ON THE HUMAN ROLE IN GENERATIVE ART: A CASE STUDY OF AI-DRIVEN LIVE CODING

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ABSTRACT

The constant evolution of philosophical views on art is interwoven with trajectories of accelerating technological development. In the current vehement emergence of generative algorithms there is an immediate need for making sense of modern technologies that increasingly seem to step in the realm that has been reserved for humans – creativity. This paper aims to understand the role of the human in generative art by demystifying implications of black-box generative algorithms and their applications for artistic purposes. First, we present examples of current practice and research in generative art with a special interest in music that served as foundation for our work. Then, we introduce *Anastatica* (2020), a part performance, part installation built on the basis of data-driven generative live coding. Finally, we discuss the various implications of AI in art through a case study rooted in Anastatica's development and performance. Here we trace the path from algorithms to intelligence, applying both musical and computer science theory to a practical case of generating a live coding musical performance, with special focus given to aesthetic, compositional, conceptual, and phenomenological implications.

Keywords: Artificial intelligence; Generative art; Live coding; Generative music; Computer art.

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1. INTRODUCTION

In broad terms, artificial intelligence (AI) is any sort of intelligence exhibited by machines (Nilsson 1998). The field of computer science that deals with artificial intelligence is commonly concerned with computational agents capable of perceiving their surrounding contexts and undertaking action in an effort to maximize their set goals and expected results (Poole et al., 1998; Russel & Norvig 2003). While technologically and philosophically correct, this definition briefly focuses only on the direct effects of AI without providing a framework for understanding either the algorithmic mechanisms it comprises or the sociological implications it poses.

With the rise of computational power and ubiquitous computing made available through smartphones and other personal devices, various forms of AI have made their ways into all layers of society and daily life (Mlynár et al., 2018). While the technological progress of the associated techniques and processes is fast and steep, individuals, communities, and societies struggle with understanding their nature and potential ethical pitfalls. This is also true of their applications in art.

These questions have been subjects of philosophical debate that predate the technologies (Heidegger, 2009 [1954]; Latour, 1999). Whilst these critiques – either from perspectives of technological determinism or social constructivism – are still valid, the essence of advanced contemporary technologies further blurs the lines of enframing, recontextualizing the discussion around AI technologies which could tentatively be characterized as becoming Dasein themselves (Herrera, 2016).

Artificial intelligence and machine learning infiltrated artistic practices through osmosis, both in academic contexts and mainstream art (Parker, 2019). The way in which artists and computer scientists approach this set of technologies is multifaceted, from simple black box usages to complex modifications and subversions of AI mechanisms. Similar to the impact in wider sociological narratives, the usage of AI in art is a controversial topic, perhaps more so than any other digital tool has been in the past. Some believe AI is to bring on “the death of art” through replacement of true creativity and human artistry, while others see immense possibility in the augmentation of human cognitive and performative capabilities (Roszak, 1994).

This paper thus aims to start the process of demystification of AI in art, specifically music, and to provide a possible view on the human role in generative art. Our findings are both exhibited by and based on an interactive, AI-driven live-coding installation-performance named *Anastatica* (2020).

2. ARTIFICIAL INTELLIGENCE AND ART

While ideas of using generative and proto-artificial intelligence techniques in art have been around for several decades (Kugel, 1981; Galanter, 2003), their wider and consistently applied use is still a fresh and relatively unexplored field. The latter part of the 2010s saw a significant increase in AI use for artistic purposes largely owing to the increase in computational power available to individuals (both in mainstream and academic settings), advances in algorithms, and open-source availability of these tools. The progress is fastest and most easily observable in visual arts and music, which follow similar tracks and on which similar concepts can be applied through mathematically described signals.

In the following two subsections, we present a number of such artistic practices that we deemed most representative and that our work either builds upon or questions. While not a comprehensive review of the field, it explains the influences that led to *Anastatica* and the artistic research presented in this paper.

2.1 VISUAL ARTS

Championed by artists like Mario Klingemann, Memo Akten, Robbie Barrat, Gene Kogan, and Mike Tyke, generative adversarial networks (GANs) have become the most widely accepted form of AI in visual arts (Schmitt 2018). These artists take publicly available algorithms and tools, train them on data sets of existing art like masters' portraits, modify their parameters, and generate new pieces in styles that mimic the original data sets, but which often surface specific artifacts inherent to the used technologies. The resulting aesthetic is still very much human, not machinic, while also revealing of the algorithm's intrinsic properties. Here, the artist has three roles: to select the data sets used for training the system, to adjust the parameters of the system, and finally to act as a curator who selects the most compelling pieces in a vast space of generated works.

Apart from GANs, artists employ various evolutionary algorithms to generate dynamic 3D artworks (Romero, 2008), virtual reality pieces (Lugrin et al., 2006), and abstract works whose aesthetic could be described as mathematic and detached from human preference (Wannarumon et al., 2008). Here, AI is often used within the boundaries of the technology's original parameters, as parameterized tools or black boxes, while some artists and researchers (e.g., Roh, 2018) make substantial interventions to the makeup of algorithms, questioning the technology itself.

2.2 MUSIC

Unlike visual arts, where GANs are prevalent, in the context of music AI has not yet found a common mode of operation, instead adopting diverse

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approaches. Rather than trying to summarize current meta-narratives, we focus on four distinct pieces which illustrate how AI can be used for music creation purposes.

Adapting the SampleRNN architecture, Zukowski and Carr created the *Dadabots* system and employed it to generate black metal and math rock similes (Zukowski & Carr, 2018). While this approach has many similarities with the use of GANs in visual arts, the distinction is that the material that they use is both contemporary and highly aesthetically recognizable. Additionally, the stylistic elements of black metal and math rock can be considered chaotic and difficult to analyse using conventional techniques due to their use of timbre and space as compositional drivers (Lee et al., 2009). Because of these characteristics, the pieces produced by *Dadabots* bring forward a tentative new aesthetic, birthing acousmatic experiences out of isolated and subverted black metal elements. As the authors state, “we are delighted by the unique characteristic artifacts of neural synthesis”, emphasizing how different the role and expectations of AI in art are contrasted to AI for general purposes. Here, errors are cherished as the researchers/musicians curate segments from *Dadabots*’ vast output.

While Zukowski and Carr welcome the unexpected outcomes of their process, researchers and musicians Holly Herndon and Mathew Dryhurst created and trained the Spawn AI for Herndon’s *PROTO* (2019) album with a specific role in mind. The process of training and using the AI was iterative. Herndon created and recorded the music, fed it to Spawn, and then used the system to transform and generate new samples. These sounds and phrases were then arranged into the final compositions. Here, the AI is used as a tool for generating sound samples in a way that a human cannot, while the final act of composition remains in Herndon’s hands. The resulting record fits within expectations of conventional electronic music aesthetics, but with an additional dimension of performativity and curious exploration of the system itself at play, as Herndon mentions naming, anthropomorphizing, and raising the AI entity.

If Herndon resides on one and Zukowski/Carr on the other side of a continuum, experimental and drone music duo Emptyset falls between them, opting neither for a fully generative process nor choosing to harness the AI purely as a sample-generator. James Ginzburg and Paul Purgas instead employed machine learning techniques to explore new, unexpected possibilities out of data sets they sourced themselves. They explain their artistic process behind the record *Blossoms* (2019) and departure towards a new aesthetic framework (Smart, 2019, p. 1):

> The machine learning system for Blossoms was developed through extensive audio training, a process of seeding a software model with a sonic knowledge base of material to learn and predict from. This was supplied from a collection of their existing material as well as 10 hours of improvised recordings using wood, metal and drum skins. This collection of electronic and acoustic sounds formed unexpected outcomes as the system sought out coherence from within this

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> vastly diverse source material, attempting to form a logic from within the contradictions of the sonic data set. The system demonstrates obscure mechanisms of relational reasoning and pattern recognition, finding correlations and connections between seemingly unrelated sounds and manifesting an emergent non-human musicality.

Finally, composer Jennifer Walshe's work *ULTRACHUNK* (2018) is an example of a piece that focuses on the phenomenology of AI itself. Realized in collaboration with visual artist and researcher Memo Akten, the work explores the emerging world of computational intelligence. *ULTRACHUNK* (2018) is an improvised piece, a duet between Walshe and an AI which acts as a mimetic partner and absorbs the main characteristics of Walshe's identity, namely her voice and face. In this sense, it is the most self-aware of presented applications of AI in music.

3. ANASTATICA

Building on top of the works presented in the previous section and our own aesthetic and philosophical framework, *Anastatica* (2020) is a musical experience which combines performative elements with characteristics of an installation. It comes into being in real time by drawing from the relationship between humans and a generative algorithm. The algorithm – inherently incessant and untiring in its roll like a rose of Jericho – generates lines of code that manipulate audio samples and create music. This seemingly endless generative process, which might start even before the audience is introduced to it, is joined by a being of flesh and blood, the Musician, who improvises and alternately builds upon and destroys the generated music.

Using live coding and other computer music techniques, the Musician creates an accompaniment for the algorithm, switching his influence from a background to a foreground presence and back. They improvise and intervene in the algorithmic results, adapting to the ever-changing flux of machine acousmatics and exploring various modalities in the relationship between harmony and disharmony. All the while, the interactions between Musician and algorithm are projected on a screen, as is common for live coding performances.

At a random point, the performance opens itself for input from the audience via a web-enabled interface. Then, *Anastatica* (2020) becomes an interactive installation that extends the original duopoly into democracy and anarchy. The audience is given a chance to manipulate the computer-generated code, with the choice between augmentation and erosion left to each individual. Meanwhile, the Musician's role gradually fades, returning the performance to its original state of infinite algorithmic possibility.

Aside from the source code makeup of the algorithm, the aesthetics of the performance are determined by the samples employed in the preparation process: audio recordings of a violin and electro-mechanic piano. By choosing these organic and real instruments, we clash the rigidity and predictability of the algorithm with the imperfect nature of the instruments, creating textures, harmonies, and rhythms.

3.1 STRUCTURE OF THE PERFORMANCE

A laptop computer is set on stage. Music is generated even before either the musician or the audiences enter the venue, giving a sense of an installation with no beginning or end. Perhaps it conjures a feeling akin to being late to an acousmatic concert. Once the audience is seated, the Musician appears and starts playing in conjunction with and in contrast to the machine, which includes influencing the algorithm itself, by means of the laptop as live coding interface. At specific times and intervals, the audience intervenes via modifications of generated code through the aforementioned web interface. Ultimately, the Musician leaves the stage. The audience is now alone with the algorithmic ghost in the machine. Everything is in their control or perhaps nothing is. It's a short but endless segment. Curtain falls.

3.2 INFLUENCES AND MOTIVATION

The idea behind *Anastatica* (2020) joins together three lines of thought. Firstly, it exposes human-machine interaction on a semantic and syntactic level, understandable to both computers and humans through program code. In this space we can observe the relationships between organic and inorganic worlds in the rawest sense. Here, *Anastatica* (2020) inherently becomes a comment on the role of computers in contemporary society and the (in)existence of choice, while simultaneously unravelling any potential mysticism woven around the generative process. It breaks the black box by giving the audience a direct view of the performance code and the possibility of intervention.

Secondly, while the modes of interaction and styles of programming music are vast, within the field of live coding they often result in similar aesthetic and artistic outputs, frequently tightly tied to identifiable electronic music tropes. By employing an (antagonistic) AI, we seek to challenge the creativity of the Musician and further push the field of live coding in terms of improvisation.

Thirdly, based on Thor Magnusson's (2019) ideas of self-built digital instruments as a part of the future of music, we build the AI-algorithm from scratch and intervene in it on a low level. By doing so, we create a new instrument, instilled with our own sense of aesthetics, and extend our cognitive and performative capabilities beyond what would otherwise be possible.

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3.3 PARTICIPATION

By observing combinations of electronic club music and bleeding-edge research tendencies, two metaphysically contrasting approaches can be identified in how humans interact with machines in the domain of music. Experimentation with various computer-human communication channels is the first of them. By employing techniques dictated by innovative interfaces, performers and their bodies are made to move and inhabit states which are unnatural and free of learned behaviours. This, in turn, encourages innovative modes of improvisation in live coding (Kreković & Pošćić, 2019). Examples of such interfaces are the self-resonating feedback cello (Eldridge & Kiefer, 2016) and various textile-based systems (McLean et al., 2017). The second trend in human-computer interactions is the employment of artificial intelligence to expand the spectrum of human capabilities on a cognitive-compositional level, where we find examples such as Holly Herndon's previously mentioned Spawn (Sturm et al. 2019).

In its condensed form, *Anastatica* (2020) presents audience members with elements from both these approaches and gives them a chance to influence the performance directly via a web-based live coding interface. The audience becomes a crucial part of *Anastatica* as they can decide in which way to impact the performance, acting against or along the algorithm and its non-deterministic variant of a pianola in the distilled role of Luigi Russolo's *intonarumori* (Serafin, 2012). They do so by using ubiquitous smartphones, via a two-way web interface piped directly into the performance core. Depending on atmosphere and mood, the audience can derail the flow and act subversively against the Musician and the algorithm, all the while participating in the creation of an interactive, extemporaneous installation. The outcome of the performance is indeterminate and context-dependent. It will vary based on the meanderings of the collective mind, edging towards dissolution or synthesis.

Figure 1: A 2020 performance of *Anastatica*. © N. Klarić

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3.4 SYNTACTIC, SEMANTIC, AND TECHNOLOGICAL CONSIDERATIONS

A major idea behind *Anastatica* is to join humans and algorithms on a level playing field. This means that both organic and inorganic participants in the performance use and communicate through computer code that generates music. Under these premises, the choice of TidalCycles (McLean, 2014) becomes obvious, due to its real time characteristics and compact syntax. Thanks to its architecture and orientation towards live performances, TidalCycles enables a human to express musical intentions in clear and traceable ways, while also being a language that's easily understandable to computers.

By "writing" TidalCycles code, the computer is no longer just an object. Instead, it is perceived as a subject that creates music, working on the same semiotic level as human participants. Now, computer code is in a natural position of shared medium between human and machine, but the specificity of *Anastatica* (2020) is the closeness of the participants' roles. The aspect of translating code into music – usually the main functionality of computers in music – becomes a corollary. It's the generative part that is key here, set in shapeshifting dynamics of antagonistic or complementary interactions.

Since it is expected that most audience members will not be familiar with TidalCycles, the web interface that exposes the inner workings of the generated code is simple and straightforward. It enables the selection of snippets of generated code, while the algorithm decides if and when they are going to be played. Each modification is coupled with an observable change in the music, dispelling audience suspicions that their actions might not have any real repercussions. Additionally, using the web interface on their mobile devices, the audience can see which piece of code has been executed on a channel and influence the algorithm in the choice of the next segment by touching snippets with their fingers.

While the performance does not question the basic extra-musical dimensions of live coding, it provides a peek into the inner workings of such artistic acts, warping and challenging the basic improvisational techniques contained in them.

4. FROM ALGORITHMICITY TO INTELLIGENCE

Anastatica (2020) represents an exploration of the relation between AI and humans, between the algorithm and creativity, and between machinic autonomy and human will. While all of these dualisms have been touched upon in the performance and the manifestation aspects of the underlying generative system, they also arose as challenges during *Anastatica*'s creation. This section, aimed at demystifying the human touch in the AI creation process, opens selected insights in technical and compositional dilemmas from the aspect of algorithmic composition.

Figure 2: *Anastatica*'s Web Interface. © A. Pošćić & G. Kreković.

4.1 HISTORY AND COMPOSITIONAL DILEMMAS OF ALGORITHMIC COMPOSITION

One of the most influential and widely cited definitions of algorithmic composition is the first paragraph of Adam Alpern's paper on algorithmic composition:

> The area of automated composition refers to the process of using some formal process to make music with minimal human intervention. This is often done on a computer, with the aid of various formalisms, such as random number generation, rule-based systems, and various other algorithms. (Alpern, 1995, p. 1)

The beauty of this definition lies in the fact that it precisely captures a distinction, yet a natural evolution from traditional compositional approaches, but it also blends well with our post-algorithmic modernity where the scopes of "formal processes" and "human intervention" are morphed.

The 20th century was a historical greenhouse of formalisms. The rise of intellectual thought and accelerated scientific breakthroughs, especially in natural and technical sciences, significantly influenced compositional approaches and resulted with radical ideas in music that were entwined in various forms of serialism, aleatoric music, the sound mass technique, and later unprecedented explosion of expressive possibilities driven by electronics. From the current point of view, the appearance of computers seamlessly took over along the same path of exploring novel formalized approaches, but relieving composers of the burden of manual work, thereby reducing "human intervention". However, the necessity of human intervention did not disappear. Instead, it shifted from manually calculating sound object's parameters to designing and improving formal processes in ways that were previously not possible. Numerous examples include tendencies to unify compositional technique on different time scales, pioneered by Iannis Xenaxis (Serra, 2009; Loque, 2009), broader

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explorations of microsound (Roads, 2004), sonification techniques (Thomas et al., 2011), and the rest of the wide world of sound synthesis.
A different, yet similar transformation of the notion of "human intervention" is happening today when machine learning algorithms replace and outperform procedurally assembled algorithms. Even though the deductive step of machine learning algorithms is also a formal, procedural process, the key difference between manually engineered processes and those obtained by machine learning is that the latter have an ability to improve their performance from data. The ingredient that makes such algorithms suitable for their tasks is not the algorithmic procedure (which is generic), but its parameters automatically learned without human intervention. Moreover, setting parameters manually for almost any non-trivial model would be practically impossible. As a result, not only do machine learning algorithms automate human work, but also open new possibilities.

This historical development confirms the far reach of Alpren's definition. Composition became algorithmic when composers ceased their heavy manual work of choosing particular sound object's parameters and when they focused on generative algorithms instead. However, compositional approaches stayed qualified as algorithmic even in the machine learning era in which the algorithm lost its appeal when composers turned their focus back to music material. Still, the definition holds because the deductive step of machine learning algorithms is a formal process and little human intervention is needed in choosing sound object's parameters.

4.2 A GENERATIVE ENGINE

The generative engine behind *Anastatica* resides between a hardwired and a machine learning system. It is a data-driven algorithm that requires interventions on all levels – from the algorithm design to preparation and selection of the material. In the context of *Anastatica*, the material refers to lines of code that serve as building blocks for the generative process. However, the majority of parameters and the overall resulting aesthetic significantly emerge from the material. Such an approach is an illustrative showcase of human influences on various levels that stop at the moment when the algorithm starts, and music begins.

The underlying mechanism and foundation of *Anastatica*'s generative process is a Markov chain, a well-proven model whose long history in algorithmic composition makes it a somewhat outdated choice in modern generative systems. Markov chains enabled the earliest experiments on formalized music back in the 1950s (Hiller & Isaacson, 1958; Brooks et al., 1957; Pinkerton, 1956), but remained a viable, although limited, approach to model melodies and musical phrases (Ames, 1989; Pachet, 2011). The Markov chain is a machine learning algorithm with parameters induced from a corpus of pre-existing compositions. Its main weakness is that the chain can capture only local statistical similarities, while failing at inducing relations on higher time scales.

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Risk	Algo-rithm	Param-eters	Corpus	Solution
Falling into long loops of same sequences	•			The preprocessing algorithm was designed to reduce probabilities of transitioning to already processed states so that all of them are lower than transition probabilities to unprocessed states.
A lack of control over musical architecture of the overall piece		•		The generative algorithm can be restarted with different parameters in order to build a higher-level musical form.
A lack of variety among movements of the same musical piece	•	•	•	The generative algorithm was designed to reset the state as configured. For even more variety, a separate corpus can be defined.
Inadequate duration of movements and the overall piece		•		The number of generated code blocks is set as a parameter.
Possible unexpected sonic results and for minimal human interventions.				This is not treated as a risk, since the generative process and the corpus were created for a diverse musical expression and for minimal human interventions.

Figure 3: Aesthetic considerations while designing *Anastatica*'s generative engine. These considerations were addressed by adapting the pre-processing or the generative algorithm (column: Algorithm), by adjusting some general parameters (e.g., the distribution of random pauses between generated blocks, column: Parameters), or by intervening in the material (column: Corpus).

The use of the Markov chain in *Anastatica* is significantly altered in order to adjust the method to the material and achieve a distinctive aesthetic. The states of the Markov chains are predefined blocks of TidalCycles code, but instead of inducing transitions between the states from pre-existing live coding performances, they are constructed algorithmically.

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This pre-processing step of setting transition probabilities runs on a predefined corpus of code blocks and calculates the probabilities in a deterministic way. The resulting transitioning probability between two states is negatively correlated with the Levenshtein distance between code blocks written in those states. This solution favours smaller changes from one block to another in the same manner as a human musician during live performances usually modifies existing code blocks rather than writes new ones (Kreković & Pošćić, 2019). The pre-processing algorithm was therefore designed to be widely and uniformly applicable to predefined corpuses of different contents and sizes, but to always reflect the same concept that the syntactic level of TidalCycles code influences the generative process.

Such a scalable, generic, and inherently data-driven pre-processing approach shaped the nature of composer's intervention. The scope of concerns shifted from individual transitions to organizing and "composing" the corpus of code blocks and to tuning some general parameters of the generative algorithm, such as the distribution of random pauses between generated blocks, the distribution of random tempo, the number of blocks that should be generated, etc.

4.3 FIGHTING AESTHETIC INDETERMINACY

One specific challenge was that TidalCycles supports multiple channels, which simultaneously interpret assigned code blocks and translate them to music. This made *Anastatica*'s engine generate mutually unrelated code sequences for different blocks at the same time. In the context of a generic system capable of producing a wide range of musical expressions, this is a desired behaviour, but the aesthetic results are less desired, as the effect of algorithmic coherence within individual channels (achieved by the pre-processing) is overridden by the lack of such organization between the channels. Instead of intervening in the algorithm, we opted for another approach – to intervene in the material.

However, the material is flexible and dependent on a compositional process, so the solution was to create a simple guideline for preparing the material for *Anastatica*. The guideline emerged together with the corpus preparation through iterative trials and eventually reflected the desired distribution of code blocks that produce certain types of sonic results into different channels. Therefore, each channel has its approximate distribution of rhythmic, tonal, and textural contents. Since the algorithm did not change, there were still possibilities of combining undesired types of sounds (e.g., overwhelming tonal contents), but those possibilities are shaped by the compositional process.

This example shows that even with such a generic generative process, a deliberate artistic approach entails creative human intervention on various levels. While this challenge was crucial, Table 1 lists additional examples of major aesthetic issues that we faced.

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While algorithmic compositions arose as a direct automatization and formalization of compositional techniques (Nierhaus, 2009) serving as a music-making tool (Guedes, 2017), and even a platform for understanding formalization of human creativity and intuition (Nierhaus, 2015), the nature of human influence in the generative music may seem changed in the context of highly autonomous generative systems based on AI.

4.4 THE END OF HUMAN INTERVENTIONS?

A valid question is whether observations drawn from *Anastatica* can be seamlessly generalized to say that generative algorithms still require human intervention and creativity, though with a different focus than in traditional approaches. If instead of relying on a Markov chain, its adjustments, and the custom pre-processing algorithm *Anastatica* employed an even more generic approach, such as a long short-term memory (LSTM) neural network, would we be able to argue that human creativity is still inevitable?

Before answering the question, it is important to acknowledge that inner workings of generative algorithms and data necessary to train or feed the algorithm are tightly related to the ability to generalize and produce a wider distribution of outputs with a different level of human intervention. If two algorithms create outputs with similar statistical distribution, one that relies more on procedural and structural aspects will encapsulate more complexity and require less data than an algorithm with less procedural details, but with better ability to learn. Although not related to generative art, an excellent example is Google's AlphaZero program that in 2017 defeated the almost thousand times more computationally powerful Stockfish 8 program, the world's computer chess champion for 2016. The importance lies in the fact that AlphaZero did not learn to play chess from humans, but from playing it with itself using a technique of reinforcement learning. And it took only four hours. Its radically different inner workings led AlphaZero to victory that proved higher computational intelligence.

So, would an LSTM trained on thousands of TidalCycles code blocks learn how to produce better music with less human intervention than *Anastatica*'s current algorithm? Probably yes, assuming that someone has selected the appropriate hyperparameters of the neural network and prepared a large corpus – perhaps at least an order of magnitude larger than the current corpus of circa thousand code blocks – with relevant distributions of examples. Such an effort definitely qualifies as a human intervention. Moreover, an intervention that requires specialized skills and clear artistic tendencies.

The final concern might be related to the black-box approach and possible hyperproduction of art. What if a trained LSTM or *Anastatica* come into the hands of someone who intends to use these generative algorithms without significant interventions and only by manipulating obvious parameters? That is a valid use case that can lead to interesting

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results, new experiences and knowledge on the personal level, popularization of art, and fun. However, such a black-box approach should not stop the civilizational urge to unbox the machine, to broaden boundaries of artistic expressions, and to immerse into endless possibilities.

While black-box usage reduces the necessity for fine skills that are traditionally needed to produce art, thereby jeopardizing some traditional artistic values, it leads to immediate results that eventually become expected and common. However, there will always be space for an (at least partially) unboxed and committed approach which usually requires mastery proportionally demanding to the complexity of the underlying technology and which may entail radical and unprecedented artistic results. From that point of view, there is no fear that humans will delegate their creativity to generative algorithms. It is an approach that simultaneously stands against and with Heidegger's idea of artists as revealers of truth (Heidegger, 2009 [1954]), able to dispel threats of enframing, while simultaneously unable to control and understand the process completely.

5. CONCLUSION

In this paper we have first overviewed examples of artificial intelligence in art with a focus on music that served as foundation and inspiration for our own contributions. Based on these works and philosophical and technological research, we introduced *Anastatica*, a combination of performance and installation artwork that aims to question the relationship between humans and algorithms, to bring AI closer to wider audiences by allowing introspection and direct interaction, and to challenge the prevalent aesthetic determinism of live coding.

By dissecting and analysing *Anastatica* both from a performative, historical, procedural, and technological perspective, we then provided insight into the workings of generative music, the challenges of using AI in art, and the still important role of human creativity in this whole process. In doing so, we have partially demystified the use of these technologies in music, while simultaneously opening avenues of future research that should further challenge currently prevalent notions of black-box approaches. As such, while a completed artwork, *Anastatica* is a stepping stone toward wider examinations.

5.1 FUTURE WORK

We see the work started with *Anastatica* and our analysis presented in this paper as branching off into three distinct directions. The first avenue of research is to improve the artificial intelligence algorithm, possibly by replacing Markov chains with more advanced techniques like LSTM. Simultaneously, the AI should be made antagonistically inclined towards

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the musician as to force them to discover new aesthetics and modes of playing in response to the machine now acting as an adversarial improvising partner.

Secondly, we should seek emerging aesthetics, alien to humans, by minimizing the influence of the composer/artist in the generative process. Both an artistic and technological challenge, these new systems of aesthetics would require artists and critics to exist within the realm of the machine, perhaps oblique to human observers.

The third and final form of further investigation would include modifications of the artwork itself, making it a permanent, interactive web-based installation that could be also used during "performative snapshots" in front of live audiences. By doing so, we would amplify the sense of tirelessness often associated with machines, where a specific performance becomes only an ephemeral projection of an endless process.

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