Feedback Sensibilities

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1 Program Notes

Feedback Sensibilities is a duo improvisation performance for feedback saxophone and a custom interface for feedback circuit sniffing. The feedback saxophone uses a bell-mounted speaker that closes the tube, creating a feedback loop where the sounds and resonances of the instrument are fed back through the speaker, augmenting an extended saxophone through feedback strategies. The circuit sniffing feedback interface captures the electromagnetic field of circuit boards through coil inductors, using algorithmic feedback to process the sensed signals into textural sounds of noise, clicks, and resonances. In this performance, feedback is the aesthetic space that brings together these two structurally different instruments, one acoustic and augmented, the other electronic and algorithmic, into an entangled musical expression within a shared textural space.

2 Project Description

Feedback Sensibilities is a duo set for feedback saxophone and a custom interface for feedback circuit sniffing. The performance is a semi-structured improvisation set, where the saxophone explores how feedback augments contemporary extended techniques, and the circuit sniffing interface how feedback allows for the electromagnetic field of selected circuit boards to be materialized into sound. Throughout the performance, both improvisers first listen and then play, knitting sonic traces until the boundaries between these instruments blur into a shared textural space.

In this performance, feedback becomes a common method to blend two structurally different instruments. The saxophone relies on physical feedback, where air, speaker, and microphone form a closed acoustic loop within the instrument's body, while the circuit sniffing interface relies on algorithmic feedback through delay and waveguide mesh with a coil re-capture loop, further introducing a physical feedback dimension.

Combining acoustic and electronic instruments often produces a disjointed aesthetic result without a certain degree of signal processing or conditions for cohabitation. In Feedback Sensibilities, we explore these two feedback mechanisms as an aesthetic space, becoming the gluing factor between the electronic and augmented acoustic sounds. Through feedback, both instruments become sonically entangled to the point of ambiguity, providing a common language where these two instruments can communicate musically.

The feedback saxophone, designed by Halldor Ulfarsson and inspired by his feedback instrument designs [5], is built with a bell-mounted speaker and a two-microphone configuration. The first microphone is positioned at the mouthpiece to provide frequency content, and the second is positioned at the bell, capturing a chaotic complex feedback signal due to its proximity to the mounted speaker (Fig. 1). The goal of positioning the speaker onto the bell is to close the tube, allowing for feedback to be excited when different combinations of the keys are closed. This closed-tube mechanism builds on the practice of John Butcher [4], whose feedback saxophone technique uses the instrument as a resonating tube, controlling feedback tones by manipulating the keys in a similar manner. However, the feedback saxophone in Feedback Sensibilities also employs the acoustic voice of the instrument, where the performer interacts with the feedback signal through extended techniques, such as multiphonics and circular breathing, so that feedback augments the extended saxophone based on the acoustic properties provided by the very closed tube. Bruce's [1] research on the post-digital feedback saxophone contextualizes this practice as minimally augmented instruments where feedback is mediated through physical technique rather than digital control.

The custom interface for feedback circuit sniffing is set up to interact with physical modelling algorithms of sound propagation in 2D planes (waveguide mesh) by exciting the system through circuit sniffing.

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Fig. 1. Feedback saxophone with bell-mounted speaker and two-microphone configuration.

Circuit sniffing is an extensively explored method in sonic art and NIME research by artists such as Christina Kubisch, Nicolas Collins [2] and Andy Keep. This practice involves using coil inductors as probes to capture the fluctuations of the electromagnetic field (EMF) of electronic devices and transform them into sound. The transformation of the EMF to sound is based on the physical phenomenon described by Faraday's law of induction. According to this law, when a magnetic field that changes over time passes through a loop of wire, it induces a voltage across that loop. Since every conductor carrying a current produces a magnetic field around it, each electronic device has a signature EMF that surrounds it. By placing a coil near the device and due to the aforementioned phenomenon, one can obtain an electrical copy of the magnetic field in the form of the induced voltage in the coil, which is, instant by instant, a representation of how the magnetic field is changing. In cases where the EMF fluctuates in rates within the human hearing range, the induced voltage, which is present at the terminals of the coil, can drive a speaker as an audible waveform. That way the fluctuation of the EMF is translated to raw sonic material consisting of noise, patterns of clicks and static tones, all of which are the byproducts of each circuit's physical operation. The measure which describes this physical characteristic of the coil is termed inductance and it is measured in Henry (H).

The custom-made interface used in Feedback Sensibilities utilizes inductors with ferrite core (Fig. 2) typically used in electronic circuit design. The inductance of the coils used is 22mH, a value which has been proven by experimentation to provide a strong enough electrical signal for audio transformation. Notably, the induced signal has a very high impedance and needs to be transformed and amplified accordingly to be used for further processing with line level systems. The coils are then attached to terminals which can be attached to the fingers through strips, thus leaving the fingers free to simultaneously control other parts of the system (e.g. faders, knobs, etc.).

The system utilizes circuit boards of wireless optical computer mice as the source for the EMF-to-sound transformation which are placed in aluminium custom-made frames (Fig. 2). These circuit boards were selected for three reasons. A) The sounds of their transformed EMFs have a high degree of diversity, ranging from sustained tones to rhythmical bursts of noise. B) They offer a desirable balance between the complexity of the sounds the user can extract and the reproducibility of these sounds. C) They have an optical sensor that the user can interact with providing an interaction pathway and performative affordances.

Following the transformation of the EMF to sound, the sonic material captured by the coils is then fed as the input signal for a waveguide synthesis algorithm which traditionally uses short bursts of noise to excite the system. Waveguide synthesis is a subset of physical modelling synthesis that simulates how sound waves propagate in 2D and 3D geometries and it is mainly used for modelling vibrating membranes, metallic surfaces etc. In waveguide synthesis a mesh of interconnected nodes is defined by a geometric topology and each pair of adjacent nodes is connected by two delay lines, each one carrying a wave in each direction. The implementation in the current setup is based on the algorithms presented in [3] and makes use of three geometric topologies, two 2-dimensional (triangle, hexagon) and one 3-dimensional (octahedron) which are used interchangeably during the performance.

For each algorithm, several parameters define the timbral identity of the output. The parameters are controlled via MIDI with use of a controller. The time of the delay lines (i.e. the distance between the nodes), the reflection amount on each scattering junction and the damping of the reflection are used to produce a wide repertoire of sounds ranging from repetitive rich metallic sounds to subtle resonances. The interaction involves the use of feedback on two stages. First, the algorithm itself is using several delay lines in feedback for the modelling. Moreover, the performance is also an exploration of the limits of the algorithm: by adjusting the reflection amount close to unity the system turns into a feedback digital instrument.

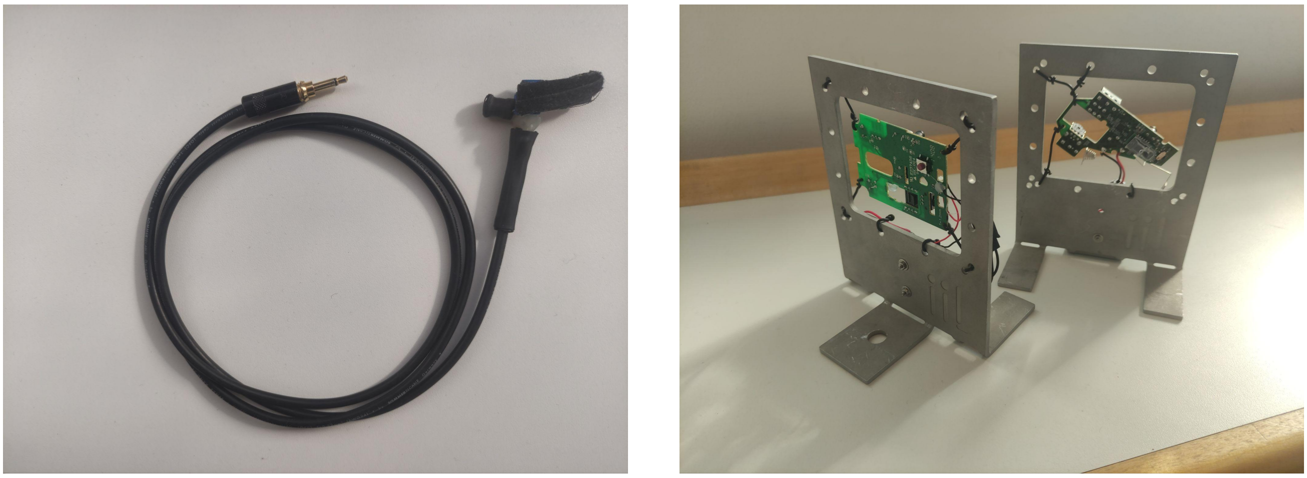

Fig. 2. Circuit sniffing interface: coil inductor probe with finger attachment (left) and circuit boards from wireless mice in custom aluminium frames (right).

For the concert, we create a defined set of techniques for each instrument to structure the sonic possibilities as a method for temporal structuring. The textural development of the circuit sniffing interface draws from electronic minimal and glitch music, while the saxophone sound moves between contemporary extended techniques and free jazz tradition. While the circuit sniffing feedback interface takes inspiration from the sonic world of Raster-Noton, the feedback saxophone extended and melodic influence is marked by John Butcher, Evan Parker, Lotte Anker, and Tony Malabi, among others. These musical backgrounds converge through the shared practice of listening where the improvisational structure is shaped by the material behaviour of the feedback systems themselves and the constrained sonic material set beforehand. Thus, the sonic space is formed by maintaining a state of fragility between these two feedback instruments, resulting in evolving textural soundscapes where the distinction between acoustic and electronic, physical and algorithmic dissolves.

3 Performance Notes

The proposed performance lasts 10 minutes and is developed through improvisation strategies. The performance format is live.

The performers bring:

- Feedback saxophone with mounted speaker and inner microphone system
- Circuit sniffing interface including laptop, circuit boards, and coil inductors

We require:

- Four power outlets (three for the circuit sniffing interface, one for the feedback saxophone)
- Mixer to connect both instruments to the venue sound system, and stereo output to speakers

- In larger venues, a microphone for the saxophone and floor monitors (the feedback saxophone can be treated as an acoustic saxophone for amplification purposes). In smaller venues, no microphone or monitors are required

Both performers are seated in close proximity. The performance works best in enclosed spaces. Setup time is approximately 30 minutes including soundcheck to balance the mix between both instruments.

4 Ethical Standards

This work was conducted as part of research at the Intelligent Instruments Lab, University of Iceland. No human participants were involved in the study beyond the authors themselves as performers.

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