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Perspectives on the Use of Artificial Intelligence Technologies in Contemporary Music Composition: Three Case Studies

Abstract

This article researches the intersection between artificial intelligence (AI) and contemporary music composition, contextualizing its use within academic sound creation and shaping its focus on the exploration of the techniques, motivations, and sociocultural interests of three composers who employ AI techniques in their creative processes: Mary Simoni (USA) Santiago Rentería (MX) and Paul Hembree (USA).
Through the presentation of three case studies, specific examples of AI-assisted compositions are analyzed, highlighting how these facilitate complex creative processes and structure aesthetic features. Finally, the cited perspectives are discussed under the axes of creativity, intellectual property, and future trajectories.

El presente artículo investiga la intersección entre la inteligencia artificial (IA) y la composición musical contemporánea, contextualizando su uso dentro de la creación sonora, centrándose en la exploración de las motivaciones, técnicas e intereses socioculturales de tres compositores que emplean técnicas de IA en sus procesos creativos: Mary Simoni (EE.UU), Santiago Rentería (MX) y Paul Hembree (EE.UU).
A través de la presentación de tres casos de estudio se analizan ejemplos específicos de composiciones asistidas por IA, destacando como estas facilitan procesos creativos complejos y estructuran cualidades estéticas. Finalmente, se discuten las perspectivas citadas bajo tres ejes de discusión: la creatividad, la propiedad intelectual y las trayectorias a futuro.

1. Introducción

> Years ago, when science still feared meaning, the new field of research called 'Artificial Intelligence' started to supply new ideas about "representation of knowledge." Are such ideas too alien for anything so subjective and irrational, aesthetic, and emotional as music? Not at all. I think the problems are the same and those distinctions wrongly drawn: only the surface of reason is rational.[1]

[1] Minsky, Marvin. "Music, mind, and meaning." Computer Music Journal 5, no.3 (Fall 1981): https://web.media.mit.edu/~minsky/papers/MusicMindMeaning.html.

Following Marvin Minsky's seminal contributions in 1981, the term "AI" has become widely utilized in contemporary discourse, presenting challenges in defining its boundaries due to the diverse array of mechanisms employed within its domain. This paper uses the term to encompass techniques such as *machine learning*, *deep learning*, *machine listening,* and generative algorithms trained on datasets to create content applicable to music creation.

To establish a critical framework regarding new creative practices in contemporary music composition, the following works: *Piano Quartet* (2021) by Mary Simoni**,** *Spectral (De)Compositions* (2023) by Santiago Rentería and *Sounding Orbs* (2014) by Paul Hembree, are analyzed as three case studies situated at the intersection of artificial intelligence and musical composition, whose methods, perspectives, and ethical and philosophical considerations act as the discursive axis for the discussion of the following questions: What are the aesthetic interests in using AI models in contemporary musical composition? What biases can be recognized in the music produced by these techniques? Is there a degree of creative loss in automating traditional composition processes? and, What are the pertinent judgments of value for their analysis?

The perspectives presented throughout the text are research results under the topic "Human-AI Interactions" led by Dr. Pooyan Fazli, as well as the mentorship of Dr. Fernanda Navarro as part of the undersigned's postgraduate studies at Arizona State University during the Fall of 2024. It is worth noting that none of the composers cited in the case studies operate directly within the entertainment industries;[2] rather, their context lies in contemporary musical composition, teaching, and software development. The case study subjects and the additional professionals consulted —Dr. Hugo Solís García and Dr.

[2] Cine, publicidad, televisión, etc.

Francisco Colasanto—, offer a significant perspective based on their professional practice and academic musical foundations, which extend to other disciplines such as computer science, audio engineering, research, and education.

I.I Case Studies

Mary Simoni (EE.UU)

Mary Simoni is a renowned American composer whose work encompasses digital signal processing, sound synthesis, algorithmic composition, and the design and programming of new interfaces for musical performance. Simoni is the author of the books "Algorithmic Composition: A Gentle Introduction to Music Composition Using Common LISP and Common Music" (2003) and "Analytical Methods of Electroacoustic Music" (2005). She is a Professor Emerita at the University of Michigan in the area of Performing Arts and Technology. She has been serving as the Dean of the School of Humanities, Arts, and Social Sciences at Rensselaer Polytechnic Institute in New York since 2011.

Santiago Rentería (MX)

Santiago Rentería is a transdisciplinary researcher working at the intersection of artificial intelligence, music, and biology. In addition to machine learning, one of his main interests is developing and understanding forms of non-human intelligence through artistic experimentation. In his practice, he engages with various media such as generative deep learning, spatial audio, and automatic listening. He is a PhD candidate in philosophy at the University of Western Australia, with an emphasis on machine learning, music, and acoustic ecology. He holds a master's degree in computer science from Tecnológico de Monterrey and is the author of the scientific articles "Data-driven Techniques for Music

Genre Recognition" (2020) and "Birdsong Phrase Verification and Classification Using Siamese Neural Networks" (2021).

Paul Hembree (EE.UU)

Paul Hembree is a composer, creative technologist, and educator who works in the musical field using artificial intelligence and interactive media. He holds a PhD in music with a specialization in composition and computer music from the University of California, San Diego. Hembree is interested in responsibly shaping the future of musical creation in the era of automation, where his contributions as a software developer for prominent commercial companies have focused on building scalable music generation systems based on ethically sourced datasets created and/or curated by expert musicians.

Through the case studies, this research aims to analyze different production approaches to contextualize the contemporary practice of musical composition using artificial intelligence and its underlying technologies. Additionally, the presented content seeks to be useful in introducing readers from various disciplines to some of the most common techniques in this context, without allowing theoretical complexity to become an understanding obstacle.

II. Related Work

Traditionally, artificial intelligence tools for music generation have used a variety of

methods, including Markov chains,[34] rule-based models,[56] and evolutionary algorithms.[78] These methods are usually parameter-based, requiring manual input of relevant criteria or settings to guide the music generation process.

One of the pioneering works that used the aforementioned methods was the ILLIAC Suite, a composition for string quartet generated from Markov chains and heuristic compositional rules of classical harmony and counterpoint, created by Lejaren Hiller with the assistance of Leonard Isaacson in 1956.[9] Several decades later, with the work of Gary M. Rader (1974), what is considered by researcher Ramón López de Mantaras[10] to be possibly the most genuine example of the early use of artificial intelligence techniques in musical composition emerged.

Rader developed a method for composing musical canons by computer, based on a set of productions, weighting rules, and applicability rules that operate on the outputs, deciding when and to what extent they are available for use.[11] The author made a value judgment about the results of his own method, calling them «mediocre for the professional,

[3] Sudhanshu Gautam and Sarita Soni. «Music composition with artificial intelligence system based on Markov chain and genetic algorithm», *International Journal of Creative Research* 6, no.2 (2018): 1202-1205.
[4] Las cadenas de Markov son modelos matemáticos que se utilizan para analizar y predecir el comportamiento de sistemas que exhiben una propiedad llamada la propiedad de Markov. Zhu, Yueyue, Jared Baca, Banafsheh Rekabdar, and Reza Rawassizadeh. «A Survey of AI Music Generation Tools and Models». *ArXiv*, (2023). Accessado Noviembre 29, 2023. /abs/2308.12982.
[5] Randall Richard Spangler. «Rule-based analysis and generation of music», California Institute of Technology (US) 1999.
[6] La generación de música basada en reglas, emplea reglas predefinidas para crear datos musicales que siguen patrones o estilos específicos.
[7]Ziyi Zhao, Hanwei Liu, Song Li, Junwei Pang, Maoqing Zhang, Yi Qin, Lei Wang, and Qidi Wu. «A review of intelligent music generation systems», (2022). Accesado Marzo 6, 2024. https://arxiv.org/pdf/2211.09124.pdf
[8] Los algoritmos evolutivos, específicamente los algoritmos genéticos, se dedican a la identificación selectiva de las mejores secuencias musicales, perfeccionandolas mediante mutaciones y entrecruzamientos, fomentando así el surgimiento de nuevas composiciones.
[9] Illinois Distributed Museum. «ILLIAC Suite», *University of Illinois Archive*, Mayo, 2024. https://distributedmuseum.illinois.edu/exhibit/illiac-suite/
[10] López de Mántaras, R. «La inteligencia artificial y las artes. Hacia una creatividad computacional», El próximo paso. La vida exponencial, Madrid, BBVA, 2016.
[11] Rader, G. M., «A method for composing simple traditional music by computer», 1974. Reeditado en Schwanauer, S. M. y Levitt, D. A. (eds.), Machine Models of Music, Cambridge, Massachusetts, The MIT Press, 1993, pp. 243-260.

although usually pleasing to the layman», outlining what has now become an inherent feature of musical creation with artificial intelligence.

> The problem is not whether computers can compose music, but how far can we go in formalizing human symbolic systems, in this case, music. The goal here is not to make aesthetically perfect music but to make it indistinguishable to the human ear from human-produced music.[12]

In contrast to the aforementioned methods, more recent models have been developed based on neural networks that receive inputs based on instructions. Non-neural models operate within stochastic processes, user-defined patterns, and algorithmic methods, facilitating diverse approaches for automation and pattern recognition. On the other hand, AI tools operating with neural network models use a variety of training datasets, music libraries, and generative mechanisms, including generative adversarial networks (GANs),[13] transformer models,[14] and variational autoencoders (VAEs),[15] among other techniques. These facilitate the generation of complex musical tasks ranging from sound synthesis to

[12] Rader, «A method for composing», 243-260.

[13] Las redes adversarias generativas (GANs) son un método basado en el entrenamiento de dos redes neuronales, una denominada generadora y otra discriminadora, compitiendo entre sí para generar nuevas instancias que se asemejen a las de la distribución de probabilidad de los datos de entrenamiento. Jordi de la Torre. «Redes Generativas Adversarias (GAN) fundamentos teóricos y aplicaciones», *ArXiv*, (2023). https://arxiv.org/pdf/2302.09346

[14] Un modelo transformer es una red neuronal que aprende el contexto de datos secuenciales y genera nuevos datos a partir de ellos. Los transformers fueron desarrollados inicialmente para resolver el problema de transducción de secuencias, lo que significa que están destinados a resolver cualquier tarea que transforme una secuencia de entrada en una secuencia de salida. Josep Ferrer «How transformers work: a detailed Exploration of Transformer Architecture» *Datacamp* (Enero, 2024), https://www.datacamp.com/tutorial/how-transformers-work

[15] Los VAEs son modelos gráficos probabilísticos basados en redes neuronales que permiten la codificación de los datos de entrada en un espacio latente formado por distribuciones de probabilidad más sencillas y la reconstrucción, a partir de dichas variables latentes de los datos de origen. Después del entrenamiento, la red de reconstrucción denominada decodificadora, es capaz de generar nuevos elementos pertenecientes a una distribución próxima, idealmente igual, a la de origen. Jordi de la Torre. «Autocodificadores Variacionales (VAE) fundamentos teóricos y aplicaciones», *ArXiv*, (2023). https://arxiv.org/pdf/2302.09363

the composition of musical forms, providing greater accessibility for users regardless of their level of musical training.

Two relevant models that utilize these techniques are *Jukebox* (2020) and *MusicLM* (2023). *Jukebox* is a recent neural network-based model for music generation that includes vocal elements in a wide variety of genres and musical styles, using variational decoders and transformers to produce new compositions. *Jukebox* generates music samples by capturing global patterns and subtle details through a hierarchical approach. To train the model, «a dataset of 1.2 million songs from various artists and genres was collected, allowing music generation in a specific style.»[16] On the other hand, MusicLM is capable of creating music in various genres and styles based on text prompts. The model produces high-fidelity melodies from simple textual descriptions.[17] According to its creators, the underlying dataset consists of a selection of 5,500 pairs of music and text described by human experts, offering numerous opportunities for both researchers and music enthusiasts.[18] However, «one of its significant limitations is that the official model has not been released as an open-source project due to royalty risks.»[19]

Despite the fact that generative AI tools are capable of efficiently achieving aesthetic and formal objectives, they offer artists limited flexibility to intervene in specific stages of the composition process. Additionally, these applications have sparked negative connotations related to the training sources they rely on. In contrast, as discussed below,

[16] Yueyue, Baca, Rekabdar, y Rawassizadeh. «A Survey of AI Music...»
[17] Como pueden ser: "la banda sonora principal de un juego de arcade. Es de ritmo rápido y animado con un riff pegadizo de guitarra eléctrica. La música es repetitiva y fácil de recordar, pero con sonidos inesperados, como choques de platillos o redobles de tambor". Google Research. «Audio Generation From Rich Captions», *MusicLM: Generating Music from Text* (Accesado: Mayo, 2024). https://google-research.github.io/seanet/musiclm/examples/
[18] Andrea Agostinelli, Timo I. Denk, Zalán Borsos, Jesse Engel, Mauro Verzette, Antoine Caillon, Qingqing Huang, Aren Jansen, Adam Roberts, Marco Tagliasacchi, Matt Sharifi, Neil Zeghidour, and Christian Frank. MusicLM: Generating music from text, 2023. https://musiclm.com/
[19] Yueyue, Baca, Rekabdar, y Rawassizadeh. «A Survey of AI Music...»

artists committed to a critical musical practice significantly diverge from the approaches established by popular tools.

III. Case 1. Mary Simoni: *Piano Quartet* (2021)

The Piano Quartet (2021) by composer Mary Simoni employs machine learning to integrate music and data. Each instrument in the quartet corresponds to a renowned classical composer. The training sets consist of symbolic data ordered in time in MIDI format, normalized in musically significant ways such as transposition to the same key, avoidance of harmonic modulations, and grouping into a specific time value. The training corpus for each of the four composers (Niccolò Paganini, Johannes Brahms, J.S. Bach, and Erik Satie) served as input for conducting a second- and third-order Markov analysis,[20] producing a statistical analysis of each composer's music. Following the analysis, stochastic processes were used to generatively produce new music that exhibits stylistic similarities with each of the four composers.[21] This composition employs machine learning to embed the musical genetic material extracted from public domain databases of the aforementioned classical composers, curating the results through methods based on traditional musical notation.

The narrative of the composition is constructed as an allegory of the collective experience of the COVID-19 pandemic, told through an essay. At the beginning, during the tuning, each member of the ensemble is introduced through their musical DNA.. The violinist represents Niccolò Paganini, the violist represents Johannes Brahms, the cellist

[20] En el análisis de una cadena de Markov de primer orden la probabilidad de los eventos futuros se determina exclusivamente por los resultados del último ciclo. Por otro lado, en un proceso de Markov de segundo orden, se toman en cuenta las probabilidades de transición durante los dos últimos ciclos inmediatamente anteriores para pronosticar los posibles eventos futuros.

[21] Mary Simoni, *Piano Quartet,* Cambridge University (UK) Centre for Research in Arts, Social Sciences, and Humanities (CRASSH) 2021.

represents J.S. Bach, and the pianist represents Erik Satie. After this introduction, the violinist starts a four-voice fugue, with the theme representing the musical portrayal of the virus genome, where each component is assigned specific tones and their chromatic variants. Following the exposition of the fugue, the main theme, serving as a metaphor for the infection, is inserted into each of the voices. The virus, now linked to the musical genetics of each performer, begins to replicate, creating mutations through augmentation, diminution, inversion layers, and various retrograde permutations in the ensemble's voices.

The creative methodology of this work is a good example of how AI enables the creation of music that would be difficult to achieve otherwise. It is valuable to question whether there is a degree of creative loss in the automation of traditional compositional processes, or whether, as the composer asserts: «Our entrenched mental habits prevent us from realizing something novel, and the way we program computers can take us beyond these habits towards new ways of thinking.»[22]

The musical result of the quartet efficiently fulfills the conceptual objectives of the work, as the musical genetics of each composer are highly recognizable throughout the piece's narrative. Although the underlying AI algorithms facilitated technical aspects of the composition, they do not play a primary role in achieving its aesthetic goals. The expressive factor is addressed through the curation of the results, where the composer acts as a stylistic hand, structuring the musicality of the work.

The methods described by the composer relate to pioneering works such as the ILLIAC Suite (1956) mentioned in the previous chapter. It is interesting to see how these contributions remain relevant in assisted composition strategies, although their validity as methods of autonomous composition has been widely questioned. According to Simoni,

[22] Mary Simoni, entrevista escrita con la autora, (Noviembre 2023).

«Unlike previous passing fancies in various methods of algorithmic composition, I think generative AI is likely here to stay. I think the underlying technologies described as machine learning will become obsolete at some point since their processing is very data and compute-intensive.»[23] The technologies Simoni refers to will likely become obsolete not only due to their technical difficulty but also because, as López de Mántaras mentions, their results are not sufficiently developed to consistently produce high-quality music.[24]

How, then, can the expressive and sensitive character in compositions stemming from automatic processes be approached? The tools that could be considered successful in such terms are built from neural models trained with large sets of musical data, which bring into play different ethical considerations regarding the sources they are based on. Since the Piano Quartet uses historical and public domain archival material without neural models, it avoids positioning itself within these dilemmas.

Regarding its creative potential, the composer considers that current creations with artificial intelligence have qualities similar to previous trends in algorithmic composition, such as evolutionary algorithms and augmented transition networks. In this vein, the unique qualities of AI systems will likely shape alternate aesthetic currents that will continue to re-contextualize the concept of creativity in contemporary composition.

Case 2. Santiago Rentería: *Spectral (De)Compositions* (2023)

[23] Mary Simoni, entrevista escrita con la autora, (Noviembre 2023).
[24] López de Mántaras. «La inteligencia artificial y las artes..»

Spectral (De)Compositions (2023) by Santiago Rentería, uses data mining[25] on the sound archive of birds to produce a multichannel soundscape. In this piece, sound fragments from an archive from western Australia are subjected to two automatic listening algorithms.[26] The first assigns numerical directions to regions of the soundscape according to signal similarity, while the second segregates the results of the algorithmic composition into six audio channels.[27] This composition uses automatic listening techniques on material initially obtained for the study of animal communication, dismantling and reconstructing sound samples into a binaural soundscape, in the words of the composer:

> The analytical sound techniques of automatic listening, although they do not replace bodily listening nor experience sound in any way, open a realm of interactive possibilities for spectral (de)composition at the convergence of sound art and environmental monitoring. By assembling carefully selected fragments from a scientific sound archive, the resulting sounds uncover the enigmatic nature of a kind of listening without ears..[28]

In contrast to the previous case, the role that AI tools play in this work not only serves a technical function but also contributes to the sound aesthetics sought by the composer, presenting another place of listening and re-contextualizing the data on which it is based. Considering the aforementioned characteristics, what musical value judgment can be attributed to the work? Given that the material relates to the formal and psychoacoustic

[25] La minería de datos es el proceso de detectar la información procesable de grandes conjuntos de datos. Utiliza el análisis matemático para deducir patrones y tendencias. Normalmente, estos patrones no se pueden detectar mediante la exploración tradicional de los datos porque las relaciones son demasiado complejas o porque hay demasiados datos. Microsoft Learn. «Data mining concepts», *Analysis Services* (dic, 2023), learn.microsoft.com/es-es/analysis-services/data-mining/data-mining-concepts?view=asallproducts-allversions

[26] La audición computacional (CA) o escucha automática es el campo general de estudio de algoritmos y sistemas para la interpretación de audio por máquinas. Wenwu Wang, *Machine Audition: Principles, Algorithms and Systems* (Information Science Reference, 2010) ISBN 9781615209194.

[27] Santiago Rentería, «Algorithmic soundscape with Australian birds», *Santiago Rentería* (Oct. 2023) https://www.renterialab.com/works/dadamining.html

[28] Rentería, «Algorithmic soundscape …»

qualities of sound, the production dynamics proposed by the author lead to a reflection on the way we interpret sound and the weight given to the meaning of the sources. In turn, Rentería's work prompts reflection on the computer-creativity binomial, questioning whether the system used for the composition exhibits creative behavior or, on the contrary, merely stimulates creativity in human terms. On this binomial, researcher Linda Candy mentions that the strengths and weaknesses of current computer systems can be judged based on whether they meet the skills, needs, and expectations of the user within a given context.[29]

In the aforementioned works, AI tools act as facilitators of complex processes rather than autonomously generating singular results. For this reason, it is not appropriate to approach them in terms of their creative potential but rather based on their effectiveness in assisting composition processes.

Case 3. Paul Hembree: *Sounding Orbs* (2014)

Due to the artist's dual training, this case establishes interesting contrasting perspectives on the applications of AI tools, highlighting the distinctions between their use in the industry (as a developer) and in the creative context (as an artist), with an emphasis on the origin of the data sets used in both cases. In the words of the composer:

> My interests in generative music involve microtonality and other techniques that can't be modeled by training on public datasets (because so little well labelled microtonal music exists, etc.). I usually write all my own algorithms using rule-based techniques that allow for parameterization of outputs, or I

[29] Candy, Linda. «Computers and creativity support: knowledge, visualization and collaboration», *Knowledge-Based Systems* 10 3- 13 (1997)

build systems that are more instrument-like than compositional in nature, and I improvise with them.[30]

Hembree's practice in the industry focuses on the generation of procedural music that relies on data sets acquired according to ethical principles, specifically created by composers for the training data set, as well as the taxonomy of compositional features curated by experts. In the artistic area, his practice is concerned with building data sets of microtonality and rule-based systems[31] that allow for the parametrization of outputs, considering such systems as instruments rather than agents.[32]

The application of these techniques is notable in the work **Sounding Orbs (2014)**, which is a generative and synesthetic virtual instrument that allows the computer music performer to synergistically explore a space of light and sound. The conceptual core of this virtual instrument is a structure of forty-eight orbs, visually represented by light-producing spheres and sonically by synthesized tones. In this context, cellular automata[33] were used for their ability to evolve dynamically and variably, smoothly across space, in a manner similar to chorale progression in tonal music. Performers are able to interact with the instrument and create musical nuances by directly manipulating cellular activity (turning certain cells on or off) or environmentally (changing the rules under which the cellular

[30] Paul Hembree, correo electrónico a la autora, (8 Noviembre 2023).
[31] Los sistemas basados en reglas emplean un conjunto de reglas predefinidas para derivar conclusiones a partir de datos proporcionados. Estas reglas por lo general se representan en forma de declaraciones *Si-Entonces* (*If-Then*) para representar condiciones y conclusiones respectivamente.
Neuron. «Sistemas Basados en Reglas: Principios y Aplicaciones» (Abril, 2024), https://neuron.com.ar/sistemas-basados-en-reglas-principios-y-aplicaciones/
[32] Paul Hembree, correo electrónico a la autora, (8 Noviembre 2023).
[33] Los autómatas celulares son sistemas computacionales discretos y abstractos; están compuestos por un conjunto finito o numerable de unidades simples y homogéneas, (los átomos o células). En cada unidad de tiempo, las células instancias uno de un conjunto finito de estados.
Stanford Encyclopedia of Philosophy. «Cellular Automata» (Marzo, 2012), https://plato.stanford.edu/entries/cellular-automata/

automaton operates), while navigating the virtual space, highlighting the activity of light and sound at various levels.[34]

If these tools are considered instruments in themselves, the way they are tuned can provide different layers of meaning to the output, «like a cybernetic feedback loop or an improvisation with a well-understood instrument.».[35]

Works like **Sounding Orbs** are designed to operate as an instrument and interact with a performer, so their artistic value has unique implications, such as the limits of modification, their level of expressiveness, and the expertise of the performer needed to interact effectively with the tool. Often, instruments that arise from intensive computational processes carry more weight in the mysticism of the process rather than in the sound or audiovisual result.

Like the previous case studies, Hembree's artistic objects do not fall under ethical dilemmas of authorship, ethics, and originality. Instead, the artist outlines a critical stance regarding his role as a developer of generative artificial intelligence tools, which are not directly referenced in this work due to confidentiality agreements.

> All generative algorithms created by the teams I've worked with have been of our own design and programming, although sometimes low-level mathematical operations and representations between data and notes have been handled by open-source libraries created by third parties. (...) My general approach is that one should not assume that a creator would approve the use of their work to train a machine learning model, even if permissions allow it; there is an

[34] Paul Hembree, «Sounding Orbs», *Paul Hembree* (2014) https://www.paulhembree.com/orbs.html
[35] Paul Hembree, correo electrónico a la autora, (8 Noviembre 2023).

unprecedented use of user data that requires all parties to pay special attention (participation must be Opt-in)..[36]

The most pressing issue for the composer lies in the impact on the economic dynamics related to the training of large generative tools. While these operate within legal boundaries, they are considered to exist in an ethical gray area because the composers in question may not have foreseen that their work could be used to train an AI in the future. As in many artistic disciplines, having a critical view of the original sources seems crucial for the artistic quality of the work produced.

IV. Discussion Axes

The following encompasses the perspectives of the previous cases based on three fundamental constants: creativity, intellectual property, and the future.

IV.I Creatividad

According to López de Mantaras, creativity is not a mystical gift beyond the realm of scientific study but something that can be investigated, simulated, and redirected for the benefit of society.[37] In the artistic field, the evaluation of a work is not limited solely to the final result but extends to the process, the context, and the creative decisions made during its development.

Although the quality of compositions generated through neural networks is significantly better than those created by traditional (non-neural) methods,[38] within the case studies, there is less affinity towards the use of instruction-based models in the context of

[36] Hembree, (Nov, 2023).
[37] López de Mántaras. «La inteligencia artificial y las artes..»
[38] Yueyue, Baca, Rekabdar, y Rawassizadeh. «A Survey of AI Music...»

contemporary musical composition, essentially because the latter significantly limits the creative process. What degree of participation does human creativity have in such processes? Are artistic objects with less artificial input more valuable and creative than those mostly created generatively? On this topic, in a consultation with composer Francisco Colasanto, the following reflection arises: «Perhaps creativity lies in what is asked of the model, and we might reach a point where the difference between artists could lie not in their mastery of the tools but in their ability to request more interesting results.»[39] The democratization of AI tools will consequently introduce a new creative paradigm where potential distinctions will exist between users and programmers. Elaborating on this premise, composer Hugo Solís proposes the following.

> Since programming AI tools means starting the composition process long before its conventional beginning, one could assume that distinctions will eventually emerge between the users and developers of these techniques. These distinctions will gradually shape the style, transforming it into a recognizable resource. Therefore, originality will manifest in how people use their specific databases, ultimately defining much of the outcome.[40]

Regarding compositional practice, the three composers found significant utility in AI-assisted tools to avoid entrenched practices, driven by an aesthetic interest in unexpected results that foster discovery experiences for both the author and the audience. A relevant differentiator between the types of results is the distinction between methods that facilitate processes which could be achieved without AI, and those in which AI acts as an agent. Such was the case with Rentería, who directs his practice towards the exploration of

[39] Francisco Colasanto, videoconferencia con autora, (Octubre 2023).
[40] Hugo Solís, videoconferencia con autora, (Septiembre 2023).

unexpected concatenations of audio phenomena that can only arise through the use of unsupervised AI. These perspectives highlight a shared enthusiasm for unpredictability and the potential for discovery at the intersection of creativity and exploration driven by artificial intelligence processes.

Finally, the statement “Co-creation with AI challenges traditional notions of individuality and creativity as inherently human attributes" was presented to each of the cited composers with the options to respond: strongly agree, agree, neutral, disagree, and strongly disagree. While Simoni and Rentería responded "strongly disagree," Hembree was in complete agreement with the statement. These opposing stances reveal that the notion of creativity within the art-technology binomial can occupy a wide spectrum of definitions. The disparity in responses accentuates the complexity and diversity of opinions regarding the role of artificial intelligence in the creative process, where the integration of digital technologies in the arts is a fertile ground for debate and exploration.

IV.II Propiedad Intelectual

The dilemma regarding intellectual property predominantly revolves around the legal complexities associated with popular generative AI tools in the music industry, as composers engaged in this practice face challenges similar to those occurring in other disciplines within the current creative economy. On the other hand, in the academic context, there is a concern about the indiscriminate use of large data sets without adequately considering the aggregated significance of the sources. This reflects a desire for a more thoughtful handling of data with the aim of establishing ethical standards and avoiding unintentional biases within the works.

Just as certain nuances in the written language used by *ChatGPT*[41] can make its use recognizable in academic texts, we can ask whether there is a distinctive sonic identity in music generated by AI technologies. Once again, the origin of the training data sets is the agent that defines the answer to this question. Emerging as the primary concern in this context, composers emphasize the task of prioritizing the sociocultural significance of the sources, as well as standardizing the ability for composers to opt out of being part of a model's training data sets.

IV.III Futuro

One of the barriers articulated by the composers, particularly concerning AI tools based on prompts, is their limited capacity to adequately represent music through natural language. According to Hembree, music is notoriously elusive for people to describe, and they often resort to evocative language rather than precise language.[42] Conversely, AI tools that do not rely on prompts may be perceived as less accessible to composers who lack programming skills, making them less attractive due to the associated learning curve. As Rentería noted, the current methodology often involves a rudimentary training approach, which forces artists to improve their competencies in technical applications, including machine learning.[43] The composers also point to the lack of labeled data sets that encompass non-tonal music or unconventional musical structures. Moreover, revisiting the idea that the aesthetic qualities produced by AI tools could become a recognizable element in the future, the artists and researchers consulted for this article draw parallels between AI

[41] ChatGPT es una aplicación de chatbot de inteligencia artificial desarrollado en 2022 por OpenAi que se especializa en el diálogo. El chatbot es un modelo de lenguaje ajustado con técnicas de aprendizaje tanto supervisadas como de refuerzo. OpenAI. «ChatGPT» (Acessado Junio, 2024), https://openai.com/chatgpt/
[42] Hembree, (Nov, 2023).
[43] Santiago Rentería, videoconferencia con autora, (Octubre 2023).

AI and the emergence of specific digital advancements in the past that shaped particular musical styles, such as granular synthesis and other trends in algorithmic composition that changed the paradigm of musical practice.

Similarly, in the future integration of AI in contemporary musical composition, a broader exploration of alternative modes of composition is envisioned, which «goes beyond simply feeding data into machine learning models or deep neural networks.»[44] This emerging aspect implies a departure from the current reliance on language-centered prompts, evolving towards more gestural and less figurative cues, leading to a debate on how we interpret sound beyond text-based experiments.

Through the incorporation of more intuitive and abstract elements, a re-evaluation of the technologies driving these innovations is expected, fundamentally transforming creative methodologies with the use of artificial intelligence.

V. Conclusión

Through the case studies presented, the article examines the evolution and impact of AI and its underlying technologies in the context of contemporary musical composition, highlighting the methodological differences between neural and non-neural network models. It explores the various complexities of production processes as well as the potential and limitations of creative computer use.

In conclusion, the aesthetic interests of using AI models in the analyzed works primarily lie in the exploration of secondary processes whose results involve a reinterpretation of the original sources through curation by the composers. In this way, the biases that may be recognized in the music produced by these techniques, as well as the

[44] Rentería, (Oct, 2023).

relevant value judgments for their analysis, are more closely related to the data sets they are based on than to the techniques they use.

Generative AI, by democratizing technical aspects of composition, recontextualizes central axes of the musical domain such as creativity, intellectual property, and the creative economy. As these technologies advance, greater exploration is anticipated in the integration of other types of extramusical elements, redefining contemporary creative practices.

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