

Twisted Circuits | Rhythm Traces - III For Buchla Music Easel, Musical Agent System, and Sonic Acceleration Box

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Abstract

The piece Twisted Circuits | Rhythm Traces - III focuses on integrating an augmented Buchla Music Easel with a musical agent system.

The Music Easel is augmented with the Sonic Acceleration Box (SAB), a synthesizer, drum machine, and multi-effect unit built with Bela Gem and programmed in SuperCollider, to extend the Music Easel's performative economy and generate new sonic possibilities.

Furthermore, the work employs a musical agent system implemented in SuperCollider using the FluCoMa library that learns in real time from performers playing Buchla and SAB and operates in a player paradigm, based on the musical material it has learned. The musical agent system can learn and adapt the instrument's tonal and rhythmic fluidity, extending its capabilities beyond its limits. Hein's musical agent learns to interact musically, creating music in real time with Hein on the synthesizer and developing the interaction between human and machine-generated musical voices.

1 INTRODUCTION

The piece Twisted Circuits | Rhythm Traces - III focuses on integrating an augmented Buchla Music Easel with a musical agent system. It presents the development and latest iteration of a line of pieces for Buchla Music Easel and musical agent systems that began in 2021. The concept has seen continuous development of the hardware and software involved (for synthesis and the musical agent system). In the following text, I will explain the different components of the piece.

2 Twisted Circuits | Rhythm Traces – III - Parts

2.1 Sonic Acceleration Box

The piece Twisted Circuits | Rhythm Traces - III focuses on the integration of the Sonic Acceleration Box (SAB), a synthesizer, drum machine, and multi-effect unit realized with Bela [5] Gem and programmed in SuperCollider [10], into the performative economy of the Buchla Music Easel. The SAB is programmed in SuperCollider and can be used as an additional synthesis voice and live electronics, or as a drum machine (with two distinct code sets). SAB uses a minimalistic interface, with a single Trill Square as a touch interface, and handles commands for multi-effect and synthesis algorithms via MIDI input (SoftStep2/FaderfoxEC4). Housed in a 3D-printed case and attached to the Music Easel with 3D-printed hinges, it integrates with and extends the performer's movement economy. The SAB integrates into the performative economy of the Buchla Music Easel, extending players' motions during performance to the sides and enabling new forms of motional and sonic polyphony [3]. Through this process, an augmented

instrument develops as an assemblage [1] that takes the instrument and develops and changes it.



Figure 1: SAB – Front Perspective.



Figure 2: SAB – Back Perspective in 3D printed hanger.



Figure 3: Buchla Music Easel with SAB attached left and right.

2.2 Musical Agent System

Twisted Circuits | Rhythm Traces - III employs a musical agent system, implemented in SuperCollider using the FluidCorpusManipulation [8] library, as well as SC MIR and other libraries, which learns in real time from performers playing Buchla and SAB and operates in a player paradigm fashion [7,4], based on the musical material it has learned. The musical agent system can learn and adapt the instrument's tonal and rhythmic fluidity, extending its capabilities beyond its limits. Heins's musical agent learns to interact musically, creating music in real time with Hein on the synthesizer and developing the interaction between a human and a machine-generated musical voice. Starting with a pre-trained memory, it continues to learn musical gestures during the performance.

The System features 3 different voices: Phrase Voice, Grain Voice, Motive/LSTM Voice.

Phrase Voice segments the live-recorded buffer into slices and describes each slice with a 16-dimensional feature vector: 8 descriptors (pitch frequency, pitch confidence, loudness, true peak, spectral centroid, spread, skewness, kurtosis). Incoming audio is analyzed with the same descriptor set and matched against the corpus via a FluidKNNClassifier with a single nearest neighbor (line 755). Matching is governed by matchThreshold, maxStepDist/minStepDist (distance constraints in feature space that control how far a jump can be from the currently playing slice — tightened for smooth wandering, widened or defeated via forceJump for larger leaps), and a triggerMode (interrupt/defer/queue-style) that decides how a new match interrupts what's currently sounding.

Grain Voice uses raw MFCC analysis of the buffer and k-NN to match incoming audio signals with musical material from the learned corpus to generate musical material. The weights of the MFCC analysis parameters are constantly shifted during performance, so even similar musical inputs trigger different musical outputs.

On top of that, a grainExplore function injects random noise directly into the query vector before the KNN lookup sets how strongly the KNN distance is additionally biased by live pitch versus timbre alone.

Motive/LSTM Voice generates live behavior tracking, a Pitch and Rhythm series from analyzed and incoming audio streams, and MIDI notes, then resynthesizes them from the recorded buffer in Phrase Voice.

Overall, the 3 different voices also exhibit different rhythmic behaviors, changing between Continuous and Reactive Modes, as well as a rhythmically Free Mode, a Guided Mode (following onset tracking of incoming audio streams), and Clocked Mode (following different subdivisions) on a tracked tempo clock.

Furthermore, a room microphone in space (as shown in Figure 4) records the sound in space and feeds it into the analysis layers of the musical agent system. This generates different layers of feedback that drive the musical dynamics, as the acoustics of the space also influence the behavior of the musical agent system.

2.3 Spatialization – IKO Loudspeaker

Music Easel, SAB, and a musical agent system are individually live spatialized on the performance (multichannel) sound system, using different audio descriptors, which are then translated into source positions in the ambisonics encoder. The voice's spectral shape and pitch content determine the sonic movement of the sources on the IKO loudspeaker. It can be modulated from slow to audio-rate, depending on settings that can be adjusted in the system during performance.

For the performance at AIMC 2026, I propose to bring my own IKO (<https://iko.sonible.com/>) loudspeaker for spatialization. If better for the conference, the piece can also be performed on a stereo or multichannel PA.

2.4 Agency and Interaction

The human and the machine musician develop an integrative system of musical materials and agency that integrates different strata of action. The interaction is characterized by a form of “cybernetic listening”: the human-machine system’s listening for influx on its own, creating and stimulating a feedback loop between human and machine.

The systemic economy of movement and the interaction with the AI musical agent create polyphonic rhythmic, tonal, and spatial structures and a performance ecosystem [9]. The piece focuses on the emergent Dances of Agency [6] between the human performer, the musical agent system, and SAB, developing a form of cybernetic listening [2]. Twisted Circuits | Rhythm Traces asks what happens to rhythmic and timbral agency when the “instrument” stops being a bounded object and becomes an ecology: a mutable field of couplings between skin, voltage, software, learned behavior, and the acoustics of a room.

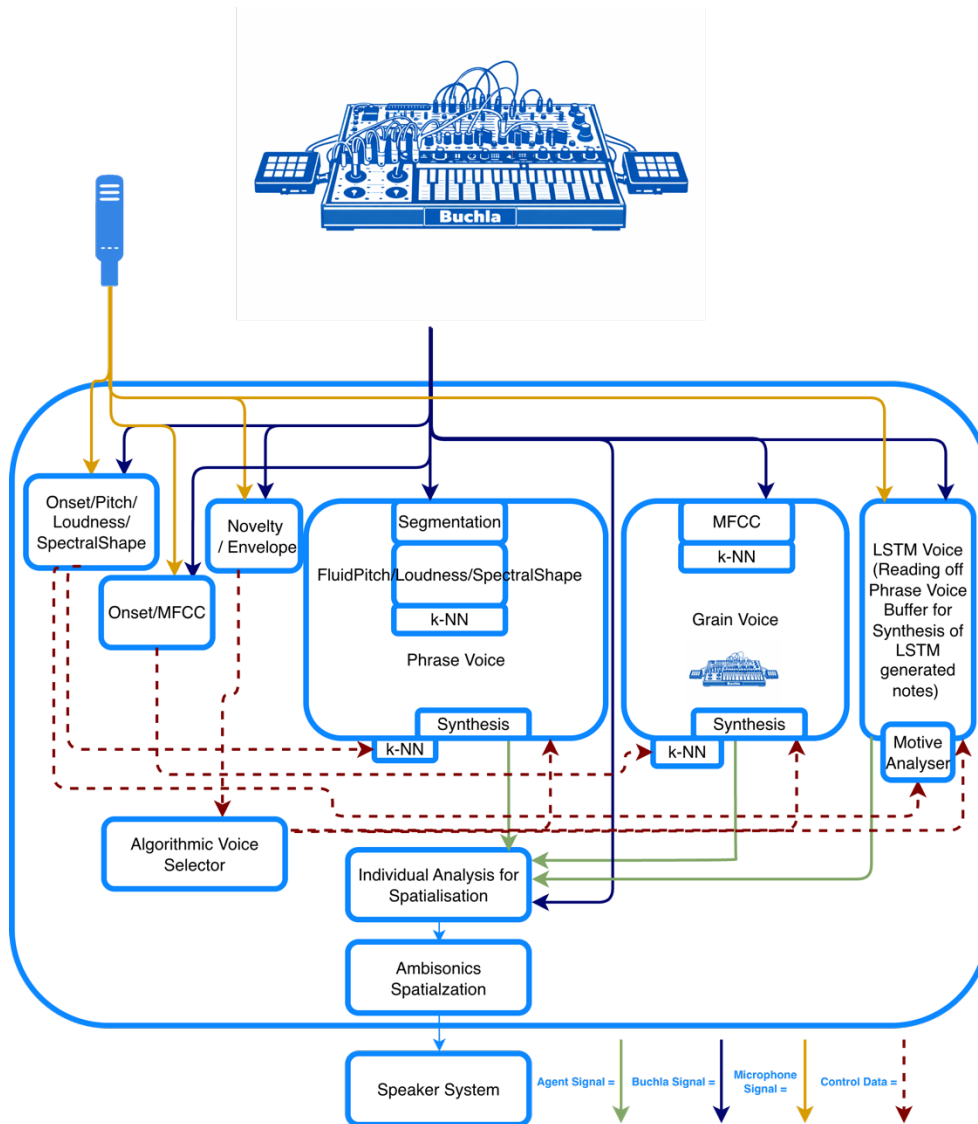


Figure 4: Structure of Musical Agent System.

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AUTHOR DECLARATIONS

No known conflict of interest exists between this work and the hosting institution of AIMC 2026. The human researcher, as the performer of their own work, consented to the research conducted to realize the work.

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