



## **LIVE AND KICKING**

### **Part 2: DMI Design in Electro-Acoustic Performance**

#### **with Axine M**

*In this Lux Cache article/tutorial series, we delve into the intricate world of electronic music performance from the ground up. In this chapter, New York-based experimental artist Axine M explores the lens of the digital luthier, unpacking the theoretical architecture of Digital Musical Instruments (DMIs). By deconstructing her own live setup, she demonstrates how specific mapping strategies can engender 'sympathetic engagement' and true liveness.*

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## INTRODUCTION

A conventional acoustic instrumentalist makes a movement which excites some physical property of an acoustic instrument, causing air particles to vibrate and activate the ear of the listener. The listener simultaneously perceives the sound and the movement which causes it. Computer music makes it possible to divorce a performer's movement from sound generation and the perceived sonic result. This cracks open a huge world of creative possibilities for live performance. Real-time control of digital audio has changed the meaning of "liveness" in electronic music performance. Computer music players may engage their instruments with a complexity on the order of driving a car, or the simplicity of pushing a single button. There are few rules and traditions to abide by, but ideally it is interesting to watch.

In this article I'll give an introduction to the field of research on custom digital musical instruments, touch on some of the literature that inspired me as an electro-acoustic performer, and discuss using existing performance information as input: performance/performative gestures, the concept of mapping strategies, and my personal approach. While I am not an active DMI designer, this research area has had an enormous influence on my live performance practice. It is the theoretical foundation underpinning the structure of my live setup. I believe it will benefit any player of electronic equipment to think about their system through the lens of a digital luthier.

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## DIGITAL MUSICAL INSTRUMENTS

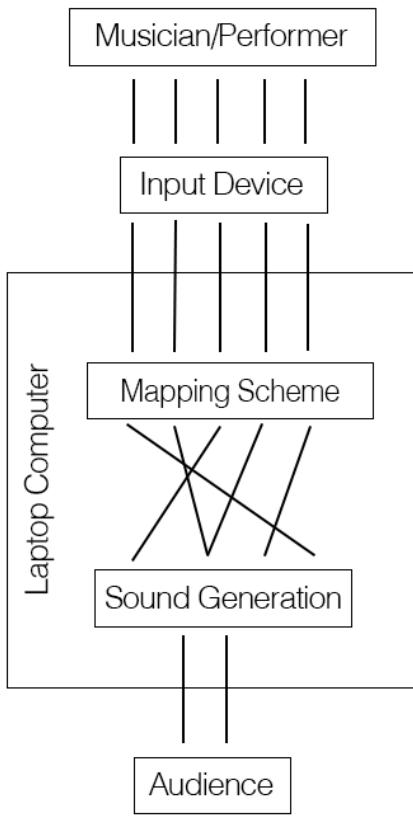
A digital musical instrument [DMI] can be described as the sum of an interface, a sound generation mechanism, and a mapping scheme; the relationship between input and output. As long as a controller or sensor array is capable of adequately capturing a motion, that gesture may be mapped to a defined musical event.

### INPUT DEVICES AND SOUND GENERATION

An interface can be made up of electronic input components (knobs, buttons, sliders, etc.) a sensor array (cameras, microphones, motion detectors, etc.), or any combination of the like. Different input modalities generate a variety of types and complexity levels of data, which can be used as control information. Like a binary switch, vs. a continuously changing value.

The ontological expansion of the musical instrument is made possible by the availability of real-time signal-processing applications, as well as advances in consumer electronics. In a DMI, sound generation might mean a synthesis model, a bank of samples, an effects chain, or all of the above.

## MAPPING SCHEMES



Mapping schemes describe the relationship between control input (the performer's actions) and sonic output. Researchers characterize mapping schemes in a few ways:

**One-to-One, One-to-Many, Many-to-One, Many-to-Many:**

How many parameters or states is each control assigned to? Do they overlap?

**Degrees of Linearity or Non-Linearity:**

Is the input data being transformed before it alters sound parameters? And how?

**Determinacy:**

Is the system recursive, generative, time-variant, or static? Or, does the system respond in the same way every time it is used?

Action-sound relationships, or mapping points, can take many forms. A simple and familiar mapping point is a volume knob. When you turn the knob to the right, the sound is louder. To the left, quieter. If you quickly move the knob to a certain position, the volume reacts in a way that is unsurprising. This is a one-to-one (knob position to sound volume), linear, determinate mapping point.

## DMI DESIGN

The “quality” or “success” of a DMI (which is highly subjective) depends on the experience of the user/performer and the experience of the viewer. Successful DMIs are accessible. They should be easily understood and engaged with on first interaction, but offer discovery and room for improvement upon further uses. Ideally, a player is able to enjoy an instrument the first time they pick it up, without becoming bored the second and third times. Furthermore, a DMI should have reproducible output. Even a DMI with a complex or indeterminate mapping scheme should be reliable enough to perform the same piece on multiple occasions. Otherwise it is just a toy.

There are whole communities devoted to novel electronic instrument design, interpreting data from new sensors, custom synthesis techniques for new controllers, and the use of machine learning therein. A conference of note is New Interfaces for Musical Expression. A paper about my Masters thesis project was published by NIME in 2020. NIME conference proceedings are freely available online, so I will reference a few.

Seasoned DMI creators such as Perry Cook have written about their experiments in detail and offer valuable insight. Since instrument design is more of an art than a science, it is helpful to consider others' findings. Cook's principles, published [here](#), have guided my thoughts on building Ableton sessions and assembling gear for live sets.

One of Cook's principles suggests that the DMI creator design control systems from the germination idea of a musical piece, rather than beginning by dreaming up a control device. This is like saying that it's good to work with limitations. If you start conjuring up an all-powerful custom gestural performance setup you'll just keep adding features *ad infinitum* and make a mess. Think of a song or track you want to get performative with, specify how, and build that. Be modular, iterate, hone in, and then after hands-on trial and error you can expand on the minimum viable product. MVP is also a concept from product development. There is significant overlap between fields.

Rebecca Fiebrink's work has been enormously influential. The Wekinator, an open-source environment for creating mappings with machine learning, is crucially important for its prioritization of the artist and the physical artifact. She thinks a lot about embodiment in performance which is rare within the DMI literature. She and Laetitia Sonami, creator of the extremely cool [Lady's Glove](#) instrument and a collaborator of Eliane Radigue's, discuss their work creating instruments [here](#).

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## THOUGHTS ON PERFORMANCE AND LIVENESS

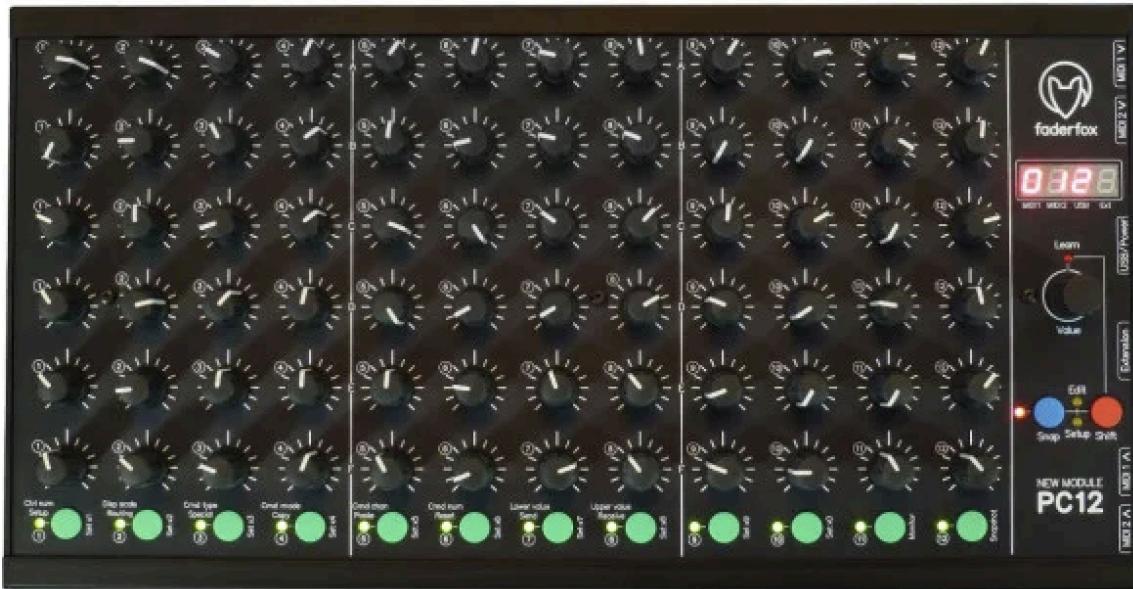
Across performance disciplines, instructors will encourage certain behaviors:

- “Never turn your back on the audience.”
- “Sit/Stand up straight.”
- “Smile.”
- “Find your light.”

If the performative act is a canvas and you want to freely express yourself, these are baseline spells for establishing audience engagement. Exuding confidence and being comfortable with eye contact are tried and true methods of getting people to listen, but rules should be learned and broken. If you consider your body as part of a musical instrument, or as a component in a system which generates musical performances, you will more likely create an embodied experience in yourself and a compelling one for the listener.

I like to focus on something I call “sympathetic engagement.” The same phenomenon underpinning cringe, or feeling pain when you see a depiction of injury. Porn would not exist if this wasn't a thing. If you have an experience of doing something, or if the action is itself easy to conceive of doing, watching someone else do it will activate real or imagined memories of doing it yourself. There is probably a scientific term for this—I am truly just bullshitting—but I will die on this hill.

## AXINE M LIVE



Faderfox PC12 MIDI Controller.

As a working music artist and frequent live performer, I'm deeply preoccupied with the intricacies of capturing and holding an audience's attention. Striking a balance between accessibility and mystery and keeping things dynamic and interesting for myself and the viewer. Among other things I've learned how to trick a loud room into listening quietly, which is really fun. Here I'll describe my live setup and elucidate the mapping schemes behind two tracks in my recent set rotation; adhering to the Cook principle: "Make a piece, not an instrument or controller."

The phenomenon of sympathetic engagement has guided my decision to abandon the pursuit of creating new objects as novel physical components of a musical interface. Instead, I rely on existing musical tools that are familiar to the viewer. These signify that a musical performance will take place without introducing any extraneous information. Nothing beats a guitar and a microphone for prescribing audience expectations. These tools are loaded with context and history, which can be useful limitations to play off of and into.

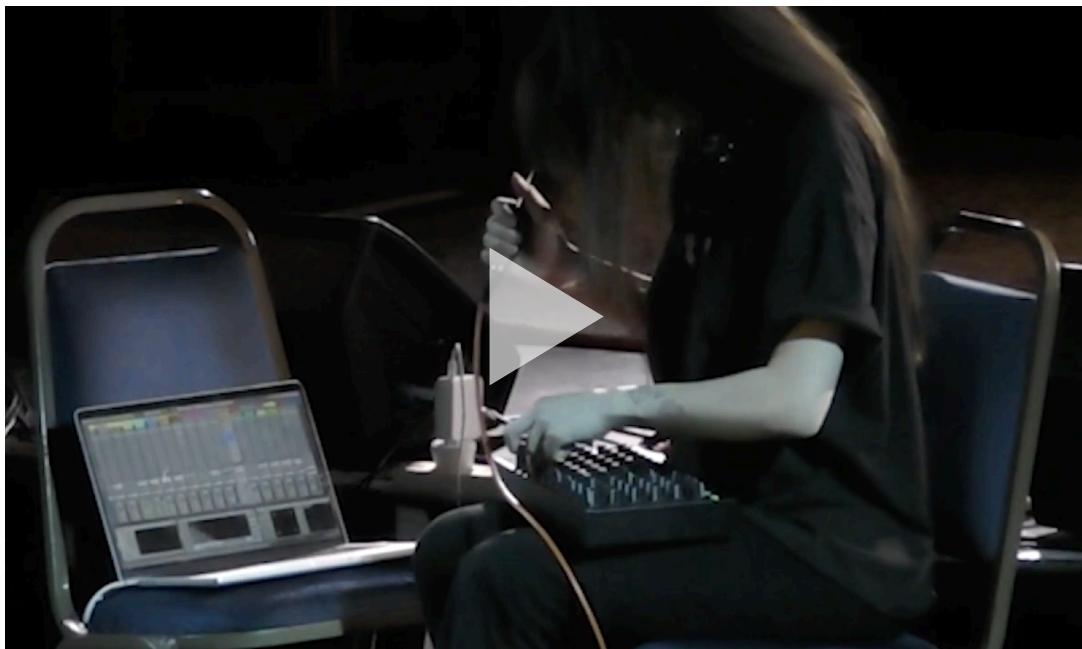
My current live gear setup is as follows:

- Faderfox PC12 MIDI Controller
- Sennheiser 835 Dynamic Mic
- A bright orange 25' XLR cable
- Customized fretless Electric Guitar (on occasion)
- Scarlett Solo 4i4 Interface
- 13" M2 Macbook Pro
- Ableton 10 with Max4Live

The Faderfox PC12 is a really straightforward MIDI controller with 72 potentiometers and 12 buttons. I think of them as 12 tracks with columns of 6 pots each. Every column corresponds to an Ableton track, some of which are vocal chains, some are groups of tracks with MIDI clip volumes assigned to pots, some are individual synth tracks with various parameters, and some correspond to samples. It's really simple to create mapping points in Ableton's MIDI map mode.

What works best for my purposes is keeping everything simple and playing off of existing audience expectations. I want to create sonic novelty in parallel with vulnerability and intimacy. I aim to engender a more introspective or haunted reaction in the audience, rather than create a huge spectacle or do something visually compelling. Controlling the visual element of the set is part of that.

I sit on one of two chairs at a right angle from each other, at a diagonal from the audience. If possible, I perform at eye-level or at the same elevation as the audience. My laptop is on the second chair, so the screen is visible. Almost all of the parameters I will control during the set are mapped to pots on the PC12, but if I have to adjust something in Ableton, the audience can follow what I'm doing. I never disappear behind the screen. This keeps us on a sort of even playing ground. I'm often singing very quietly or intimately with my eyes closed, so I like to stay visible. I keep my posture somewhat open and stay facing the crowd. If I hide away there will be nothing to see, to be engaged by, and it will defeat the purpose of being IRL. Body language is powerful.

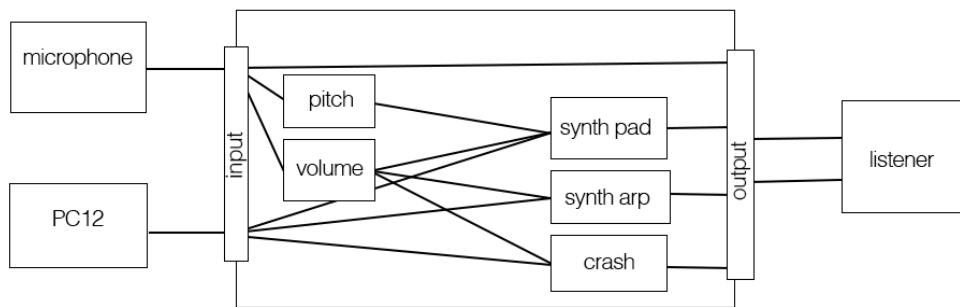


*Live in Newcastle, UK April 2025. Courtesy of Doxology.*

## CASE STUDY: “RIPPLE SKEW MORPH”

A sort of pared-down, ballad rendition of an old song, “Ripple Skew,” this version’s core is a solo lead vocal line with lyrics structured in verses, bridge and chorus. The timing is loose and there are long pauses after held notes at the end of each phrase. This makes it work well, to dramatic effect, a cappella.

Using a Max4Live device, I MIDI-trigger a few chains: synth pad, arpeggiated lead, and a crash cymbal. When the vocal level exceeds a threshold, all of the chains are triggered. The threshold is in a region where I am able to exert really subtle vocal control, so I can decide on-the-fly whether or not to have instrumentation beneath each vocal phrase. The fun part is that it’s not immediately obvious that my vocal is a control source for the MIDI, so when I take luxuriously long pauses between phrases, people in the room go quiet. The Cook principles “leveraging expert technique is smart” and “some players have spare bandwidth” come to mind. I have a lot of experience using a microphone, so I multiplied its usefulness within my set.



This is a many-to-many, linear, slightly indeterminate mapping. There is a visual activation of a sonic incidence, and the intensity of the input and output are correlated. This makes the action-sound relationship legible and therefore accessible to the viewer.



[“Ripple Skew Morph” live in Newcastle, UK April 2025. Courtesy of Doxology.](#)

## CASE STUDY: “BRUTAL ENCODER”

Another relatively stripped-down version of a more maximal beat track. In the live version of “Brutal Encoder” I use the symbol of the guitar to effect an attitude, more than anything.

In this version I play a repeating bass line on the guitar, with ad libs in between repetitions. There are vocals with lyrics in verses and a chorus. The mapping is even simpler: a Max4Live device detects the pitch of the guitar signal, and plays back a looping sample at one of five speeds. The chorus sections don’t contain the bass line, so I am able to improvise the chorus vocal over the beat at different speeds.



📹 [“Brutal Encoder” live in New York City at Emily Harvey Foundation, December 2024.](#)  
[Courtesy of Issue Project Room.](#)

This is a one-to-one, linear, determinate mapping. It is very legible to audiences. Simplicity can be extremely effective.

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## CONCLUSION

There are as many valid approaches to live performance as there are performers. When you consider the entirety of your live setup, including yourself, as a single instrument, you may think differently about what your actions are conveying and discover ways to make a performance more impactful. DMI research can be an inspiration for anyone engaged in the art of performing electronic music.



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*You can [explore her work on their website axine.net](http://axine.net) and follow her on Instagram [@axine.m](https://www.instagram.com/@axine.m)*

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