Six Strange String Theories: A Performance Installation

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Six Strange String Theories is a sound installation and performance environment that bows before historical figures: Sun Ra, whose numerous innovations included creating the concept album *Strange Strings* (1967) with his Astro-Infinity Arkestra, calling it "a study in ignorance"; Alvin Lucier, who invented ways to compose with the material agency of things, including long strings; Bebe and Louis Barron (1956), who created the first cybernetic circuits that made music; and David Tudor, who invented ways to let the strange agency of electronic circuits and physical objects speak for themselves (Nakai 2021). Our work consists of six long strings stretched across the space where they are set up, into which we can play source sounds; the resonances of the strings are picked up, and mixed with the sources; and when we send the resonance sounds back into the network of strings, they become a cybernetic feedback system, autopoietically creating their own sound world, which continues to evolve even without sources. These three layers can be activated in live performances; in self-playing mode, the setup moves through its possibility space informed by a machine listening program. As *Six Strings* is also a performance environment, we propose to play several live sets between 10 and 20 minutes with S4NTP members, and we welcome interested xCoAx attendees to also play with us.

Keywords: Live Electronics, Installation, Autopoiesis, Cybernetics, Improvisation.

Background

While attempting to recreate Alvin Lucier's *Music On a Long Thin Wire (MOATW)* for didactic purposes, we learned that the piece is intended to surprise listeners by changing its sonic behaviour over time. The technical setup for the *MOATW* installation is very static: a long string und tension going through a strong magnetic field; an audio oscillator with a single fixed frequency and amplitude driving the string by means of a strong power amplifier; a contact microphone picking up the mechanical vibration which is made audible through a loudspeaker (Lucier 2005). But successful exhibitions of the piece document quite a range of time-varying, dynamic sonic behaviours, so two questions arose:

1. Where does the nonlinearity come from that enables this wide range of resonant behaviour?
2. What would happen if the input to the system were more dynamic?

The first is relatively simple to answer: the fundamental resonant frequency of the string is sensitive to environmental influences, where small temperature changes in the space may already suffice to shift the fundamental resonant frequency by a small amount; this changes the interaction between the driving oscillator and combination of string overtones it will excite most strongly. A likely larger influence is the amount of electrical power flowing through the string: it will over time warm up the string, which makes it more elastic, thus lowering its resonant frequency; this leads to different overtones being excited, which changes the overall amplitude of the string's vibration, which may cause it to cool … given enough electrical power input, this can well cause the dynamically changing sonic behaviour heard in realisations of the piece.

Experiments

To answer the second question, we began exploring: playing all kinds of sound materials into the string creates long resonant sounds reminiscent of spring reverbs; playing the sound of the piezo pickup on the string back into the string creates eminently evocative and malleable complex feedback sounds. This led us toward the idea of multiple strings to play with, and eventually to the idea realised in the piece: a network of strings where all feedback paths have tunable weights, so any thinkable feedback topology can be created. We began with the most obvious examples.

Six one-string loops create a polyphony of 6 independent feedback processes with relatively simple feedback orbits; 3 loops of 2 strings each, and 2 loops of 3 strings each reduce polyphony, but create more variety in each loop; one big loop passing through all strings creates quite complex behaviors with 6 different listening points along the loop. Applying random weights to the feedback paths created even more variety, and enabled us to find parameter "sweet spots", where the behaviour seemed sonically interesting. These can be stored and recalled as presets, and used as end points for cross-fading movements in parameter space.

At this point, it became clear that many mechanical details of the setup would influence its vibro-acoustic behaviour: choosing more stable locations to fix the strings will make it steadier; string thickness and length has an influence, as thinner and longer strings are more elastic and have more electrical resistance, they are more sensitive to heating up; when attaching several string terminal points to the same architectural anchor, they may influence each other by mechanic vibrational crosstalk. We designed our own wooden string mounting boards fitted with locking guitar tuning pegs, and with a lighting clamp for flexible mounting options. A smaller variant takes the head end, holding the piezo pickup and screw terminals for loudspeaker cable from the amplifier. The other version is a longer board of ca. 50cm, also with a guitar tuning peg, and a U-shaped frame for attaching adjustable neodymium magnets.

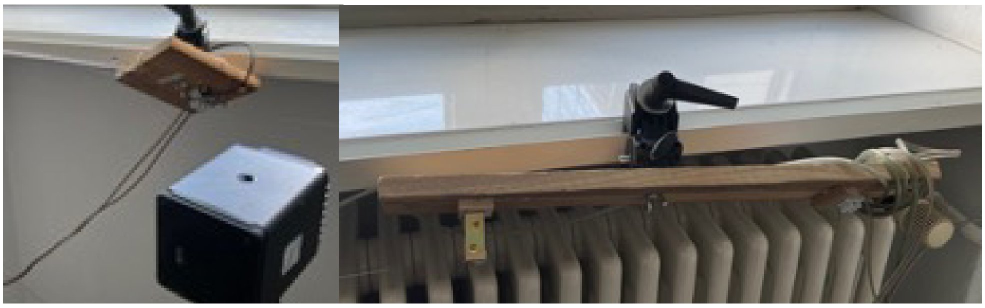

Figure 1: String mounting plates with guitar tuning peg and clamp; left: Piezo-side small plate with speaker cable and associated loudspeaker; right: Magnet-side longer board.

Installation and Performance Setup

Our experiments converged into a setup that equally supports a self-playing installation mode, and live performances. The computational part of the piece, written in SuperCollider, routes all audio inputs and outputs, provides the preset mechanisms for the weight matrix of feedback network, and a task that keeps the installation moving though its possibility spaces in self-changing mode.

For live performance, we can play external sound sources from live musicians into the setup, both for direct amplification through the same speakers as the strings, and as sound input to the string network. All live performance aspects, such as the levels of microphone, string pickup, and synthetic sound to loudspeakers and to the strings, can be played equally from a GUI (Fig. 2), and from a MIDI controller, where we preferably use a FaderFox UC4.[1]

1. The codebase for *Six Strings* will be published on GitHub shortly (pending cleanups).

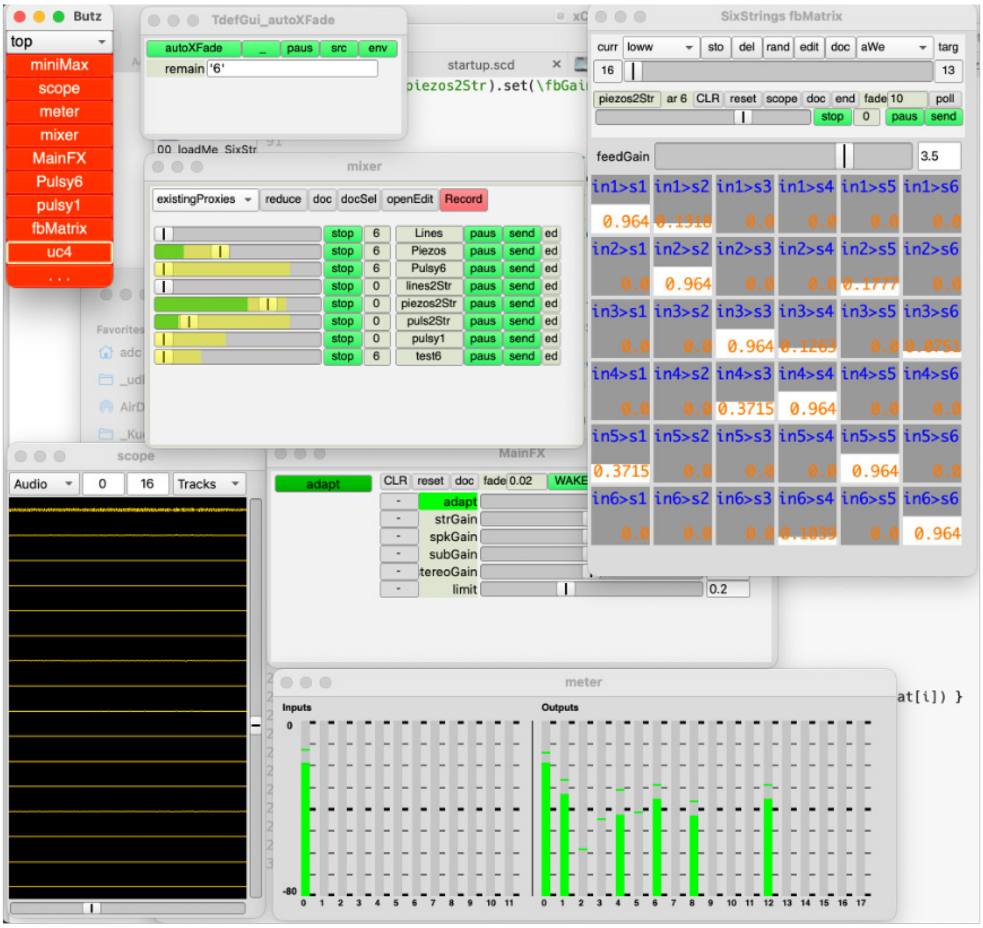

Figure 2: The SuperCollider GUI for the performance setup.

Public Exhibitions and Performances

Six Strings was shown on several occasions so far: at LaborAtelier 2, an event at Universität der Künste (UdK) Berlin, celebrating 20 years of university status (May 2022); within the Campus program at Ars Electronica (Sept. 2022), and in the CTM Vorspiel program event at Mahalla Berlin (Feb. 3-5 2023). At these occasions, we performed with musicians playing a variety of instruments: string instruments like the clavichord, electric guitar, (Korean) Gayageum, and the Polyharpye (de Campo 2020); and many electronic sound sources. Single string setups can be included in other pieces, as for example in *Neural Labyrinths,*[2] and two strings are integrated in the Biophonium setup.[3]

As the Society for Nontrivial Pursuits (S4NTP) will do a group excursion to xCoAx 2023, multiple members will be available as live performers with the *Six Strange Strings*.

***Six Strange Strings* website**
https://sixstrings.cargo.site

2. See *Neural Labyrinths* xCoAx 2023 paper in this volume.
3. See https://biophony.cargo.site/

Figure 3: performance situation at Laboratelier 2, Concert Hall of the University of the Arts Berlin. Left to right: Avinoam Shalev, clavichord, Alberto de Campo, Six Strings, Zihern Lee, Gayageum.

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