic production. By creating a custom AI agent (or building the algorithms and mathematical system of artificial neural network) as the art object in itself, and then through performing and ‘tuning’ and training this AI, creative agency and aesthetic experience take shape as a collab-oration between these two cognitive systems: the AI and the artist. Which in turn is experienced by an audience which then makes up a collection of other cognitive as-assemblages or systems.

As you, the reader, and I ponder the convergence of mind, body, and experience into a cybernetic feedback loop, I propose we think about how we constantly tune and adjust to our experience, our mind–body systems within the environment. Further, I propose we ponder how these systems are applied to aesthetic experience and my (or any artist’s) research and production of aesthetic experiences and objects. The aesthetic experience (or the object of creative production) be-comes a dialogue between various cognitive systems that are enmeshed together: the artist, the AI agent, and the audience. The language used in this dialogue exhibits the topology of embodied, aesthetic experiences that fold into one another and this, in turn, generates a possible model of the highly contingent morphology of these creative cognitive systems.

In these various ways, variable and hybrid nonconscious (and conscious) cognitive assemblages are generated and enacted in an embedded aesthetic experience. This idea has always been at the core of my interest in the landscape as an artist and my exploration of concepts surrounding the landscape in my work. How we move through our environment which is changing, as we alter it with technologies, etc., and we change to adjust to new alterations to the surroundings. I’m interested in this feedback loop between sensorimotor data, our navigation through the landscape’s infrastructure, learning its features, and then designing alterations to the constructed and experienced landscape. It’s truly inspiring how I’m engaged in a feedback loop between all of these biological, technological, and cultural systems that make up the environment and that make up myself as an embodied mind–body system.'

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