



**The Persistence of Elusion: Hard and Soft Dances
— Machine Learning Glitch Version
Live Performance**

Topic: Music

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Abstract

In pursuit of exploring the underlying nature of a 1980s-style drum machine, this work uses basic and even banal approaches to synthesise bass and snare drums, cymbals, etc. and exploits their creative potential by using them in unintended ways. Every voice is driven by and derived from a single clock signal. This clock signal is intended to increment by 1 with each processing cycle, and the resulting music sounds commonplace when it does. However, a rich variety of surprising material results when the direction and speed of this clock signal are manipulated.

In this improvised performance, an indeterminate process steers the clock signal in unpredictable ways, and the performer is given only the mundane and limiting controls of a drum machine interface to roll with these rash changes and to shape the performance aesthetically. This wild and awkward predicament serves as a crucible or creative performance that allows native features of the interface, the sound-production model, and human creativity emerge in ways that would not have happened in a calm environment with unlimited control. As such, it is a reflection on the relationship between constraints and creativity and how our tools may unintentionally shape them, for better and for worse.

The video content is structured to intensify immersion in this situation. It shows glimpses of the performer's gaze and his computer screen, although fleeting and glitchy ones, as well as text from an essay on the aesthetics of this work, presented in a randomly meandering way, driven by the audio. This allows viewers to form multiple and tenuous connections among words as they appear in proximity, with speed and obtuseness that might allow the audience to perceive deeper, more poetic meanings across the words than any standard, formal writing might express. The title is a reference to Salvador Dalí's work including his *The Persistence of Memory* and related paintings as well as his theoretical reflection on the 'hardness' and 'softness' of things, which those paintings explore.

This version of the performance uses errors made by a k-nearest neighbour machine learning system in place of a standard (pseudo-)random number generator as a way to give voice to the natural patterns of wavering and unconfidence when it occurs in such a system, thereby reflecting on the inherent nature of such a process.

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Key words: Dalí, drum machine, glitch, improvisation, live video



Divining Rod
Live Performance

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Abstract

Although my creative work covers many genres, styles, and techniques, the majority of my creations are unified under the concept of *native composition*—that is, devising new composition methods for each project that leverage the situation of the artwork to generate or shape the artistic content as much as possible. This may include site-specific works, data sonification or visualisation, various sensors, feedback systems, exploiting glitches, and other techniques, in order to create new works and discover new ways of creating work by making the venue, the parameters, the goals of the performance resonate maximally and in their most natural ways. When invited to pursue the underexplored potential of machine learning through a grant program of the Texas A&M University President's Excellence Fund, I did not seek ways to make machine learning techniques more fool-proof but rather to better understand such systems by studying the ways in which they fail.

Divining Rod is the first project in this inquiry. In pursuing this approach, I needed a physical interface that could simultaneously give me (a) reliable, deterministic input reflecting how the performer is interacting with the interface and (b) a way for a machine learning model to attempt to determine the same information. A computer keyboard provides this kind of *crib sheet* most naturally (comparing questionable results to reliable answers): software easily and reliably determines what keys are being pressed via the HID input protocol, and a camera suspended above the keyboard lets a neural network attempt to determine the same information, so I can give voice to the difference between the two results. At the time of writing this abstract, the system uses a 16 x 16 pixel video, i.e., 256 inputs (the maximum allowed by the tools used at this time), with a k-nearest neighbour classification algorithm, trained with approximately 7000 frames, averaging 134 frames per key.

To give voice to the errors in the machine learning (ML) system, the HID input is mapped to the frequency of a sine wave oscillator, and the ML input is mapped to the centre frequency of a bandstop filter, such that it will silence the sine oscillator if both inputs match. Any difference between the inputs results in audible sound, and any audible sound is a sonification of errors made by the ML system. Erroneous values are mapped to the parameters of a frequency modulation synthesizer driven by the sine oscillator described above, so the intensity and distribution of the sidebands (i.e., the fullness and complexity of the sound spectrum) portray the degree of error. Since this is an artistic portrait of the this system's tendencies rather than an empirical and quantified data analysis, this audio output

is sent into a network of delay lines that build the sound into a rich contrapuntal tapestry, reflecting aesthetically on the natural character of this system, or as Roland Barthes might have put it, focusing on the *grain* of this voice rather than any intended message. The video accompaniment is derived from the computer's glitchy live view of the keyboard, shaped by changes in the sound, to build an intermedia counterpoint between the sonic and visual content.

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Key words: error, glitch, improvisation, intermedia, machine learning