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The Society for Electro-Acoustic Music in the United States

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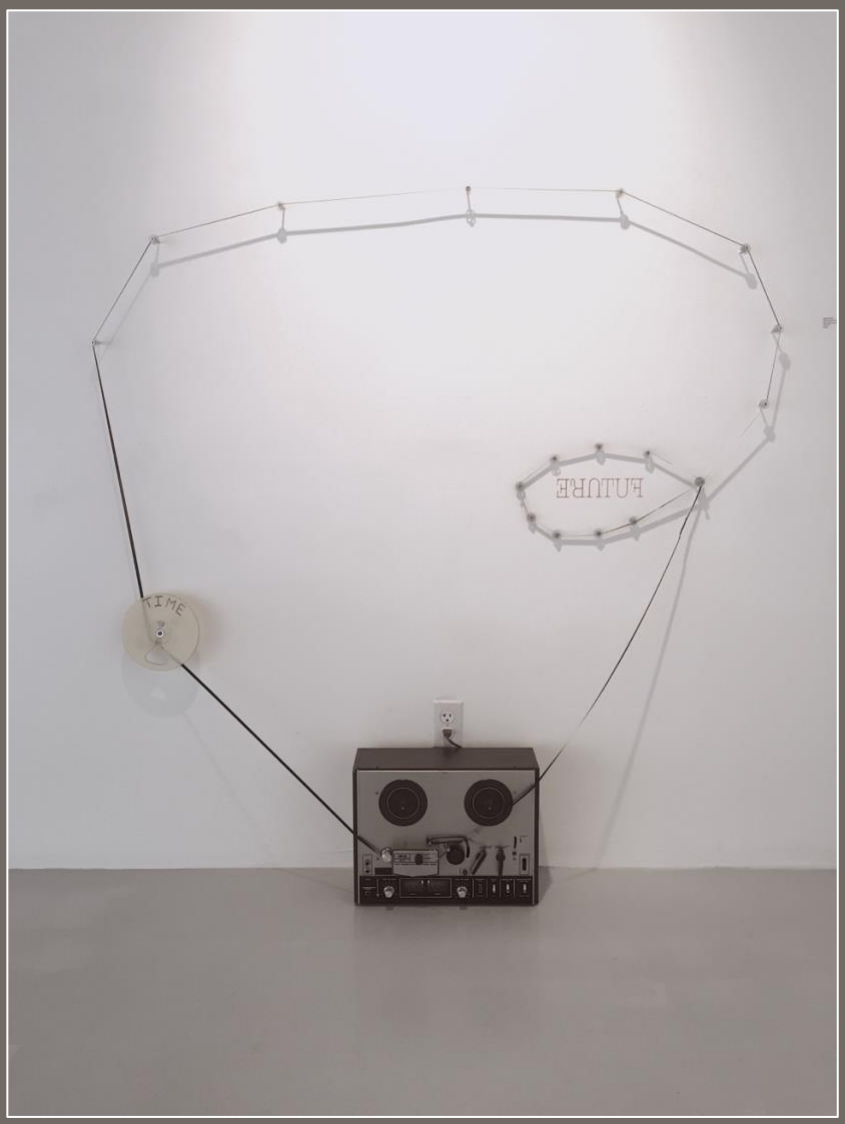

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Information for Contributors

Interested contributors should submit manuscripts electronically. Microsoft Word is the preferred format. If another word processor is used, files should be saved in rich text format (RTF) with an accompanying PDF version. Main articles are generally 2,000 to 6,000 words.

Editing Guidelines Please use Times New Roman fonts with font size 12. Manuscripts should be formatted and prepared using *The Chicago Manual of Style,* 17th edition (2017) as a guide. References should follow Author-Date format. Specific citations should be provided in text in parentheses. Footnotes should be used sparingly and reserved for explanation beyond the text of the article. All references should be listed after the text of the article in a section labeled "References." Any computer code should be placed in fixed-width format to facilitate readability. Images, figures, musical examples, and other graphics should be sent as separate attachments for ease of layout. The approximate location of each graphic should be indicated in the text by a (sequentially numbered) label and a brief caption.

Graphics Any artwork, graphics, photos, and flowcharts should be sent as separate individual files. We recommend uncompressed graphic files such as TIFF at 300 dpi.

Submission All submissions, including articles, reviews, review proposals, and items for *Tips and Tricks* should be emailed to the Editor-in-Chief, Drake Andersen: journal@seamusonline.org.

About SEAMUS

Founded in 1984, the Society for Electro-Acoustic Music in the United States (SEAMUS) is a national non-profit organization of composers, performers, and teachers of electro-acoustic music representing every part of the country and virtually every musical style. Electro-Acoustic music is a term used to describe those musics that are dependent on electronic technology for their creation and/or performance. Many members of SEAMUS—like Jon Appleton, the guiding light in the conception of the Synclavier—are recognized world leaders in their fields. All are dedicated to the use of the most advanced technology as the tools of their trade.

SEAMUS seeks to provide a broad forum for those involved or interested in electronic music. Through its journal, newsletter, national meetings, and its national archive at the University of Texas, SEAMUS seeks to increase communication among the diverse constituency of the relatively new music medium.

The Society's objectives include:

To encourage the composition and performance of electro-acoustic music
To develop a network for technical information and support
To promote concerts and radio broadcasts of electro-acoustic music both in the US and abroad
To create an exchange of information through newsletters and other means of communication
To establish and maintain a national archive and information center for electro-acoustic music
To attract a wide diversity of members and supporters
To advocate licensing and copyright concerns

SEAMUS strives to address not only relevant technology but also the non-technical issues pertinent to the electro-acoustic music community. In a field usually dominated by technical concerns, it is refreshing to hear paper sessions devoted to aesthetics, collaboration, education, and the ethical and social issues facing electro-acoustic musicians. The provocative sessions provide fuel for lively discussions during the national meetings.

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Volume 33, Number 1–2, 2022

From the Editor

I am pleased to share the publication of Journal SEAMUS Volume 33. At the center of this issue is a major colloquy featuring ten contributions from the SEAMUS community gathered under the theme "Perspectives on AI in Music." Over the past few years, as the use of artificial intelligence (AI) and related tools has increased exponentially, so have concerns around this potentially transformative technology. This colloquy was convened to highlight some of the prevailing perspectives within the SEAMUS community, showcasing a variety of stances—from skepticism to full-throated embrace—and potential use cases, from human-computer interaction in creative work to acoustic modeling to generative tools to working with datasets. The essays in this colloquy also examine the impact of AI across a compelling diversity of scales, from global trends and perspectives to novel concerns drawn from personal experience.

The cover art for Volume 33 is a photograph of a piece by Justin Boyd called "The Future is Unmade."

This issue also features June Violet Aino's memorial essay for composer and longtime SEAMUS member Charles Menoche, who passed away in September 2024. Charles attended graduate school at the University of Texas at Austin, where he first became involved with SEAMUS while studying with Russell Pinkston, helping to organize the 1993 SEAMUS National Conference in Austin. More recently, his composition *Soundpiece #1: Four Text-sound Études on Words of Walt Whitman* was featured at the 2007 National Conference at Iowa State University.

If any members of the SEAMUS community have further memories, information, or photographs of Charles they would like to share, please feel free to reach out by email: journal@seamusonline.org

As always, we love to hear from the SEAMUS community with new ideas for articles and other content. Please don't hesitate to contact us with your inquires or submissions: journal@seamusonline.org.

And finally, a big "thank you" to the Journal SEAMUS staff, SEAMUS leadership, and especially the SEAMUS community. I look forward to hearing from you!

Drake Andersen, Editor-in-Chief

Articles

In Memory of Charles Menoche (1965–2024)

June Violet Aino

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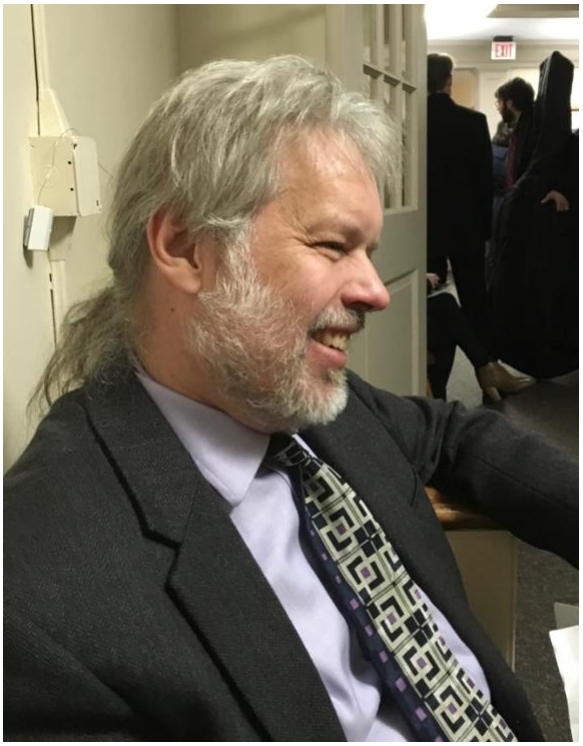

Charles Menoche (1965–2024). Photo courtesy of the Central Connecticut State University Music Department.

I knew Charles Menoche as an enthusiastic, odd-ball professor who loved bad jokes almost as much as much as he loved anything related to music technology. Those two loves combined often but my personal favorite is his little half-joke he would exclaim while introducing the theremin, "It's the only instrument you can play without touching!"

I met Charles in 2016 after his year on sabbatical, in preparation for a concert of his music in downtown New Britain, CT. Alongside some premiers of scored video art and bass clarinet electroacoustic works, the focal point of the concert was his new exploration of notation with a set of 3-D printed scores that you "read" by touch rather than sight. The musical medium to show off these tactical scores was none other than the CCSU iPad ensemble, a group of his creation only a few years old.

As a new music composition student (barely an undergraduate sophomore), I was just as surprised as the other three members in the group, "We're just supposed to read by touching them?" Which, designed for the iPad medium, made perfect sense – one hand can "read" the score while the other operates an array of intuitive iPad music apps. Isolating the sense of touch, ended up producing a fruitful musical experience with lots of interaction and variety. Some sections of the piece had simple instructions on how to read the 3D notation and react musically, while others were more abstract and open. A favorite part of mine used the general texture/shapes of the 3D score to relate to pitch, volume, and complexity. For example, a rise in the surface results in an increase in volume and the width of the structure related to pitch. For anyone familiar with the aleatoric world of graphic scores, relating shapes to sound qualities/productions, feels very natural, and the 3D scores fit into that world perfectly. Having these 3D scores as one of my first true "thrown-off-the-deep-end," new music experience, was wonderful. In the immediate performance space, everything strange or foreign about the notation dissolved and the whole experience just made sense.

Charles was an expert at providing these spaces of blissful discovery for his students. If it wasn't provocative performance experiences, it was insightful and inspiring classroom lessons. Hearing Charles carefully introduce the incredible marvel that is Pierre Schaeffer's *Études de bruits,* was just infectious. The energy

generated from in-class lessons flowed right into creative projects that pushed both engrossed music makers, like me, and the more casual students to make exciting experimental soundscapes. All this happening in an advanced and accessible music technology lab that he designed, managed, and fought for.

Charles Menoche was a bright light within the often-overwhelming space of music academia. Knowing him as a professor, mentor, and eventually a colleague and friend, was a pleasure.

AI in Electroacoustic Music: A Tool, a Collaborator, or a Creative Disruptor?

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The French composer Pierre Schaeffer introduced *musique concrète* in 1948, defining a fundamental contrast between this new approach and traditional, abstract music. Unlike conventional composition, which begins as an abstract idea before being notated and performed, *musique concrète* was created experimentally from pre-existing sound materials. This shift represented a radical departure from centuries-old compositional practices, prioritizing direct auditory manipulation over written notation (Schaeffer 1952, 35).

This transformation aligns with a broader trajectory of musical disembodiment, as proposed by Brazilian composer Flo Menezes. He suggests a historical transition from the *sound of the body* to the *body of sound* (Menezes 2014). In the Middle Ages and Renaissance, composers were often singers, producing music directly through their voices. The Baroque and Romantic eras introduced the composer-instrumentalist, externalizing sound while maintaining a physical connection to their instruments. By the late 19th and early 20th centuries, the rise of conducting further distanced composers from direct sound production. This abstraction continued with *integral serialism*, *stochastic music*, and *chance operations*, which removed composition from instrumental-based invention to a highly conceptualized process. The electroacoustic studio further detached composers from performance, granting them direct access to sound as raw material. No longer bound by instruments or notation, they could sculpt and inhabit the very body of sound itself.

However, the electroacoustic studio also introduced a moment of reversal in this trajectory. Composers found themselves once again in the role of artisans, engaging in a hybrid practice that blurred the boundaries between composition and performance. From the 1950s onward, the development of audio recording technologies required them to master tape manipulation, a hands-on engagement that persists in the digital domain. Even today, mastering discrete digital tools like plug-ins demands technical expertise and time. Composers gained unprecedented control over sonic microstructures, meticulously shaping sound at both the temporal (grains) and spectral (partials) levels—an intricate craft that, despite its digital nature, remained grounded in direct manipulation.

Nevertheless, the emergence of high-speed computers and platforms like Max and SuperCollider indeed marked a profound shift. Rather than manually sculpting sound, composers could now design algorithms that generate it autonomously, delegating aspects of the creative process to programmed structures. This transformation pushed abstraction further than ever before, arguably representing the final step in distancing human touch from sound creation.

AI's Impact on Electroacoustic Music

The rise of artificial intelligence—particularly large language models (LLMs) and autonomous AI agents—suggests another potential paradigm shift. However, will AI reshape human sensibility as profoundly as recording technology once did, altering not just how music is created but also how it is perceived and experienced?
Recording technologies fundamentally transformed human perception, requiring listeners to adopt new ways of engaging with

sound. *Musique concrète* and subsequent forms of electroacoustic music extended this transformation, demanding that both composers and audiences develop new listening strategies. AI may enhance sound synthesis, processing, spatialization, and immersive 3D audio environments, but will its impact on musical perception be as transformative? There are three reasons to approach this with skepticism:

1. **Timbre exploration in the 20th and 21st centuries has been vast.** Computer generated sounds have greatly expanded the sonic palette, making it unclear whether AI will introduce fundamentally new territories or simply refine existing ones.
2. **AI remains constrained by computational architecture.** If we consider computers as musical instruments, AI functions as an exceptionally skilled performer, like a Disklavier (an autonomous piano) capable of unmatched precision. AI may control computers in ways humans cannot, but will it push beyond existing spectromorphologies, unveiling entirely new timbres?
3. **Music remains a fundamentally human activity.** AI is still bound by human sensory limitations, such as frequency perception (20 Hz – 20 kHz) and auditory density thresholds, suggesting that AI will enhance but not transcend existing perceptual frameworks.

AI and the Future of Composer-Machine Interaction

AI can represent a significant epistemological shift in composition, particularly in how it mediates between composers and machines. Over decades, the combination of artistic practice with research in digital signal processing and psychoacoustics has contributed to a vast body of scientific and creative knowledge, shaping how composers engage with sound in the digital domain. AI now has the potential to surpass human expertise in navigating these systems, as seen in models like AlphaGo, ChatGPT, and DeepSeek. If this trajectory continues, AI could become a powerful creative assistant, potentially challenging or even redefining the traditional plug-in model. AI agents could function as *omni-plugins*, capable of executing any type of audio processing operation dynamically.

However, a crucial challenge remains: transferring the deep connections between digital signal processing and psychoacoustics into AI models. For AI to meaningfully contribute to composition, it must leverage deep learning architectures trained on vast psychoacoustic datasets, allowing it to determine optimal processing chains and refine results autonomously. Furthermore, iterative refinements could be achieved through conversational interaction, mirroring how visual artists engage with AI-generated imagery. Unlike earlier algorithmic composition techniques, which required coding expertise, AI introduces a potentially more intuitive approach through natural language interaction. LLMs have demonstrated an ability to interpret poetry and figurative language, suggesting that AI could process more evasive and ludic instructions as well. This abstraction could allow composers to move away from programming, shifting toward a broader artistic direction where musical ideas can be expressed both technically and creatively rather than solely through parameter-driven commands. AI could also make computer-assisted composition more accessible, particularly for those who experience psychological barriers to programming.

A step further would be AI assistants capable of learning not only psychoacoustics but also user-specific aesthetic values, tailoring their outputs to match individual artistic goals based on the composer's taste. Such a system could adapt dynamically to creative preferences, offering not just technically optimized results but also compositions that align with distinct artistic identities, effectively bridging the gap between machine intelligence and human expressivity.

Addressing Inequalities in AI and Musical Creation

Despite its potential, AI-driven creative tools risk deepening existing inequalities. As a composer from Latin America, it is impossible to ignore the asymmetries shaping artistic production,

particularly as the vision of a hyper-connected, borderless global society fades. Despite technological advancements, creating art remains far more accessible in economically developed regions such as parts of Europe and North America than in underdeveloped regions like Africa, South America, and the Middle East. State-of-the-art AI technologies continue to be a privilege of those who can afford access, leaving many composers at a technological disadvantage. As AI evolves, addressing these inequalities becomes crucial, ensuring that technological progress does not reinforce disparities in artistic opportunities and resources.

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AI in Music: Why Would Anyone Want It?

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I wonder if the buzz surrounding AI in music is based largely on the oft-perceived illusion that new tech is automatically good tech. Granted, I am now in the dinosaur composer ranks, yet I work with tech and have delved deeply into stochastic processes in my electro-acoustic compositions (and live performer improvisation in my acoustic instrument works) for over forty years. With that preamble, I cannot imagine any scenario in which AI would be beneficial, or even moderately interesting to me. I want my music to be the result of my thoughts, my endeavors, and my labor. And the actual labor, the old-fashioned hard work of putting pen on paper to write notes, of trying and re-trying electronic gestures to get just the desired sound, of setting maximum and minimum limits and logical if-then branches for parameters subjected to stochastic algorithms that I have written (or at least modified) to suit the specific needs of the soundscape at hand – this time consuming labor is the fun part of composing, the intense contemplation that allows thoughts to fully develop and for unexpected new results to bubble to the surface. Why would I want an AI algorithm, that someone else constructed, to attempt short cuts within this process? It seems pointless and artistically defeating to me.

The primary argument that I have read in favor of AI in music, as in AI writing text, is to generate initial ideas. Do not you and I have enough ideas of our own? I certainly do. I don't need AI to suggest melodic lines, or harmonic structures; just as I don't need AI to generate a draft letter of recommendation or this current brief essay, which I am directly writing and rewriting over a period of several weeks.

Thankfully, in the end, we are discussing music here, and not a field that carries life and death consequences. So, no one will get hurt whether we use AI or not – good for us! I am leery of AI creeping into other areas of our lives. Search algorithms, especially in social media, are already an evil conspirator. I read this week in *Science News* about steps toward using AI-guided robots to perform medical surgery. Count me out for that! As with so much of our rapidly advancing technology, just because we can do something does not automatically imply that we should do that thing. Again, for us, it is only music we are discussing. Still, any reliance on AI in music runs the risk of losing the composer's voice in the mix, and why would we want that? To embrace or reject AI in music is an individual choice, at least for now, and I simply have no need for it in my work.

AI is Here to Stay

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"AI is here to stay." We hear this often, but these words have a flattening effect on the depth of disruption that artificial intelligence has caused in our lives and our professions. It depicts AI as a monolithic technology, whose annoying, exciting, and terrifying elements are all expected to continue and intensify indefinitely. In reality, these qualities are all influenced by how AI is implemented and the goals of the people implementing it. AI is indeed here to stay, but we can tease apart what that means for us as creative individuals and support the exciting bits while rightfully defending against the negative ones.

I use machine learning regularly in my own works. That said, those works draw on existing technology and frameworks developed by people in SEAMUS with a far deeper understanding of that technology than I can boast. As my own understanding of the technology grows, however, I've increasingly found that I have become an effective advocate for the ethical use of AI in music. In asking myself whether I had anything worthwhile to add to this special discussion, I decided that my strategies for this advocacy are the most useful things I can offer a professional society like SEAMUS.

To begin with, we should separate AI into "generative" and "non-generative" (i.e. predictive or analytical) forms. Most laypeople conflate generative AI like ChatGPT and Suno with the technology as a whole, and many of those people correctly assume that the existence of these platforms is disruptive and largely unethical. Generative AI's usage of copyrighted material and its ability to mimic human-created products are major sources of concern for both creators and consumers of new media, but I've found that the best way to address these concerns is often not a nuanced discussion of intellectual property rights. To begin dismantling these fears, I introduce the concept of AI that does not rely on copyrighted material and does not seek to replicate human art. Machine learning can analyze data at a deep level and categorize it in unexpected ways. These analytical methods can be used to create music that humans can't, and that makes them a useful tool to augment what creative work we are already doing, instead of acting as a digital competitor.

Once people are introduced to the possibility of non-generative AI as an ethically feasible tool, I have found it helpful to demystify the complexity of the algorithms themselves. A linear regression, which many people learn about in high school algebra, is a simple form of machine learning. A neural network, even with complexities like backpropagation and perceptrons, is just a deeper implementation of similar mathematical concepts, and with a similar goal: to categorize data made up of a certain number of variables, and to predict where new entries might fall on that graph. This element of the discussion can even be applied to assuage fears about large language models like ChatGPT, because it follows that same logic. While it essentializes many issues around the technology, ChatGPT can be seen as an algorithm that expertly predicts the next word in a sentence. AI is so ubiquitous that its opacity to laypeople is shocking. However, framing the discussion in this way offers an inroad to developing an understanding of it, and allaying misplaced fears about it along the way.

At this point, with the scope broadened and the technology simplified, people often ask: "What's the point?" AI is lauded as a world-changing technological movement, yet the experience of average people is one of uselessness, annoyance, and malicious intent. To advocate for AI as a tool, we not only must demystify it, but also show why it is worth our time. In answering this question, I have found that relying on my own personal experience with machine learning tools to be the best place to start. I explain that machine learning enables the analysis, categorization, and prediction of audio

data in ways that are both novel and intuitive to humans.

For instance, the FluCoMa library for Max/MSP can arrange sound samples by timbre, creating connections between different sources of sounds that human musicians might never have put together. Ted Moore's piece, *saccades*, combines analysis of eye movement with a machine learning-powered synthesizer, establishing a consistent communication between audio and visual components of the piece. Through it, an audience member can begin to predict what the music will sound like when the eye is in a certain position, because the data from both has been connected and controlled in a consistent – and delightfully unexpected – way.

If you are advocating for the usage of AI in music, you certainly have your own experience in the field. Any discussion of its utility or importance would benefit more from drawing upon that experience than trying to regurgitate my own.

These discussions take time and energy, both physical and emotional. However, I feel it is crucial as stewards of music technology that we have them with our friends, our colleagues, and our administrators. We have the ability to help our community understand how AI might be used ethically and productively in the arts, to encourage the adoption of sensible AI policies and initiatives, and to safeguard against sensational or underdeveloped technology.

Considering the Life of Composers in the Age of AI

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In early 2025, I listened to an episode of the podcast "On the Media" about the rise of AI in the field of music. I was especially struck by the last segment of the show, which was narrated by a composer, Mark Henry Phillips, who for several years has made his living writing music for commercial situations. In his segment, Phillips said that most of his composing work had come from clients who wanted to avoid paying the licensing fees for existing music. In essence, they wanted Phillips to write something new that clearly imitated someone else's music.

After setting this context, Phillips demonstrated the results of his recent experiments with AI music software. He did not name the app he had used, but he played music synthesized by the app side-by-side with tracks he was trying to model, including works by himself and others. The music created included pop songs with vocals and instrumental soundtrack music. Phillip's conclusion was that the output of the software was so good that he now needs to find a new career. He said that the economics of the situation were such that it would almost never make sense for clients to pay a person like him to write music and make a recording when instead they could type some keywords into a prompt and get results from an app for free within seconds.

As I was listening to Phillips narrate his experience, I felt a rising sense of existential dread. "What does this development mean for the future of musicians and composers?" I wondered.

Actually, I had known that this turn of events was possible. At least since the release of Wendy Carlos's *Switched-On Bach* in 1968, technology had been demonstrating its ability to replace music performers, from string pads, to bass, drums, and eventually nearly everything but the expressive human voice. Then, during the last ten years or so, even voice synthesis began to cross through the uncanny valley and sound like real human performances.

As someone who has used algorithmic approaches in my music for most of my career, I knew that creative coding has the power to output some quite interesting musical material. Over the years I've had a lot of great experiences building software instruments and bots who will generate material for me to play with, both during the composition process and to literally play with, live onstage.

However now it seems that apps are replacing the entire composing and production process, and for me this raises some big questions for all music composers, songwriters, and producers. Most importantly, I wonder how we can keep our own creative lives vibrant amid the coming avalanche of instant, AI-generated music? Secondly, what are the economic implications of this development for composers, educators, and young creators looking for their paths forward?

In terms of one's own creative practice, I certainly can imagine integrating AI tools as part of my process. For instance, I've already played with machine learning algorithms to process real time sensor data, and I've found it quite interesting thus far. And after years of composing with patterns, grammars, chance, probabilities, Markov chains, fractals, automata, data mining, etc., I certainly can imagine that I might have some intriguing experiences with AI apps that might output complete realizations of full arrangements as the result of text prompts.

That last element, the imaginative engagement with the tool, is what I'm most concerned about. As an experimental music composer, I've never worried much about my music as a direct means to financial renumeration. But I'm definitely concerned that if composing becomes "too easy," then all the fun of the process will pop and disappear like a soap bubble hitting a blade of grass. Then, if expertise to realize music is no longer needed, what will happen to all the knowledge that has been passed from teachers to students over generations? Will

it be subsumed into the database and stop being something that is explicitly taught and learned? And if so, how bad is that, really? Perhaps instrumental musicians have been considering this for decades, but now I'm feeling it personally.

For better and worse, I seem to be genetically wired to be an optimist. As a consequence, my guess is that creative weirdos are already hacking the new AI apps, getting them to "Do it backwards," in ways that will bring surprises and joy. As Brian Eno's Oblique Strategies says, "Don't be afraid of things because they're easy to do." That is worth contemplating as well. As the software becomes more powerful and widely disseminated, hopefully creative misuse of it will bring compelling results to us.

On the other hand, as a long-time music educator, the rise of one-step AI music generation makes me confused about how our curricula should respond. At Brooklyn College, we have an MFA program in Media Scoring, that is, writing commercial music in a way reasonably similar to what Mark Henry Phillips has been doing. To me, this degree program has always seemed like the practical composer's path, a way to gain hard skills that are in demand in the capitalist marketplace. In other words, a path to a job in the creative media industry.

But what now? If scoring to media moves from being a career path to something one mostly or only does out of their love for the practice, how might that change what we teach and how we do it? Moreover, although it isn't quite happening yet, I've seen apps for mixing and mastering tracks. Already careers in music production aren't as prevalent as they were thirty years ago. How should we change our music technology pedagogy if the artistry of recording and mixing also moves from a "practical" career path to something more economically tenuous, like becoming a virtuoso bassoonist?

Perhaps some say, "We shouldn't be in this for the money," and none of the implications of AI music seem problematic to them. I understand that philosophically, but I teach at an urban, public university. Most of our undergraduate students are musically ambitious but also want to gain skills that will lead them to professional careers, just in case they don't reach the pinnacles of fame and fortune as musicians and producers. Meanwhile our Music department is trying to respond to new federal requirements that we document how many of our alumni find jobs in the field of their major within two years of graduating, with implications that departments who don't do this well might get downsized or eliminated. What is a nerdy professor to do? We're only beginning to contemplate how to respond.

I feel that music composers and producers are at the start of a new era. Revolutionary changes are afoot in our field, amid the myriad other challenges of the wider world. My advice is that we should all experiment and share what we learn. Part of what makes music valuable is the community it can engender. This is something we should treasure and help guide us forward.

GenAI and Access in Computer Music: The Future Is Already Here—It's Just Not Evenly Accessible

Eli Stine

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One of the most exciting aspects of computer music composition is how quickly the field evolves. From mainframes to personal computers to real-time electronics on a laptop, computer music adapts to technology, ingenuity, and cultural aesthetics. However, these changes become problematic when framed as methodological advances but impose restrictive limitations and/or take advantage of artists. This concern applies to generative artificial intelligence (GenAI) via large language models (LLMs) for raw digital audio creation, particularly when such tools limit creative control or rely on unauthorized training data. While I fear some aspects of these technologies could be detrimental to computer music production, I also recognize they are in an early stage—awkward to use, lacking expressivity, and still being shaped into creative tools.

My first experience with GenAI for raw audio generation was a decade ago. As someone who has spent thousands of hours editing raw audio for music, film, and game sound design, and explored AI-driven digital audio methods like concatenative synthesis, I found it both electrifying and concerning. While I saw huge potential for experimental computer music, I also imagined a future where hands-on engagement with sound was replaced by more hands-off automation. Automation itself is not the issue—automation has always shaped music, from player pianos to sequencers to drum machines. Nor will handcrafted digital audio disappear, much like traditional woodworking persists after the introduction of electric tools. However, after engaging with both boutique, technically involved tools (nn~, RAVE) and consumer-friendly GenAI (Suno, Udio, etc.), a common issue became clear: access.

Access is central to computer music composition. Composers need specialized hardware—computers, microphones, outboard gear, and software—all requiring financial investment. Learning also depends on access to training, whether through lessons, conferences, concerts, or online resources. Additionally, controlled acoustic environments are essential for production and listening.

GenAI for raw audio generation presents new barriers to access. First, training LLMs demands immense computational power, beyond the reach of most creators. Second, available LLM-based systems are often opaque, with training data hidden and the sources of generative output being inaccessible. Third, access is restricted by how users interact with the model—text-based inputs, token limits, or training biases that fail to recognize musical language. For instance, current GenAI tools do not understand precise technical instructions like "extend the fourth section by two seconds and add a high pass filter at 10kHz," limiting their usefulness for trained computer musicians. Ultimately, access is determined by what the LLM includes or excludes—decisions outside the user's control.

Access barriers and usability issues are not new in computer music. Early computer music composers relied on time-shared mainframes, using punch cards during off-hours. Before MIDI, connecting digital synthesizers was cumbersome, or impossible. Before DAWs, expensive studio hardware was necessary. Today, full-featured, free DAWs on PCs and mobile devices have democratized music production.

What is the future of raw audio GenAI? Will it remain restricted and inexpressive, controlled by a few, or will open-source efforts lead to more accessible, expressive tools? White-box models trained on consumer hardware with composers' needs in mind are beginning to transform the landscape. I know with GenAI a future tool of computer music composition is already here—it's just not evenly accessible.

The AI Imperative in Music

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The atmosphere in my academic institution here in China is at the threshold of a new revolution. From the 2025/2026 academic year onwards, every major on campus will have an introductory class in AI technology, while using AI in the design of courses may also soon be made compulsory. It is very indicative of this progressive move for the country towards fully integrating AI into every life sphere. But in our rush to embrace this technology, as transformational as it is, we must engage in some critical thinking regarding its wider implications. Greater diffusion of AI in music generation may irretrievably alter how we think about human creative work and artistic authenticity.

AI is irreversibly upending the music production world. Currently, tools like OpenAI's Jukebox, AIVA, and Suno have produced music with extraordinary sophistication—mastering tasks like creating stems, remixing tracks, and even inventing new genres—all in a fraction of the cost and time of its human counterpart. Democratizing this domain, framing this in a zero-sum relationship between AI versus human musicians glosses over an altogether more layered nature of cultural production. While sound itself, music is also about story, context, and connection. But whereas AI can mimic patterns, it cannot make meaning. It's bereft of that intentionality at the core of human creativity.

The assumption in the question that is made—that somehow the "human factor" behind the music creation is becoming immaterial—underestimates the strength of lasting emotional and cultural resonance. Audiences in studies continue to report music as important due not only to aesthetic appeal but also to its relationship to human experience (Hargreaves and North 1997). At the core, artists bring personal struggles, complex identities, and multifaceted histories within their work—qualities that algorithms currently cannot replicate. As Simon Frith noted, music "like identity, is both performance and story, describes the social in the individual and the individual in the social" (Frith 1996). Those genres that stress narration and authenticity—folk, jazz, indie rock—, and those that push the boundaries of sonic expression—like electroacoustic music—will keep their currency precisely because of the humanness and imperfection they convey.

In embracing AI so wholeheartedly, there are risks, particularly its potential to reinforce cultural homogenization. Because AI models are trained on historical data, they often replicate and amplify the patterns and biases embedded in that data—even when recombined via prompt in a mash-up of genres. This creates a troubling feedback loop in which niche and experimental genres are sidelined in favor of commercially viable but formulaic styles. While AI promises democratization and makes music most accessible, in reality, democratization requires diversity. Those local and folk traditions that are considered "minor markets" are essential to cultural resiliency; technologies that target mainstream appeal do so at the risk of erasing smaller communities' distinctiveness should they fail to move according to more inclusive design principles, as indicated by Pasquale (2020).

This is not the first time that there has been concern about AI flooding the music market with low-cost, undifferentiated content. The streaming platforms already face an oversupply of music, but they have devised ways of sorting through such plenty. Curated playlists, recommendations, and niche discovery platforms do indeed mean that quality and originality still manage to rise to the top (Aguiar and Waldfogel 2018). It might, however, be somewhat true with regard to AI dominating certain genres—for example, electronic mainstream music, since loops, samples, and autotune are already a big part of such genres. But even then, star artists in those fields have much more to their appeal than just the music. The persona and cultural relevance

continue to be important facets of their success—AI simply cannot compete on those levels. Moreover, in live contexts, AI faces significant challenges due to Moravec's paradox. While generating similar-sounding music is relatively simple for AI, replicating the advanced perception and motor skills needed to perform in a live setting remains far beyond current technological capabilities.

Another concern is that it devalues professional recording studios somehow, making them obsolete. Even though digital tools, along with AI, have opened access to many creative possibilities, the role of a professional studio goes much further than offering technical expertise. A studio is the place where ideas are shared between musicians, producers, and engineers to create something new. Jazz and classical music, along with many other genres, still rely on high-fidelity recording environments for their acoustic quality and live performance dynamics. In addition, the social aspect of studio work creates creative synergy that no algorithm can replace (Burgess 2013).

Fairly, AI's compelling role is augmentation, not replacement. The most promising path ahead is that of a hybrid model in which the AI acts as a tool to enhance the artistry. Artists could use the capabilities of AI to experiment with new sounds, accelerate production, and expand the creative horizon while remaining in control of the artistic process. For emerging artists, AI will reduce production costs and level the playing field by making high-quality outputs possible without access to an expensive studio. But all of this is a hybrid that requires thoughtful integration.

As my institution prepares to integrate AI into the curriculum, it is essential to move beyond a purely technical approach and focus also on the broader social, cultural, and economic implications of this technology. Students must not only develop technical proficiency but also engage in critical discussions about the ethical challenges and societal impacts of AI. Understanding how AI can shape labor markets, influence cultural production, and reinforce or challenge existing inequalities is crucial for equipping students to navigate an AI-driven future. By fostering this broader perspective, we can help students become thoughtful leaders equipped to address the multifaceted challenges and opportunities of AI. Their ability to navigate these complexities will play a pivotal role in shaping a future where AI serves as a force for progress, equity, and innovation in society.

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Exploring the Frontier of AI-Driven Acoustic Modeling

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The SEAMUS community has long been captivated by the power of spatial audio and its ability to create immersive sound experiences that push the boundaries of artistic expression. At Lyrai, a company founded by SEAMUS members Nick Hwang and Margaret Schedel, we harness the power of AI to revolutionize acoustic modeling by creating digital acoustic twins of physical spaces. Our approach automates data collection and analysis, leverages advanced Bayesian deep learning, and offers transformative applications for composers, sound artists, and industry stakeholders. By pushing the boundaries of practical design, we aim to redefine how spatial audio is captured, modeled, and experienced in diverse real-world settings, from concert halls to restaurants.

Lyrai brings together a multidisciplinary team that bridges art, technology, and science. On the academic side, we are joined by Derek Kwan, a percussionist and doctoral candidate in artificial intelligence, who contributes both creative insight and technical expertise. Audio engineer Robert Pond plays a crucial role in ensuring the precision of the acoustic data, while computational cultural evolution researcher Mason Youngblood specializes in Bayesian methodologies that enhance the analytical framework. Our media artist and scholar Sofy Yuditskaya provides science and technology expertise, bridging the gap between technical innovation and creative application.

The idea for Lyrai came from a challenging experience when one of our members had to spatialize a composition for a concert venue with well over a hundred loudspeakers. Many concert halls and other specialized spaces have dozens of loudspeakers to attract unique sound experiences, while improvements in both hardware and software make it increasingly easy to set up temporary surround sound systems for smaller venues. However, visiting composers and performers often have very little time to get used to the acoustics of these spaces - in this case, our member only had 6 hours - often wrestling with the technology that operates these systems at the same time. The resulting rush to arrange their music spatially often leaves composers uncertain that they realized the full immersive potential of the space.

Meanwhile, the solutions to acoustic modeling remain out of reach or insufficient for most of the community. Most of the available software is geared more towards architects, acousticians, and sound engineers than to composers and musicians, often with interfaces and price tags to match. Many of these solutions lack the interactivity needed to play multiple simultaneous audio streams, which even the most basic of spatialized compositions almost always require. In addition, the most cutting-edge particle- and wave-based algorithms can be incredibly computationally expensive, while lighter and more accessible methods struggle with complex volumetric spaces.

We strongly believe that deep learning models offer a solution to this challenge, as well as several other promising applications for the SEAMUS community. To train such a model, we are currently assembling a comprehensive library of oversampled impulse responses collected from various environments, including classrooms, concert halls, lofts, and indoor markets. These are paired with 3D models of the environments

generated by LiDAR scans, which are swiftly becoming a quick and accessible alternative to traditional 3D modeling, as well as the component materials of the space. This library will allows us to evaluate the accuracy of synthetic data generated by various spatial acoustics models and build a custom deep-learning pipeline from scratch.

Bayesian deep learning is pivotal in our research, enabling the analysis of extensive datasets of impulse responses and spatial configurations. This approach identifies patterns and relationships that traditional methods may overlook while accounting for noise and measurement error. A key advantage of using Bayesian deep learning is the ability to measure uncertainty, allowing us to reduce the number of measurement points needed to create an accurate digital twin. By combining predictions from the Bayesian model with a targeted set of crucial measurements, we can efficiently capture the essential acoustic characteristics of a space, optimizing the data collection process and reducing the time and resources required. This methodology has the potential to uncover novel mathematical relationships that more accurately describe sound behavior, with applications extending beyond acoustics to other phenomena involving wave interactions.

The potential applications of our research are extensive. For composers and sound artists, our approach promotes creative exploration while reducing the time and resources required for physical experimentation. With our virtual rehearsal technology, composers can fine-tune their pieces in advance by accessing a digital twin of the concert hall, enabling them to refine their piece for a future space before a dress rehearsal. Sound artists in more flexible venues could freely experiment with sound source arrangements, crafting unique experiences for listeners standing at or moving between different points. The possibilities of this research in VR experiences are practically unlimited, from recreating real, present and historic spaces to building new ones.

While our research has shown promising results, it is important to acknowledge that our approach is still theoretical and needs validation in complex architectural volumes. Further research and testing in real-world environments are necessary to refine our algorithms and ensure the reliability of our digital twins across a wide range of architectural contexts. We are collaborating with industry partners to accurately model speakers and acoustic treatments, and are in the process of building our library of sampled spaces.

We are committed to advancing the field of acoustic modeling and delivering innovative solutions that bridge the gap between the SEAMUS community and industry. Through ongoing research, development, and collaboration, our AI-driven approach will transform the way we understand, design, and experience sound in physical spaces.

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Introduction

This opinion piece follows on ideas put forth in an my article *Music, Art, Machine Learning, and Standardization* (Brook, 2023A), which examines how machine learning and artificial intelligence (AI) influences the creation and marketing of cultural products with a focus on music and visual art. Building upon Adorno and Horkheimer's critique of the culture industry (Adorno, 1947), I argue that machine learning and AI contribute to stylistic standardization and the consolidation of economic power in the arts. The applications of AI have rapidly expanded since the time of publication, with AI playing a much larger role in the production, curation, and distribution of music. Similarly, the financial incentives for AI art have intensified, culminating in a Christie's auction of AI art with starting prices at hundreds of thousands of dollars and accompanied by blockchain integrations (Christie's 2025).

While the capacity for AI models to generate music is remarkable, their outputs continue toward the standardization of artistic forms and iteration within established genres. Large-scale datasets used in training machine learning models tend to reinforce dominant patterns and biases, leading to homogenization in musical outputs. In contrast, the use of small, custom-made datasets and models tailored to specific artistic intentions offers a compelling alternative, one that might expand aesthetic sensibilities of artists and enable unique forms of expression.

Machine Learning, Standardization, and the Culture Industry

Theodor Adorno and Max Horkheimer's critique of the culture industry argues that mass-produced cultural goods, shaped by economic imperatives, lead to the erosion of artistic uniqueness. Similarly, contemporary AI systems trained on extensive, commercially oriented datasets privilege predictability and marketability over experimentalism and idiosyncrasy. For example, music recommendation algorithms operate by reinforcing user preferences based on past listening habits, subtly narrowing exposure to the unfamiliar. When AI is employed to generate music, it perpetuates aesthetic conventions dictated by past successes rather than enabling novel expressions.

Adorno and Horkheimer's critique was initially formulated in response to mid-century American culture, reacting to the mechanical reproduction of art that Walter Benjamin had previously envisioned as liberating. As they encountered the realities of postwar capitalism in the United States, their views broke from Benjamin's socialist-utopian optimism to a deep skepticism regarding the culture industry's role in maintaining false consciousness. Their alignment with high modernism as a counterforce to cultural standardization has proven insufficient in resisting capitalist modes of production, their core analysis remains relevant in understanding how market logic and technological advances—including AI—drive cultural homogenization.

Demystifying AI: Viewing Machine Learning as a Tool

A major barrier to more creative and equitable use of AI in artistic expression of all kinds is the prevailing perception of machine learning as an inscrutable "black box" (Sheikh et al. 2023, and Queiroz et al., 2021). This opacity stems in part from the proprietary nature of many AI models, which limits users' ability to understand and influence how decisions are made (Carvalho et al. 2019). However, interpretability of AI depends on how it is designed, implemented, and represented to users and the public writ large. AI is not a neutral force, but a designed system shaped by human values and decisions. By understanding AI as a tool—one that can be reconfigured and reprogrammed to serve diverse artistic intention—artists can develop

participatory relationships with AI, using it to explore unique creative possibilities rather than passively accepting outputs.

The Potential of Small, Bespoke Datasets and Models

One way to counteract the standardizing effects of AI in music is by shifting from large, generalized datasets to small, bespoke datasets whose creation is part of the artistic process. Unlike large-scale datasets compiled from public music libraries, bespoke datasets may be curated with specific goals in mind and incorporate unique compositions, rare sonic textures, or nontraditional harmonic structures. By training AI models on specialized datasets, musicians can guide the algorithm toward producing outputs that align with their creative vision and build on the AI model iteratively rather than using it passively. Many artists engage with AI in this way (Boucher 2023 and Schroff 2023), most notably from the realm of music are Holly Herndon and Matt Dryhurst, who have trained AI models for several of their recent works. This approach treats AI not as an autonomous creator but as a tool for augmenting human creativity, enabling musicians to explore new sonic territories without automatically being constrained by preexisting industry trends. In my own work as a composer, I first introduced computer creativity in the form of human-in-the-loop co-creation using probabilistic algorithmic compositional techniques (Brook 2020), and later furthered this approach using with the integration of audio-corpus-based computer improvisation trained on small datasets (Brook 2023b), where the imprecision and whimsical glitchy "errors" that often result from small datasets is welcomed as an artistically generative feature (Ippolito et al. 2022).

The Role of Data Curation in Artistic Autonomy

The process of curating a bespoke dataset is itself an artistic act, requiring intentional decisions about which elements they wish to foreground and what aspect(s) of the artwork will be affected. Furthermore, the use of bespoke datasets mitigates some of ethical concerns associated with large-scale AI models, such as the unauthorized use of copyrighted material in training. Moreover, bespoke datasets encourage diversity in musical AI applications. While mainstream AI-generated music leans towards widely accepted tonal structures and rhythms, smaller datasets facilitate genre-specific or culturally distinct musical explorations. This is particularly relevant for non-Western musical traditions, which are underrepresented in large AI training datasets (Mehta et al. 2024).

Conclusion

The increasing role of AI in music production brings opportunity. While large-scale machine learning models contribute to the standardization of musical output, small, bespoke datasets offer a viable alternative that fosters artistic innovation and autonomy. By curating datasets that reflect their unique creative intentions, musicians can harness AI as a tool for exploration rather than replication. As AI continues to reshape the culture industry, demystification of AI will be essential to preserving diversity and ensuring that technological advancements serve the interests of artists rather than merely reinforcing commercial imperatives.

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Our Vision for the Creative Applications of Deep Learning: The Center for Experimental Music and Intermedia, University of North Texas

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Popular conceptions of artificial intelligence (AI) miss a critical fact about intelligence. Intelligence exists within networks of relationship and social interactions. Rather than strive as a primary goal to imitate and replace human abilities, we believe it is essential to focus on enhancing broader systems that increase human productivity and creativity and work cooperatively with human agents. The focus on centralized, ultra-large models has channeled financial, computational, and data resources to an increasingly small and elite group of engineers and venture capitalists. We need a different, rhizomatic approach that fosters cooperative efforts so that we can grow this technology for the good of society (Ash Center 2021).

The Center for Experimental Music and Intermedia at the University of North Texas (CEMI) is an interdisciplinary center focused on music and arts technologies within the Division of Composition Studies. CEMI fosters the integration of electroacoustic music, live performance, video/film, plastic arts, and theater. It is a unique and vibrant creative environment for research, education, and public performance, known for its innovative output. At CEMI, artists and researchers engage with generative deep learning for music and visuals through artistic creation, course design, and workshops.

CEMI's vision for AI is based on three pillars:

1. **Complementarity**. Technology should complement and cooperate with existing intelligent ecosystems, not replace them. Technology should broaden the surface area of complementarity across individuals, organizations, and systems, allowing for an increasingly networked evolution.
2. **Participation**. Intelligence is collective, not autonomous. Technology should work to facilitate the social nature of intelligence, and to facilitate deliberation on and participation in setting outcomes in equal measure to driving the achievement of outcomes.
3. **Mutualism**. Decentralized, heterogeneous approaches under the umbrella of digital plurality can build on and benefit from each other: technologies evolve in interaction with each other and artistic, social, political, and economic institutions, and ecology.

We recognize the exploitation of human creativity through indiscriminate scrubbing of online data for training large applications in the commercial ecosystem. We believe that creative AI must not infringe upon original human work, nor through inaction, allow human originality to be compromised. We believe that the unauthorized exploitation of human work should be recognized and compensated (Center for Art Law 2024).

While there is much to critique regarding the training methods, interfaces, and biases of large models, there are also ways in which these tools empower artists and open new vistas of creative potential.[1] We reject the idea that something original cannot be created with these methods, even if much of what is created is not original. We are in a moment of profound de-

[1] These issues are substantially mitigated by our proposal of a rhizomatic, decentralized approach to generative deep learning. Small models, trained on ethically sourced data, will allow for a broader uptake of this work in the research community.

centering, and generative AI is only one aspect of what we are forced to confront, as researchers, artists, and people. We see a near future in which these techniques will take their place within the larger palette of creative possibility.

We believe that it is urgent to equip our students with the tools and the knowledge necessary to navigate this new environment so that they can champion a different way forward for the role of technology in society and the arts. In doing this we stress the importance of developing decentralized open-source models trained on local data, following the same paradigm of openness of large community-based projects like Csound, Pure Data, and Audacity.

This vision of AI finds different realizations in the work of individual composers, artists, and researchers at CEMI. Approaches within our center range from deep engagement with commercial products, with a focus on iterative prompt engineering and the fine-tuning of models, to the integration of discrete machine-learning tools in larger projects, and the development of new AI-powered software focused on ethically sourced data and accessibility. This research has led to the development of a multi-semester curriculum on generative deep learning, emphasizing the importance of teaching the technical workings of these models and providing students with the necessary knowledge for "owning" the technology. With an emphasis on accessibility and decentralization, we are developing a suite of user-friendly applications that empower composers and artists to leverage powerful neural network architectures for audio/visual synthesis, symbolic music generation, music information retrieval, live audio and video reactivity, and analysis—without needing advanced programming skills.

CEMI envisions a future in which AI serves as a catalyst for human creativity rather than a replacement. We recognize intelligence as inherently relational and socially embedded. By emphasizing complementarity, participation, and mutualism, we aim to foster decentralized and equitable innovation that respects artistic authorship and open collaboration. This approach ensures that AI remains a tool for expanding creative potential rather than diminishing artistic agency. Through critical engagement, ethical AI development, and education, CEMI seeks to empower artists and researchers to shape, rather than respond to, the evolving landscape of generative technologies.

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AI, Retro, and Music of Our Time

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As musicians, our mandate is to create music ***that speaks to our time***.

Art is always shaped by its era, and recent advances in machine learning mark a technological and cultural shift that demands artistic examination. Just as, previously, we electronic musicians embraced recording technology, synthesizers, and algorithmic composition, now we can explore the expressive potential of AI, finding new creative opportunities and subversive implementations. Our art can inspire conversations around the technology, help determine the ethical implications of its use, and shape its future through our speculative experiments.

Of course, as we are seeing, some uses of AI for music creation can be threatening to artists, challenging authorship and deprioritizing human expression. For this reason, it is useful to distinguish two broad aesthetic approaches in the use of AI: the focus on ***results*** and the focus on ***process***—AI as an automated composer or as an interactive system, respectively.

The ***results*** of AI music creation, particularly the generation of music from text prompts, can be impressive, offering convincing imitations of past works and entirely new pieces in the style of existing artists (see David Cope's EMI, Google's MusicLM, OpenAI's Jukebox, etc.). As a technical feat, this music is astounding; as expressive art, though, it has limitations.

As we know, AI operates through pattern recognition and recombination of existing data. These machine learning models are trained on vast datasets of existing, ***past*** information to generate new content. AI music models inherit biases from their training data, disproportionately privileging dominant musical traditions such as Western tonal harmony, commercially successful genres, and widely recorded artists. Furthermore, an output from these systems is deemed "successful" when it meets the expectations of these biases, perpetuating existing ideas rather than generating progressive ones.

Clever artists will likely find opportunities here—as Ethan Mollick writes in *Co-Intelligence* (2024), "To get the AI to do unique things, you need to understand parts of the culture more deeply than everyone else using the same AI systems."—but this prioritization of hegemonic, past forms limits an AI's ability to generate new, external ideas. As Jaron Lanier wrote in "Agents of Alienation" back in 1995: "An agent's model of what you are interested in will be a cartoon model, and you will see a cartoon version of the world through the agent's eyes." New technologies should inspire new culture, not be subordinate to past culture.

In the early 2010s, music critic and cultural theorist Mark Fisher (2014) argued that culture was already caught in a cycle of nostalgia, repeatedly recycling past styles rather than exploring new artistic ideas. He tied this obsession with retro to the "slow cancellation of the future", describing people's loss of hope that the systems of the world might be improved from the status quo. Fisher argues that cultural production has become increasingly retrospective, fixated on past styles rather than innovation.

Supporting this idea, consider how many contemporary science fiction films—a traditionally speculative genre—are intellectual properties that are over 40 years old (*Dune*, *Star Wars, Star Trek, Mad Max, Alien, Transformers, Blade Runner, Planet of the Apes*, etc.), and how many of these films' soundtracks consist of 1980s-style synth music. Fisher (2014) writes, "Invited to think of the futuristic, we will still come up with something like the music of Kraftwerk, even though this is now as antique as Glenn Miller's big band jazz was when the German group began experimenting with synthesizers in the early 1970s."

Generative AI risks deepening this cultural stagnation by automating nostalgia. When trained solely on existing music datasets and trained to reproduce existing conventions, AI-generated compositions privilege the familiar, rather than contributing to meaningful contemporary explorations. To repurpose a phrase from Christian Gossett's comic, *The Red Star*, this use of AI becomes "a machine that forges the past into chains for the future."

AI's creative potential, however, is not limited to imitation. Many artists are now exploring the aesthetics of ***process*** in machine learning, interrogating its mechanics and interacting with the AI (rather than simply asking the AI to interact with "big data").

To offer a few more mainstream examples, I mention David Cope's EMI (beginning the early 1980s) above as being concerned with results, but, in Cope's later work, he worked more collaboratively with the AI Emily Howell (late 2000s), which uses feedback on its output to try to craft a novel artistic voice. In a more contemporary example, Holly Herndon's album *Proto* (2019) heavily features the AI "Spawn", trained on voice data, as an improvisational partner. More recently, Herndon's *Holly+* (a more developed AI singer trained on her voice) has released a cover of Dolly Parton's "Jolene", and a website now allows anyone to upload their own audio files to create their own *Holly+* cover. Significantly, these examples draw from smaller, personalized datasets, and they bring the focus to the process of creation. Arguably, in these cases, the AI models are the art, not their output.

Our mandate as artists is to create music that reflects our time and imagine possible futures. To avoid cultural stagnation, artists can explore AI as an interactive environment with its own emergent behaviors (and perhaps its preference for the past), while bringing their own new perspectives to the conversation. Benjamin Tallis (2020) proposes that "Taking stylistic cues and inspiration from positive pasts is fine—if they are transposed or transformed into new elements through the new technologies in the light of new ideas."

No one owns the technofuture, and all technology is an extension of human ingenuity and our "humanness." As Bryan Norton (2024) writes in a recent essay, "Technological development can destroy our sense of ourselves as rational, coherent subjects, leading to widespread suffering and destruction. But tools can also provide us with a new sense of what it means to be human, leading to new modes of expression and cultural practices." If AI is indeed a transformative technology, its impact on the arts must extend to content.

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