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The Role of Artificial Intelligence in Music Creation: Implications for Artists and the Industry

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ABSTRACT

This article explores the multifaceted implications of artificial intelligence (AI) in the music industry, primarily focusing on its application in music creation, production, and the evolving legal and ethical landscapes. With AI becoming increasingly central in businesses and technology, its role in music has expanded, ranging from AI-driven music generation services to instruments, effects, and voice models. I delve into the practical applications of AI in music, such as royalty-free background music for content creators and audio mastering, and the more public-facing research-oriented pursuits of industry leaders like Google and OpenAI. I also present examples of how AI has been used in recent commercial music releases, particularly by electronic producers such as Holly Herndon. Similarly, I critically examine the legal and ethical implications of deep learning in music, especially in the context of copyright issues. I also underscore the importance of transparency in AI applications, the economic impact of AI on musicians, and attempts within the music industry to guide the use of AI in music. Finally, I emphasize the responsibility of AI researchers and developers in understanding and mitigating the impacts of their creations, advocating for a critical examination of AI's socio-cultural effects and the environmental impacts of its energy needs. There is vast potential for AI in music, and I advocate for collaborative efforts among artists, developers, legislators, and other stakeholders to navigate the complexities of AI in music creation and production.

1 Introduction

Since the debut of OpenAI's ChatGPT in 2022, artificial intelligence has become a focal point, with businesses eagerly capitalizing on the heightened interest in AI technologies. However, the fluid nature of our conception of AI is evident, as encapsulated in axioms such as Tesler's theorem asserting that "artificial intelligence is whatever has not been done yet" [1]. This evolving understanding is further reflected in phenomena such as the "AI effect," the notion that "when an allegedly uniquely human ability or skill is being automated by means of computer technology, we refer to it as 'AI.' Yet, as soon as this automation is seamlessly and fully successful, we tend to stop referring to it as an 'AI case'" [2].

2 Emerging Applications for AI in Music

In the contemporary landscape, AI utilization spans various domains. Digital culture theorist Lev Manovich outlines a taxonomy of AI applications: "1) *Selecting* content from larger collections," "2) *Targeting* content," "3) *Assistance* in creation/editing of new content," and "4) *Fully autonomous* creation" ([3], emphasis in original). Current AI audio research and services largely fall into the latter two categories. To illustrate a taxonomy of AI-driven music products and services, Table 1 contains examples of such products and services categorized into music generation, plug-ins, mixing and mastering, source separation, voice models, music-driven productivity or wellness apps, and audio enhancement.

Table 1. AI Music Products and Services.

Company	Service/Product	Use
Google	MusicLM	Music generation
Suno AI	Suno	Music generation
Audialab	Emergent Drums 2	Drum machine
Sonic Charge	Synplant 2	Synthesizer
LANDR	Mastering (online/plug-in)	Mastering
RoEx	Mixing and mastering (online)	Mixing/mastering
AudioShake	Instrument Stem Separation	Source separation
LALA.AI	Stem Splitter	Source separation
Holly+	Holly+	Voice model
Voice-Swap	Voice-Swap	Voice models
Brain.fm	Brain.fm	Productivity/wellness
Endel	Endel	Productivity/wellness
insoundz	Revive	Audio enhancement

2.1 Music Generation

Music generation models can produce songs or song fragments, typically through a text prompt. Some ways current AI music generation services can be differentiated include their licensing options and how users can interface with the underlying models. Most services offer licenses for content creators and/or artists. The content creator licenses are less permissive, as they only allow creators to use tracks royalty-free in their content as background music. The licenses for artists are more permissive, allowing for commercial use of the output. These services also differ in the amount of freedom users have in querying the models. Some services such as Udio and Suno offer text and audio prompts for generating music, while others such as Boomy and Soundful are less open-ended, with options limited to certain parameters such as genre, theme, mood, instruments, and key signature.

Traditional tech companies have yet to release a commercial product or service for music generation, but Google, Meta, and OpenAI have introduced music generation models as demos: MusicFX is available through Google's AI Test Kitchen, Meta's MusicGen is available as a demo on Hugging Face, while OpenAI's Jukebox is less accessible to novices as users can run it on Google Colab. These demos serve as showcases for the cutting-edge research conducted by these companies, illustrating their commitment to staying abreast of AI developments. This contrasting approach between start-ups and traditional tech companies highlights both the practical venture capital-driven applications of AI in music creation and the currently research-oriented pursuits of industry leaders.

2.2 AI Instruments and Effects

AI-driven plugins are primarily oriented toward mixing and mastering tasks, exemplified by tools from iZotope and Sonible. This inclination may stem from the fact that these tools rely on analyzing incoming audio, which has been extensively researched in the field of music information retrieval. However, there are also notable AI-driven instruments, such as Emergent Drums 2, a drum machine, and Synplant 2, a synthesizer. Additionally, effects such as TAIP, a tape saturator, and Neutone, which runs various AI audio processing models, contribute to the expanding repertoire of AI-enhanced music production tools. An increased demand for AI-driven music-making tools is likely to spur the creation of a more diverse range of plugins. However, a potential obstacle lies in the computational overhead associated with running these models, whether locally or remotely. Balancing the need for advanced capabilities with the practical constraints of computational resources will be crucial for the seamless integration and widespread adoption of AI-driven plugins in music production.

2.3 Voice Models

Before the sophistication of AI, synthetic vocalists were created using either vocal synthesis or samples. Now producers can use AI to create virtual singers using models trained on recordings of real singers. The AI-generated voice clones of Drake and

The Weeknd on the song "Heart on My Sleeve" uploaded by TikTok user Ghostwriter977 in April 2023 brought widespread public attention to the capabilities of this technology [4]. While some AI music generation platforms such as Suno and Udio can generate vocals, there are presently few standalone officially licensed commercial voice models. Current offerings include Yamaha's VOCALOID6, a singing synthesizer with built-in AI functionalities, and Voice-Swap, a platform that has licensed voice models marketed for producers making demo tracks. Artists like Grimes and Holly Herndon are adopting alternative approaches by making models of their voices available for other musicians to use, albeit with certain stipulations [5], [6]. YouTube's DreamTrack is a notable experiment by a traditional tech company. A portion of users have access to voice models licensed from artists including T-Pain and Charlie Puth to generate songs as background music for the YouTube Shorts format [7]. The scarcity of official voice models likely stems from artists' and labels' hostility toward the technology, especially when it is open for anyone to use.

3 Examples of AI-Assisted Music Creation

Limited published research has focused on the intersection of artificial intelligence and music creation (see [8] and [9] for examples of existing research). However, insights gleaned from interviews with artists who integrate AI into their work shed light on the role of AI in their music-making process. Vocalist and producer Holly Herndon's 2019 album *PROTO* stands as an early example of AI incorporation, employing a machine learning program, Spawn. Trained on Herndon's voice, Spawn acts as a collaborator throughout the album [10].

The year 2023 witnessed a surge in music integrating AI technologies, potentially reflecting increased accessibility for the average user. Electronic producer Lee Gamble utilized voice models in his album *Models* to explore the potential humanization of AI technologies [11]. Similar to Herndon, Gamble trained one model on his voice and considered the voice models as collaborators in the music-making process. Another electronic producer, patten, asserts to have created the "first LP made entirely from AI-generated sound sources," *Mirage FM*, which, similar to Herndon, he hopes demonstrates the possibilities of AI-assisted creativity [12]. *Mirage FM* is composed of samples taken from Riffusion, a text-to-audio model. Riffusion is based on a fine-tuning of Stable Diffusion, a text-to-image model, on spectrograms [13]. It produces low-fidelity output, however, patten embraces this limitation, considering it an integral part of the tool's aesthetic. In contrast to the other artists' motivations, electronic producer Oneohtrix Point Never's album *Again* features some tracks composed with the assistance of various AI tools, including Riffusion and OpenAI's Jukebox, to explore the limits and failings of current AI technologies [14].

4 Legal and Ethical Implications of Deep Learning

Deep learning is accompanied by a plethora of legal and ethical implications, further complicated by the novelty of the technology. Firstly, there is the question of whether the training and output phases of AI models infringe on the copyright and/or rights to publicity of artists. Secondly, the copyright status of the output is complicated by questions of authorship and whether AI-generated works should be granted copyright. Lastly are questions surrounding the transparency of datasets and the implementation of AI within products and services, as well as the financial impact of AI on artists.

4.1 Copyright: Training and Output, Right of Publicity

Generative AI introduces the potential for copyright infringement during both the training and output phases. Notably, organizations like the Authors Guild, the New York Times, and Getty Images contend that training AI programs on copyrighted materials violates copyright law. In contrast, tech companies and their advocates argue that such activities fall within the realm of fair use [15]. As of now, multiple lawsuits on this matter are still pending, leaving both perspectives untested in a legal context. While some AI services decline prompts involving copyrighted characters or the imitation of a particular artist's style, others may permit users to generate such works, potentially exposing both the AI services and their users to legal action.

This year has marked new developments in music labels' approach to generative AI companies. Labels seem to be taking a two-pronged approach: they want to benefit from AI while maintaining control over their IP. For example, Universal announced in June 2024 that they were working with SoundLabs, an AI company, to develop voice model plug-ins for internal use by artists and producers on their roster [16]. I believe the trend of labels forming strategic partnerships with tech companies will continue as it will enable labels to take advantage of AI while granting them oversight of the training and implementation of

the technology. In addition, we are likely to see continuing legal action by labels against unauthorized use of their music by tech companies. Warner Music Group and Sony Music Group posted public letters they sent to tech companies stating that models were not to be trained on their content unless given prior authorization [17], [18]. Furthermore, Warner, Sony, and Universal filed suit against generative AI music companies Suno and Udio in June 2024, alleging that their models were trained on their copyrighted content [19]. The attitude of startups like Suno and Udio around training data may contrast with that of traditional tech companies such as YouTube, which has reportedly been offering lump sums to labels in return for permission to train its models on their catalog [20].

For unauthorized voice clones in particular, state laws governing the use of another's likeness (right of publicity laws) are one avenue for legal recourse [21]. Tennessee may provide an example for other states looking to modernize their right of publicity laws; the ELVIS Act, passed in March 2024, restricts certain uses of a person's voice, name, image, and photograph [22].

4.2 Copyright: Status of AI-Generated Content, Authorship

One of the largest concerns for both tech companies and the music industry is the copyright status of AI-generated content, which is delineated in a report prepared by the Congressional Research Service [23]. Presently, the U.S. Copyright Office restricts copyright to works authored by a human being, even if the work is generated based on a text prompt. However, if the AI-generated material undergoes arrangement, modification, or combination with human-authored materials, it may be eligible for copyright protection.

The attribution of authorship in AI-generated work also raises significant questions. Determining whether the author is the human who supplied the prompt, the AI program itself, or the developer is an ongoing challenge. At present, there is no clear rule governing this aspect. Some services, such as OpenAI, address this ambiguity by assigning copyright to the user, thereby circumventing the complexities surrounding authorship and copyright ownership.

4.3 Transparency: Datasets and Implementation

Transparency surrounding the datasets used to train AI models and the role of AI in commercial products and services is another concern. While companies may justify the secrecy around datasets as necessary to safeguard proprietary models, it is plausible that the reluctance to disclose this information stems from models being trained on copyrighted works, exposing companies to potential legal challenges. Stability AI is one example of a company that discloses its dataset; their Stable Audio model was trained using audio files supplied through an agreement with AudioSparx, a stock music company [24].

What might legislation around transparency entail? Article 53 of the European Union's Artificial Intelligence Act will require "providers of general-purpose AI models… [to] draw up and make publicly available a sufficiently detailed summary about the content used for training of the general-purpose AI model" [25]. The act is being enforced in stages, with this requirement estimated to be enforced starting July 2025. Additionally, Recital 105, which builds on previous legislation related to data mining, will require authorization from rightsholders to train models on copyrighted works. Without legislation, companies worried about copyright must voluntarily respect opt-out requests and/or seek licenses for copyrighted content. Spawning AI is one organization that helps artists opt-out of inclusion in training data and helps developers access this opt-out information [26]. Hugging Face and Stability AI are listed on Spawning's website as examples of companies that have pledged to respect such opt-out requests.

Transparency around datasets should not be the only area of interest, though. The commercial value of the term "AI" has led to it being "often used interchangeably with, or instead of, the specific kind of machine learning that companies and labs are doing" and obfuscates the part AI plays in a product or service [27]. This ambiguity is exemplified in a study on the AI-powered mastering service LANDR, where researchers posit that the platform likely "uses ML for part of the process, for instance in analyzing the sound of an uploaded audio track, and then select[s] from a matrix of preset possibilities for processing" [28]. This suggests that the machine learning component may not be tailored to each track, but the exact process remains undisclosed, as LANDR does not provide insights into the inner workings of its mastering program. In contrast, Yamaha, although somewhat concealed within the research and development section of their website, offers an article dedicated to explaining how AI is incorporated into their Vocaloid product, providing a more transparent approach to showcasing the integration of AI in their offerings [29]. Other examples include LALAL.AI's explanation of its Orion stem separation model and Baby Audio's explanation of how AI is used in its TAIP tape saturator plug-in [30], [31].

4.4 Economic Impact on Musicians

It is clear that AI will have a large impact on the music industry, but because machine learning-driven AI tools are still a recent development and there are ongoing uncertainties surrounding copyright, no one can predict how these changes will economically impact musicians. In what could presently be the only study of its kind, Goldmedia, a Berlin-based consulting firm, was jointly commissioned by a French and German performance rights organization to predict the impact of AI on French and German musical artists. The firm's research predicts that "by 2028, 27% of [German and French] music creators' revenues will be at risk due to generative AI," which is particularly troubling because there is currently no system in place for artists to be compensated for their work if it is used to train the models that they will be competing with [32].

One possible system would be for artists to allow companies to train models on their music in return for revenue sharing. LANDR announced their Fair Trade AI Program in July 2024, in which "20% of the proceeds generated from new AI-based tools is paid back to participating users, proportional to their data contribution" [33]. This may be the first public AI revenue-sharing program so many questions remain, such as how many companies would utilize such a dataset, if such datasets would need to be created on an ongoing basis, which would allow for future earning potential, and most fundamentally, if this represents a significant money-making opportunity for musicians already contending with existing economic models, such as streaming services, and now facing competition from AI-generated music for business opportunities.

Acknowledging that "much of the efficacy – and hence much of the value – of machine learners depends on the datasets on which they are trained," it becomes imperative for compensation models to adapt in tandem with technological advancements for artists to sustain their livelihoods [34]. Without legislative changes, the risk persists that the "cultural capital of individual musicians and communities" will continue to be "exploited by capitalist firms for private interests" [35].

4.5 Industry Activism

One way the music industry has reacted to developments in AI is by forming organizations and interest groups to campaign on AI-related issues. These include the Artist Rights Alliance, a musical artist-focused organization that promotes its Artists' Bill of Rights, the Human Artistry Campaign, whose members include global professional organizations from music and other creative fields, which promotes its seven core principles for artificial intelligence applications, and AI for Music, whose members are primarily music tech companies, which promotes its seven Principles for Music Creation with AI [36], [37], [38]. These organizations have overlapping beliefs related to the implementation of AI, such as requiring consent for inclusion in training data, compensation and credit for artists whose work is used as training data, and the importance of equal political participation for musical artists. These organizations have the potential to influence policymaking, public opinion, and AI companies' business practices, especially if they coordinate their strategies and messaging.

5 Researcher Accountability

AI researchers and developers must embrace accountability for the technology they create, taking the lead in critically examining its impacts and working toward mitigating negative consequences through research, supporting regulation, and other measures. Researchers have themselves critiqued their respective fields, such as human-computer interaction ("while the field [of human-computer interaction] examines and generates… systems… its political dimension—that is, the varying balances of power between who produces the technology, who designs it, who uses it, and what socio-cultural impact it may have—is rarely addressed" [39]) and music information retrieval ("MIR [music information retrieval] is not yet engaging in the 'ethical turn' that other technology research fields are undergoing" [35]).

5.1 Artist Collaboration

An important recommendation is for researchers to collaborate more closely with artists, not only to enhance the development of better models and services but also to understand and address artists' concerns. In an article focusing on "research applying machine learning to music modelling and generation," the researchers emphasize that "rarely does such work explicitly question and analyse its usefulness for and impact on real-world practitioners, and then build on those outcomes to inform the development and application of machine learning" [8]. Another researcher supports this assessment while also challenging the

fatalistic assumption surrounding AI deployment: “Also problematic and unchallenged is the axiomatic assumption that ‘AI will help musicians make music’. To the best of my knowledge, no investigations have been conducted to pinpoint what specific help musicians need, prove that such help is actually beneficial, or ensure that these tools will contribute to a more just music industry” [35].

5.2 Mitigating Risks

A noteworthy project that attempts to address safety and transparency is Google’s DeepMind laboratory’s tool, SynthID, designed for watermarking and identifying AI-generated images and audio [40]. This technology holds promise for addressing challenges related to misinformation and enhancing the transparency of AI-generated media. However, at this time, the paucity of AI regulations and lack of watermarking standards makes it difficult to identify AI-generated content with any certainty and opens up their use to bad actors [41]. Hopefully, researchers will persist in developing tools to combat the complex issues that accompany AI. A scrutiny of research papers on AI-generated music from major entities like Meta, OpenAI, and Google, reveals a shared acknowledgment among researchers regarding various risks associated with AI deployment. These risks include built-in bias or a lack of diversity [42], [43], [44], [45], [46], the potential for use in misinformation or scams (such as “creating remarkably realistic deep fakes and voice phishing” [44]), misappropriation of training data [45], and ethical concerns surrounding the sourcing of training data and competition for the work of musical artists [46]. Nevertheless, the extent of ongoing efforts to address these challenges remains unclear, and the willingness of researchers to be vocal about the issues, especially when their ideals may conflict with the economic models of their employers, poses an open question.

5.3 Environmental Impact

Lastly, the environmental impact of AI, including its significant water usage, is a lesser-discussed aspect of the technology [47]. However, this will likely change as the consumer and business adoption of AI technologies increases, along with its power consumption. At the 2024 World Economic Forum, OpenAI CEO Sam Altman highlighted this issue, stating that an “energy breakthrough” is necessary for AI due to the substantial amount of power it requires [48]. The current commercial interest in AI has tech companies building more data centers, which train and run AI models at scale and have considerable energy needs. While these energy needs may lead to clean energy breakthroughs in the future, at this time they are increasing fossil fuel usage, so much so that some coal plants are delaying retirement [49]. Responsibly meeting the energy needs of these data centers will be a pressing issue in the years to come.

6 Conclusion

“AI” is an ambiguous term that encompasses a range of meanings. Existing AI-driven tools for music and audio typically engage in selecting content, targeting content, aiding in the creation or editing of content, or generating entirely new content. While there is currently a limited variety of AI-driven products for music production, the sustained global interest in AI technologies will likely continue fueling their development. Commercial music releases are already incorporating AI into the music-making process. However, more published research on AI-assisted music creation will benefit both developers and musicians.

Despite the proliferation of startups and established companies actively developing AI-driven music products and services, the ethical, legal, and economic implications of this technology remain unsolved. Pressing issues include whether training models on copyrighted work constitutes a violation of copyright laws, the copyright status of AI-generated media, and how to alleviate the economic impact of AI on musicians. Transparency from companies is crucial, particularly regarding the sources of their datasets and the role of AI within their products or services.

Developers also bear the responsibility to address difficult ethical questions surrounding the systems they develop and to engage with musicians, producers, audio engineers, and others who will be most impacted by advances in machine learning in music. I firmly believe that addressing the challenges posed by AI will require collaboration and mutual understanding among artists, developers, legislators, and other stakeholders. By fostering cooperation, these diverse perspectives can contribute to the development of equitable solutions that navigate the complexities surrounding AI in the domain of music creation and production.

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