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Introduction

Carefully Improvised Techno (CIT) emerged from a crucial artistic and conceptual gap in live electronic music performance, where the labour of sequencing, filtering, routing, layering, and timing deeply shapes how the music breathes but often remains visually hidden within software environments, small gestures, and technical interfaces. In DJ and laptop performance, composition and improvisation are not separate phases but continually shape one another through technologies that loop, sequence, mediate, and respond (Butler 2014). CIT takes this condition as a starting point and asks what might become visible if those processes were given visual material consequence.

The project connects live electronic music performance with robotic abstract oil painting through a cross-modal studio-instrument that translates sound into physical painting gestures in real-time. Musical actions generated through sequencing, controller input, and structural change are routed into movement on canvas. Rhythm, pitch, timbre, stereo motion, and looping are not treated as data to be illustrated, but as forces that produce painterly behaviour. The result is not merely a visual supplement to the performance, but a parallel material form through which the same musical process becomes visible.

CIT grew out of my practice as an interdisciplinary artist who simultaneously paints, composes, and performs across sound and image. Its conceptual ground was established in Connected Spirituality[1] (Ha 2024), where electroacoustic improvisation and abstract oil painting were performed together within the same embodied session. It brought improvisation and abstraction, sound and image, and musical and visual decision-making together within a cross-modal practice. It also exposed a physical limit, as painting and mixing simultaneously placed too much labour on the performer's body. CIT developed from this tension as a way to redistribute that labour into an instrument while keeping human authorship and live decision-making central.

[1] Ha, Yoonwoo. 2024. *Connected Spirituality*. MA thesis, Institute of Contemporary Music Performance. https://static1.squarespace.com/static/68680f8ec648ad40d7363f1f/t/6906b5ad239b4440456b7baa/1762047405987/Connected+Spirituality+-+Yoonwoo+Ha.pdf

The title "Carefully Improvised Techno" names the project's method. "Techno" refers both to techno as a musical genre and to technology as artistic material, connecting electronic music culture with instrument building and electronic lutherie. "Improvised" describes its emphasis on live responsiveness, generative processes, and real-time human–machine co-creation. "Carefully" points to the project's human-centred concern with authorship and agency, and with the changing role of the human performer in an era of creative AI and technologically mediated practice. Together, these terms frame CIT as an interdisciplinary artistic practice in which sound, machines, gesture, and painting are brought into a shared performative system.

CIT develops through an iterative process of instrument building, cross-modal mapping, live experimentation, autoethnographic reflection, and theoretical analysis. Each stage feeds the next, allowing technical design and artistic practice to evolve together. The following sections trace this development from its conceptual foundations through system design and prototype development to live performance and reflection. At its centre is the proposition that electronic visual music performance can do more than produce a synthetic visual representation of sound. Through CIT, musical actions become materially consequential, leaving physical traces whose form emerges from the timing, pressure, gesture, and instability of the live event itself.

Background

Visual Music

CIT extends electronic visual music performance into physical painting, moving beyond the predominantly screen-based forms of the field (Payling 2024). Visual music has often explored relations between sound, colour, movement, rhythm, and form (Watkins 2018). In many contemporary audiovisual practices, this relation is produced through projection, animation, live visuals, or digital image processing. CIT shares this concern with audiovisual correspondence, but shifts the site of visualisation from the screen to the canvas. The image is not projected beside the music. It is physically produced through the same temporal process as the performance.

This shift grows from my interdisciplinary practice as both an electronic music producer and abstract painter. Before CIT, my work had already combined ambient-immersive techno, electroacoustic texture, and abstract oil painting. Album artworks and cover images were not separate promotional materials placed after the music. They belonged to the same artistic world as the tracks themselves. The colour, density, and gesture of the paintings shaped how I understood the atmosphere of the music, while mixing decisions shaped how I imagined visual depth, pressure, and space.

Mixing is especially important here. It is not only a technical stage in which frequencies are balanced, but a spatial and material practice. A low-frequency layer can create weight. Reverb can extend a sound into imagined depth. Delay can produce distance, repetition, or afterimage. Filtering can make a texture feel submerged, brightened, narrowed, or opened. Stereo movement can shift the perceived position of a sound across a field. These decisions suggest thickness, distance, colour, pressure, and movement.

CIT develops from this way of listening. Pitch, rhythm, timbre, stereo motion, and loop structure are not treated as neutral data. They are approached as forces that behave differently when they pass into paint. Rhythm can become repeated stroke, interruption, or cyclic pressure. Pitch can suggest vertical placement. Timbre can inform colour and material quality. Stereo motion can become lateral drift. Looping can become recurrence across the surface. These relations are designed, but they are also tested through the resistance of matter.

The canvas therefore does not behave like a neutral display. It has thickness, resistance, texture, and memory. Oil paint accumulates, drags, smears, interrupts, and partially refuses control. A projected image can disappear when the signal ends, but paint remains. This allows CIT to treat visual music not only as a relation between sound and image, but as a relation between sound, gesture, matter, and duration. Tangible spatial-musical imagery provides a useful precedent for treating gesture and spatial form as embodied, perceptual phenomena rather than purely symbolic representations (Barrett 2015). CIT develops this idea through oil paint, motor movement, and live electronic music.

Connected Nature × Connected Spirituality

Connected Spirituality (Ha 2024) established the practical and conceptual ground for CIT. In that work, electroacoustic improvisation and abstract oil painting were performed within the same embodied session, exploring how musical gesture, colour, texture, movement, and atmosphere could operate across sound and image through semiotic analysis and autoethnographic reflection.

Rather than treating painting as an illustration of music, the project approached sound and image as interconnected forms of improvisational thinking. The body became the point at which musical and painterly decisions met. This immediacy was fundamental to the work, but it also exposed a physical limit. Painting and mixing simultaneously concentrated too much creative labour in the performer's body.

CIT emerged directly from this constraint. The robotic painting system was developed not to replace the performer, but to redistribute physical labour through a cross-modal instrument while preserving human authorship and live decision-making. The performer continues to shape musical structure, mappings, timing, and interpretation, while motors extend those decisions into physical actions through paint and canvas.

This redistribution also creates a more reciprocal relationship between the two media. Painterly activity now unfolds as part of the performance rather than before or after the music. What appears on the canvas can alter how I hear and develop the sound, while musical decisions continuously reshape the material surface. A dense area of paint may lead me towards restraint. A recurring visual gesture may encourage a loop to continue. Drag, accumulation, or mechanical resistance can introduce tension that feeds back into the music.

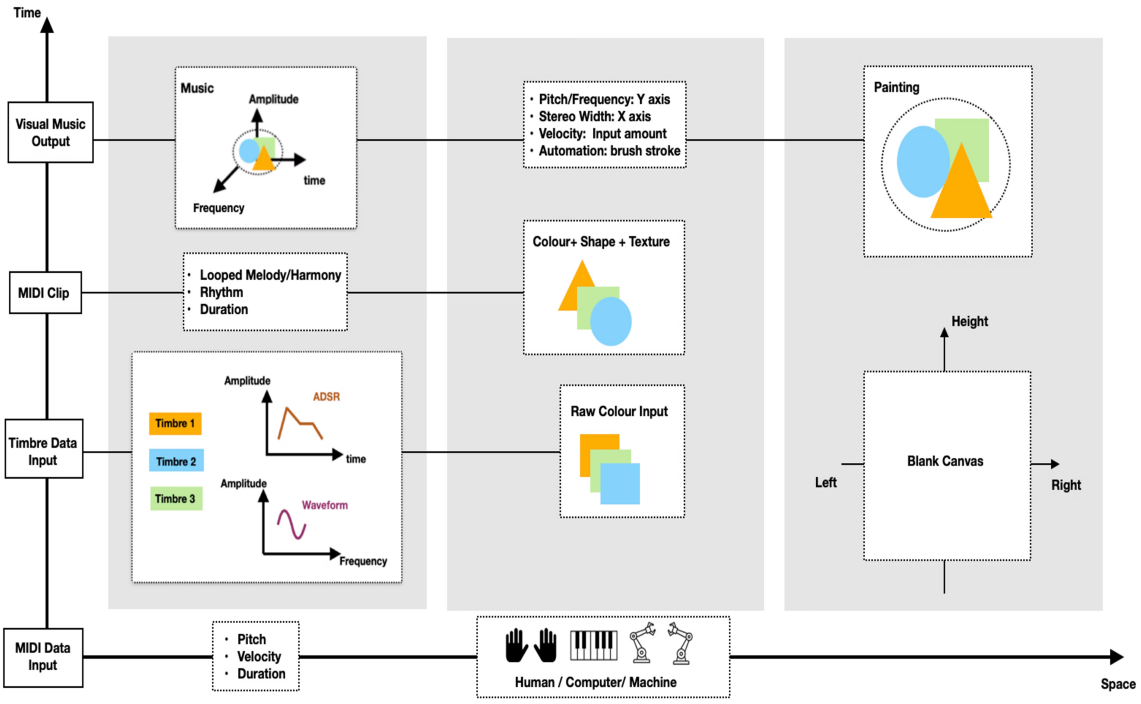
CIT therefore extends Connected Spirituality (Ha 2024) from simultaneous sound and painting towards an integrated system in which music, bodily intention, machine behaviour, and physical matter continuously act upon one another.

System Design

The overall cross-modal workflow of CIT redirects musical time, MIDI data, timbre, and gesture into movement on the canvas. Pitch, velocity, duration, automation, and sound character become ways of shaping position, pressure, colour, and trace. The

system therefore works less like a sound-to-image converter and more like a shared performance environment between electronic music, robotic movement, and painting.

Figure 1. System Design



Cross-Modal Mapping Logic

CIT approaches cross-modal mapping not as a direct translation between equivalent properties, but as a designed relational topology across musical, spatial, mechanical, and material domains. Musical parameters provide the source conditions of the system, while visual parameters establish corresponding dimensions through which those conditions can become spatially and materially articulated.

The mapping topology operates through four interconnected layers. Musical parameters define the source structures of performance. Visual parameters establish the painterly dimensions through which these structures are reconfigured. Robotic actions provide the physical mechanism connecting the two domains, while semiotic logic describes the conceptual relation that makes each mapping meaningful within the artistic system.

Table 1. The Connected Nature Cross-Modal Mapping Topology

Musical Parameter (Source)	Visual Parameter (Target)	Robotic Action	Semiotic Logic
Time (Duration)	Space (Canvas Size)	Horizontal Linear Actuation	Temporal-Spatial Flow
Pitch	Height (Y-Axis)	Robotic Arm Position	Vertical Frequency Alignment
Repetition (Loops)	Geometric Shape	Circular / Cyclical Rotation	Cyclic Loop Reification
Rhythm	Texture	Velocity & Pressure Modulation	Kinetic Energy Transfer
Timbre	Colour	Paint Selection	Spectral-Chromatic Identity
Harmony	Colour Mixture	Mixing Strokes	Polyphonic Visual Integration
Physiological Biofeedback	Brush Opacity	Z-Axis Pressure Modulation	Emotional Empathy and Tension

Table 1 formalises these relations. Time is organised through space, pitch through height, repetition through cyclical form, rhythm through texture and kinetic intensity, timbre through colour, and harmony through mixture. These correspondences are not intended as universal or deterministic associations. They function as compositional propositions through which structures in one medium can be reorganised within another.

The topology therefore provides a framework rather than a fixed conversion system. Mapping establishes the conditions through which musical organisation can acquire spatial, mechanical, and material form, while the resulting behaviour remains shaped by performance, robotic actuation, and the physical properties of paint and canvas.

MIDI as a Cross-Modal Interface

MIDI is the practical language through which CIT turns musical decision into painterly action. Notes, controller data, velocity values, clock information, and continuous control changes are not used only as musical instructions. They become a shared protocol between live electronic music workflow, mapping logic, microcontroller, motor movement, and canvas.

CIT uses the possibilities MIDI allows to connect electronic music performance directly with robotic painting. Musical control signals are mapped to movement,

allowing the performer to remain within a musical workflow while its consequences become painterly.

Two studio examples clarify how this interface operates. In the first, a MIDI controller is used to perform music while simultaneously directing the painting process, allowing the same live control gesture to act across sound and image. In the second, MIDI signals generate robotic movement without continuous direct control, allowing painterly gestures to emerge through the behaviour of the system itself. Together, these examples establish MIDI as both a medium for direct cross-modal authorship and a generative structure through which painterly behaviour can emerge beyond continuous manual control.

Seen in this way, MIDI is more than a technical connection between music and painting. It provides a flexible layer through which human gesture, musical structure, automated behaviour, and material response can be organised within the same instrument. This places CIT within recent digital lutherie research, where instrument design is understood not only as technical problem-solving, but as a practice shaped by artistic intention, embodied interaction, craft knowledge, and the performer's specific needs (Armitage, Magnusson, and McPherson 2023; Renney and Gaster 2024).

From Studio to Stage: Hardcase Groovebox

The hardcase format is central to the work's identity, functioning not simply as a container but as the flexible, portable body of the instrument, designed to travel from studio and rehearsal to installation and ultimately the stage. In this sense, it behaves like a groovebox expanded into a cross-modal studio-instrument while remaining a coherent object across different creative contexts.

This portability allows the same cross-modal system to operate flexibly across studio production, exhibition, and live performance. In the studio, it serves as a composition and production environment for developing both musical and visual material. In exhibition settings, it can be encountered as both a technical and artistic object. On stage, it reaches its fullest form, integrating synthesisers, MIDI controllers, sound processing, robotic painting mechanisms, and painting materials into a single performance instrument. This reflects recent work showing that digital instruments acquire meaning through use, context, and practice as much as through technical

specification (Benford et al. 2024).

Moreover, the cross-medium translation from digital control to physical canvas is central to that ecology. Oil paint introduces viscosity, drag, smearing, delayed settling, and irreversibility. These material properties directly shape each stroke, as viscosity, resistance, and existing layers continually affect how paint is applied across the canvas. This emphasis on matter as constitutive rather than secondary connects with work on materiality in digital musical instrument design, where gesture and instrument identity are shaped by the physical properties of what they act through (Zheng, Bryan-Kinns, and McPherson 2022).

Prototypes and Performances

First Prototype: Generative Movements and Shapes through Magnetic Glitch

Early experiments used magnetic coupling as a way of translating motor movement into painterly action while preserving a degree of instability. Rather than fixing the brush or painting element rigidly to the motor path, the system allowed slippage, partial detachment, and re-alignment. I describe this behaviour as *magnetic glitch*: a moment when programmed movement meets the resistance of paint, friction, and surface.

In performance, this instability could become musically expressive. During one session, a dense percussive loop and filtered delay sent repeated movement into the same area of the canvas. As the paint thickened, the magnetic element began to slip, producing a broken circular trace that moved between loop, smear, and interruption. Hearing the musical repetition continue while seeing the painted gesture fail to close changed my perception of the section. I stopped hearing the rhythm simply as forward drive and began to experience it as tension.

However, the same instability that made the prototype expressive also exposed its practical and compositional limits. The magnetic mechanism was relatively straightforward to operate in performance, but it was difficult to transport, align, and reproduce consistently across different spaces. More importantly, the indirect magnetic connection made it difficult to produce clear and meaningful correspondences between

musical action and painterly output. Straight, repeatable movements were especially unreliable, and the resulting marks could become visually disconnected from the musical gesture that initiated them.

The prototype therefore demonstrated both the potential and the limitation of controlled instability. Failure, drag, and misalignment could become expressive thresholds, but the system needed a more direct mechanical relationship between musical control and physical mark-making. This led to the development of the later cyclic brush mechanism, which retained material resistance while allowing clearer, more repeatable, and more performable relationships between sound, movement, and paint.

Techno on Canvas: Direct Cyclic Brush

Later work shifted the system towards a more direct cyclic brush mechanism. A brush was attached to a motor positioned next to the canvas, allowing rotational contact with the surface. This made the techno logic of the work more visible, translating musical loops into physical gestures that struck and dragged paint across the canvas.

This version produced a clearer relation between musical decision and painterly consequence. Increasing rhythmic density or extending a pattern changed the intensity and persistence of contact with the canvas rather than simply making the image busier. As paint accumulated in particular areas, filter movement, delay feedback, and rhythmic layering could appear as saturation, friction, and loss of clean separation.

In performance, this made the system more playable. A repeated visual rhythm might encourage me to remain longer in a loop. An overloaded surface might lead me to reduce the musical density. A clean mark might invite a more open sonic space. The system became less a device that received musical information and more a field of response in which sound, machine movement, and matter continuously affected one another.

Discussion

Human–Machine Co-Composition

Across these stages, CIT operates as a form of human-machine co-composition, but not in the sense that the machine becomes an autonomous author. The machine contributes movement, constraint, delay, repetition, and unpredictability. The performer remains responsible for the musical structure, mapping decisions, thresholds, timing, and interpretation of what happens on the canvas.

This distinction matters, as the system can appear generative. Marks are produced in real time, and some outcomes cannot be fully predicted in advance. However, this unpredictability emerges from a designed relation between human intention, computational routing, mechanical behaviour, and material resistance.

Rather than delegating authorship to autonomous AI, CIT is generative through the liveness of the situation while agency remains with the artist. This also distinguishes CIT from adjacent robotic painting systems. Robotic arm painting through real-time music analysis shows how music can be translated into painterly movement by robotic means (Savery, Savery, and Baird 2022).

CIT differs in treating the full setup as a portable instrument ecology with its own technique, memory, and performative identity. The aim is not simply to translate sound into image, but to develop a studio-instrument whose behaviours can be learned, negotiated, and shaped through performance over time.

Culture, Graphic Score, and the Studio-Instrument

CIT is not only a technical setup or a performance method. It is also a cultural position. The project emerges from electronic music culture, but it does not remain confined to that field's usual visual language. Club-oriented electronic practice produces powerful forms of collective time, repetition, pressure, and bodily synchronisation, yet its material traces are often minimal or indirect. CIT extends that condition by insisting that the same practice can also become visibly and materially legible.

The studio matters strongly here. In electronic music culture, the studio is rarely just a neutral site of production. It is a compositional environment, a listening space, a

rehearsal space, and often an instrument in its own right. Sequencing, routing, layering, and iterative control are not simply preparatory acts before performance. They already belong to performance logic.

CIT carries these workflows into a cross-modal instrument, consistent with broader accounts of electronic music as a situated practice shaped by technical environments and musical cultures (Butler 2014; Tragtenberg et al. 2024).

Once painting enters the system, the performance leaves a visible trace. The canvas is not a conventional score, but a material record in which force, layering, spacing, and accumulation remain after the event. Graphic and animated notation demonstrate how visual inscription can move beyond documentation and function as performative structure in its own right (Hope 2020). CIT extends this idea by producing its visual inscription through the performance itself rather than preparing it in advance, allowing the canvas to retain the structure and material consequences of the live event.

This relation also changes how the project moves between scenes. In a club context, repetition and pressure organise collective bodily attention. In a gallery or research context, that same repetition may be perceived as process, method, or inscription. CIT does not collapse these frames into one. Instead, it uses the studio-instrument to carry one logic across them. The same looping structures that drive a live electronic set can also generate the density of a visual field; the same sequencing decisions that organise sound can leave behind a surface shaped by performance.

The project therefore proposes a broader understanding of what an instrument can be culturally. It can be a studio process, a live performance device, a score-generating system, a research object, and a visual art apparatus at once. Electronic music culture gives the project its temporal language of loops, pressure, and collective intensity. Instrument making gives it form, threshold, and technique. Artistic research gives it a reflective frame in which practice becomes inquiry. The studio-instrument is where these dimensions meet.

Conclusion

Carefully Improvised Techno proposes a way of connecting live electronic music, abstract painting, cross-modal studio-instrument making, and artistic research through an integrated composition–performance system. Rather than merely adding

digital visuals to electronic sound, the project asks how musical processes can acquire material consequence. In CIT, repetition can become accumulation, timing can become pressure, sonic density can reshape the canvas, and musical decisions can persist as physical traces.

The article has argued that CIT belongs to the broader history of visual music while shifting its emphasis away from screen-based representation towards material process. Its significance lies not only in establishing a cross-modal language between sound and image, but in extending that mapping across digital, human, mechanical, and physical domains. Musical processes become machine actions, embodied performance decisions, and ultimately material traces in paint, where resistance, slippage, accumulation, and change continually reshape the result. The first prototype revealed the expressive value of glitch and partial control, while later mechanisms made these behaviours more playable and more closely aligned with techno's logic of looping, recurrence, and gradual transformation. The mapping therefore does not remain a stable computational correspondence, but becomes a live cross-medium negotiation in which sound acquires physical consequence and the painting emerges not as an illustration of the music, but as a material record of decisions made under live conditions.

In the age of creative AI, these qualities become crucial to CIT's position as an interdisciplinary combined-arts practice, proposing three connected principles for a human-centred cross-modal generative practice.

First, the human keeps authorship. CIT uses technology to extend artistic action without transferring creative responsibility to the machine. The system may produce unpredictable behaviours, but the performer remains the one who listens, interprets, chooses, intervenes, and gives those behaviours meaning. Generativity becomes a condition for human judgement rather than its replacement.

Second, CIT creates a direct movement from music into physical visual form. Musical action is connected to movement, tools, paint, and canvas. Sound becomes motion, motion becomes contact, and contact becomes a mark. Meaning emerges through embodied decisions, metaphor, association, and personal interpretation rather than being delegated to a generative model.

Third, materiality matters. At a moment when creative images and sounds

increasingly exist within digital and synthetic environments, CIT deliberately returns electronic music to physical matter. Paint has weight, viscosity, friction, texture, and permanence. Each action alters the conditions for the next, leaving evidence of time, error, touch, resistance, and consequence.

These principles are inseparable. Human authorship is reinforced by direct physical causality, while material resistance gives consequence to human decisions. More importantly, CIT treats the connection between artistic domains as a creative act in itself. AI can generate sounds and images with increasing sophistication, but interdisciplinary art depends on more than the production of convincing outputs. It depends on the human capacity to construct meaningful relationships between sound, image, movement, material, memory, metaphor, and lived experience. Connecting these domains therefore becomes especially significant in the age of creative AI because their artistic meaning lies not in any single medium, but in the human intention and interpretation that bring them together.

CIT actively embraces AI, computation, and generative technology as means of expanding the domains through which human creativity can operate. Rather than replacing or flattening human creative processes, it uses technology to extend and materialise them while carefully preserving authorship, agency, and personal meaning at the centre of the artistic practice. Its improvised nature depends not on computational randomness, but on the distinctly human capacity to respond, interpret, adapt, and create meaning in real time. Techno functions here both as a musical language and as a technological condition through which sound, image, movement, and matter can be connected across art forms. CIT ultimately proposes that the future of creative technology should be measured not only by what machines can generate, but by how powerfully technology can amplify and materialise what humans can uniquely connect, interpret, and create.

References

Armitage, Jack, Thor Magnusson, and Andrew McPherson. 2023. "Studying Subtle and Detailed Digital Lutherie: Motivational Contexts and Technical Needs." In *Proceedings of the International Conference on New Interfaces for Musical Expression*, 1–9. https://doi.org/10.5281/zenodo.11189088.

Barrett, Natasha. 2015. "Creating Tangible Spatial-Musical Images from Physical Performance Gestures." In *Proceedings of the International Conference on New Interfaces for Musical Expression*, 191–94.

Benford, Steve, Glenn McGarry, Adrian Hazzard, Alan Chamberlain, Rebecca Gibson, and Juan Pablo Martinez Avila. 2024. "Augmenting Musical Instruments with Digital Identities." *Journal of New Music Research* 52 (5): 436–55. https://doi.org/10.1080/09298215.2024.2423613.

Butler, Mark J. 2014. *Playing with Something That Runs: Technology, Improvisation, and Composition in DJ and Laptop Performance*. Oxford: Oxford University Press.

Ha, Yoonwoo. 2024. *Connected Spirituality*. MA thesis, Institute of Contemporary Music Performance. Available at: https://static1.squarespace.com/static/68680f8ec648ad40d7363f1f/t/6906b5ad239b4440456b7baa/1762047405987/Connected+Spirituality+-+Yoonwoo+Ha.pdf

Hope, Cat. 2020. "The Future Is Graphic: Animated Notation for Contemporary Practice." *Organised Sound* 25 (2): 187–97. https://doi.org/10.1017/S1355771820000096.

Payling, D. 2024. 'Electronic Visual Music - The Elements of Audiovisual Creativity'. New York: Routledge.

Pelinski, Teresa, Andrew McPherson, and Rebecca Fiebrink. 2025. "Ways of Knowing, Ways of Writing: Technical Practice Research in New Musical Instrument Design." *Journal of New Music Research* 53 (1–2): 79–92. https://doi.org/10.1080/09298215.2024.2442348.

Renney, Nathan, and Benedict Gaster. 2024. "Insights Into How Digital Luthiers Approach Design." In *Proceedings of the International Conference on New Interfaces for Musical Expression*, 505–15. https://doi.org/10.5281/zenodo.13904935.

Savery, Richard, Anna Savery, and Justin Baird. 2022. “Robotic Arm Generative Painting Through Real-Time Analysis of Music Performance.” In *HAI ’22: Proceedings of the 10th International Conference on Human-Agent Interaction*, 253–55. New York: Association for Computing Machinery. https://doi.org/10.1145/3527188.3563913.

Tragtenberg, João, Filipe Calegario, Marcelo M. Wanderley, and Virgínia Pereira Cavalcanti. 2024. “Designing DMIs with(in) a Music Culture: A Participatory Design Process with the Xambá Quilombola Community.” In *Proceedings of the International Conference on New Interfaces for Musical Expression*, 367–76. https://doi.org/10.5281/zenodo.13904882.

Watkins, Julie. 2018. “Composing Visual Music: Visual Music Practice at the Intersection of Technology, Audio-Visual Rhythms and Human Traces.” *Body, Space & Technology* 17 (1): 51–75. https://doi.org/10.16995/bst.296.

Zheng, Jianing, Nick Bryan-Kinns, and Andrew McPherson. 2022. “Material Matters: Exploring Materiality in Digital Musical Instruments Design.” In *Proceedings of the 2022 ACM Designing Interactive Systems Conference*, 976–86. New York: Association for Computing Machinery. https://doi.org/10.1145/3532106.3533523.