xCoAx 2024
12th Conference on Computation,
Communication, Aesthetics & X
Fabrica, Treviso, Italy
2024.xCoAx.org

416

Suspended in Gabba: Musical Improvisation for Embodied Human-Machine Learning

Lauren Hayes
lauren.s.hayes@asu.edu
School of Arts, Media and Engine-
ering, Arizona State University,
Tempe, AZ, USA

Suspended in Gabba is a musical improvisation for embodied human-machine learning. This involves a methodology that is myriad and maximal in its relationship to sound synthesis and music production. That is to say that it is ambivalent about particular or specific synthesis techniques, dominant lineages of electronic music, or purist ways of working. Instead, this research project conveys an approach to sound synthesis, digital sound manipulation, and music production as a way of knowing. Many types of synthesis are messily accumulated into the performance system alongside elements such as machine listening, machine learning, sampling, live re-sampling, analysis and resynthesis, and other approaches to the creation and transformation of digital sound. Drawing on enactive-ecological, and embodied approaches to live electronic musical performance, it is the very non-linear complexity of being a living, encultured human navigating the world, encountering materials, and embodying processes that informs this way of engaging with sound.

Description

Suspended in Gabba is a musical improvisation for embodied human-machine learning. This involves a methodology that is myriad and maximal in its relationship to sound synthesis and music production that has evolved over the last seventeen years. That is to say that it is ambivalent about particular or specific synthesis techniques, dominant line-

xCoAx 2024

12th Conference on Computation,
Communication, Aesthetics & X
Fabrica, Treviso, Italy
2024.xCoAx.org

417

ages of electronic music, or purist ways of working with digital sound. Instead, this research project conveys an approach to sound synthesis, digital sound manipulation, and music production as a way of knowing. It does not discriminate on the techniques that are used. Many types of synthesis from frequency modulation (FM), amplitude modulation (AM), subtractive synthesis, pulsar synthesis, and micro-sonic techniques are messily accumulated into the performance system alongside elements such as machine listening, machine learning, sampling, live re-sampling, analysis and resynthesis, and other approaches to the creation and transformation of digital sound. Yet this work follows philosopher and cognitive scientist Hanne De Jaegher in her resistance to privileging what I will sum up in brief as the 'computational' language that is often used within cognitive science research; she asserts that "our most sophisticated knowing is full of uncertainty, inconsistencies, ambiguity, contradictions" (De Jaegher 2021, 848). Informed by enactive-ecological (Rietveld, Denys & van Westen 2018), and embodied approaches to cognition, it is the very non-linear complexity of being a living, encultured human navigating the world, encountering materials, and embodying processes that informs this way of engaging with sound and performing live electronic music (see Hayes 2019).

Since 2007, I have developed bespoke software and hardware in order to create musical performance systems. My typical hybrid analogue/digital performance system includes laptop, custom software written in the graphical creative coding language Max, controllers, voice processors, drum machines, analogue synths, which all mutually affect each other by way of the ecological software design and machine listening techniques (see Hayes 2022). This creative practice is deeply informed by the theories of embodied music cognition, specifically the enactive-ecological approach (Hayes & Loaiza 2022). In this, the affordances of my system are not cerebrally mapped out, but are explored–and music is produced–via the dynamic, playful, and ongoing navigation between myself and the system. Musicologist Jacob Hart has provided an in-depth technical analysis of a recent iteration of my performance system, yet astutely notes that: "it is a complicated web of interconnecting parts, a sonorous body that will produce sound without her intervention; small changes in her gestures are amplified through a chain of connections of agency into sonorous results that can be unpredictable. This is something that she actively looks to create. When looking at the complicated state of the Max patch, we can conceivably extend this idea to the code itself: an impenetrable object, full of agency, which the musicker must resist and fight to find a place in" (Hart 2021, 213-4).

xCoAx 2024

12th Conference on Computation,
Communication, Aesthetics & X
Fabrica, Treviso, Italy
2024.xCoAx.org

418

Fig. 1. Embodied hybrid analogue/
digital performance system in 2020.
Image credit: Tobias Feltus.

The design of the enactive-ecological performance system (see Figure 1) is informed by early models from cybernetics and artificial life and has explored notions of feedback, unpredictability, autopoiesis, and dynamic systems. As musician and scholar Tara Rodgers has noted, "To take seriously [an] analogy between sounds and forms of life-as fleeting, overlapping, and ever in transformation-requires that we dismantle the subject position of detached and knowing observer that persists in audio-technical discourse, and recognize ourselves amid the currents, always provisionally defined in relation to other humans, species, things and environments" (Rodgers 2016, 209). In the case of the human, the design has been shaped by the many communities of practice that I have participated in over these years, by way of friends, mentors, educators, students, collaborators, workshop leaders, workshop participants, community groups, ensembles, research groups, and so on.

More recently, this performance system has incorporated machine learning and complex sound decomposition techniques as part of my participation in the Fluid Corpus Manipulation (FluCoMa) research project, University of Huddersfield (Tremblay, Green & Roma 2019). Within this community of practice, I was commissioned as one of eight international artists to create a new work using the creative coding toolkit. The project studied how creative coders and technologists work with and incorporate new digital tools for deconstructing audio in novel ways. This project allowed me to explore if and how machine learning could be used to augment my already mature improvisational system in Max, and how this could be embodied through performance practice. In *Suspended in Gabba*, I implement and perform a technique that I describe as 'third-order improvisation'. Firstly, I perform and record an improvisation; then, I segment the recording, order the segments according to a variety of descriptors, and then re-improvise with this ordered material using k-nearest neighbour (KNN) algorithms within FluCoMa to create punchy percussive and rhythmic patterns that I can move away from gradually–or rapidly–into new sonic territory. This second pass is also recorded. Finally, this material is then re-improvised live via another

xCoAx 2024
12th Conference on Computation,
Communication, Aesthetics & X
Fabrica, Treviso, Italy
2024.xCoAx.org

419

KNN-based approach that is tailored towards real-time performance and omits various computationally intensive analysis elements.

Suspended in Gabba seeks to question, challenge, and reshape the established protocols of sound synthesis and electronic music performance by drawing inspiration from the enactive-ecological framework, incorporating the historic, emergent, and structurally-coupled relationships between musical agents, materials, and sounds. In her work on digital musical instrument design and "embodied autoethnography" (Mainsbridge 2022), musician and scholar Mary Mainsbridge exemplifies this process, stating: "I refine the instrumental and expressive capacity of my body as it develops through varied activities and phases" (Mainsbridge 2022, 5). The title of the project alludes to one of many such 'activities and phases' of music as I it experienced viscerally–as loud and fast beats, distorted bass and kick drum in rooms full of moving bodies–in the late 90s. Yet, earlier still, it was the physicality of learning to play and create music on acoustic piano that I struggled with and embodied as a young child. This project explores live electronic musical performance and sonic art through this historic, encultured, and very much embodied lens. It is not the technological developments that are necessarily of importance within this practice: it is the socio-musical configurations that are reified within the embodied performance of such techniques that hold the most potential for creating new (musical) worlds.

References

De Jaegher, Hanne.
2021. "Loving and knowing: Reflections for an engaged epistemology." *Phenomenology and the Cognitive Sciences, 20*(5), pp.847-870. https://doi.org/10.1007/s11097-019-09634-5

Hayes, Lauren.
2022. "Why should we care about the body? On what Enactive-Ecological Musical Approaches have to Offer." In *The Body in Sound, Music and Performance*, edited by Linda O Keeffe, Isabel Nogueira. Routledge.

Hayes, Lauren and Juan M. Loaiza
2022. "Exploring attention through technologically-mediated musical improvisation: an enactive-ecological perspective." In *Access and Mediation: Transdisciplinary Perspectives on Attention*, edited by Maren Wehrle, Elizaveta Solomonova and Diego D'Angelo. Berlin, Boston: De Gruyter Saur, 2022. https://doi.org/10.1515/9783110647242

Hayes, Lauren.
2019. "Beyond Skill Acquisition: Improvisation, Interdisciplinarity, and Enactive Music Cognition." *Contemporary Music Review*. London: Taylor & Francis. https://doi.org/10.1080/07494467.2019.1684059

xCoAx 2024

12th Conference on Computation,
Communication, Aesthetics & X
Fabrica, Treviso, Italy
2024.xCoAx.org

420

Hart, Jacob.
2021. *Performance Cartography, Performance Cartology: Musical Networks for Computational Musicological Analysis*. PhD diss., University of Huddersfield.

Loaiza, Juan M.
2019. "From Enactive Concern to Care in Social Life: Towards an Enactive Anthropology of Caring." *Adaptive Behavior* 27, no. 1: 17-30. https://doi.org/10.1177/1059712318800673

Mainsbridge, Mary M.
2022. "Feeling Movement in Live Electronic Music: An Embodied Autoethnography." In *Proceedings of the 8th International Conference on Movement and Computing* (MOCO '22), 13. New York: Association for Computing Machiner. https://doi.org/10.1145/3537972.3537989

Rietveld, Erik, Damiaan Denys, and Maarten Van Westen
2018. "Ecological-Enactive Cognition as Engaging with a Field of Relevant Affordances: The Skilled Intentionality." *The Oxford Handbook of 4E Cognition*, edited by Albert Newen, Leon De Bruin, and Shaun Gallagher. Oxford: Oxford University Press. https://doi.org/10.1093/oxfordhb/9780198735410.013.3

Rodgers, Tara.
2016. T"oward a Feminist Epistemology of Sound: Refiguring Waves in Audio-Technical Discourse." *Engaging the World: Thinking After Irigaray*, edited by Mary C. Rawlinson, 171-187. State University of New York Press.

Tremblay, Pierre Alexandre, Owen Green and Gerard Roma.
2019. "From Collections to Corpora: Exploring Sounds through Fluid Decomposition." In *Proceedings of the 2019 International Computer Music Conference*.