Feedforward | unChambered

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1 Program Notes

Feedforward unChambered is an interactive robotic sound installation in which a microphone mounted on a robotic arm continuously moves through the acoustic field of loudspeakers. The installation listens to itself: sound is captured, analyzed, amplified, and reintroduced into the room as an evolving feedback/feedforward process.

Incoming microphone signals are analyzed in Max/MSP. These values influence both audio amplification and the movement system. Max communicates through OSC with a Node.js layer that generates and reads movement patterns, as well as with a Python control process connected to the xArm SDK and a differential inverse kinematics library. Together, these components translate sonic conditions into robotic motion, while the changing microphone position continually alters the acoustic feedback being measured.

Over time, the system tends toward self-reinforcement. Certain resonant bands intensify while others fade, creating an audible echo chamber that becomes increasingly shaped by its own previous outputs. This behavior functions as a sonic analogy for recursive digital systems, recommendation loops, and AI model collapse, where repeated training on synthetic or self-generated outputs can reduce diversity, adaptability, and responsiveness (Shumailov et al. 2024).

Audience engagement functions as a form of distributed performance. Visitors may introduce sound, and this action does not simply trigger the system; they enter its feedback loop and alter the conditions for subsequent measurement and movement. In this sense, the work frames community as an intra-active field of human and non-human agencies: bodies, microphones, loudspeakers, software, robotics, architectural acoustics, and accumulated sonic memory all participate in the unfolding work (Barad 2007).

2 Project Description

Feedforward unChambered explores how contemporary technological systems shape perception and agency through repetition, measurement, and self-reference. The work is grounded in Karen Barad's theory of intra-action: observation is not a neutral act performed by a separate observer upon a pre-existing object. Rather, the act of measurement helps produce the phenomena it measures (Barad 2007). In the installation, sound, sensing, movement, and space do not operate as independent components; they emerge through their relations.

The installation consists of one robotic arm equipped with a microphone at the end-effector, surrounded by loudspeakers. The microphone continuously moves through the loudspeaker field. Its signal is routed to a control computer, where Max/MSP analyzes the incoming sound and translates changing acoustic conditions into movement parameters through OSC communication.

The movement system is divided into several interacting layers. Node.js generates and reads movement patterns, including scanning behaviors, listening gestures, pauses, accelerations, and trajectory variations. Max/MSP receives and negotiates these movement patterns in relation to the current feedback state, then communicates via OSC with a Python control layer. Python handles real-time robot communication through the xArm SDK, while an inverse kinematics library translates target positions and orientations into joint configurations. This layered structure allows the robot's movement to be shaped by both composed movement logic and live acoustic conditions.

As the microphone moves, it changes the sound it captures. This captured sound is amplified and reintroduced through the loudspeakers, which then changes what the microphone hears next. The result is a recursive sonic system in which each act of listening alters the field that will be listened to again. Feedback may emerge, intensify, break apart, or narrow into specific resonant bands. The system's behavior is therefore neither fully scripted nor fully autonomous; it is produced through ongoing intra-actions among microphone position, loudspeaker output, room acoustics, software mappings, robotic motion, and audience presence.

In machine learning, recent studies describe how models trained recursively on their own generated data can undergo model collapse, gradually losing diversity and adaptability over successive iterations (Shumailov et al. 2024). Feedforward unChambered translates this process into sound and space. When a limited set of resonances is repeatedly captured and reinforced, the system can become less responsive to difference, stabilizing around a narrow sonic identity. Collapse is not represented as a sudden failure, but as a gradual perceptual narrowing: a seductive, immersive, and fragile form of self-confirmation.

At the same time, the installation does not present collapse as inevitable. Audience presence introduces perturbations into the loop. A voice, a movement through the space, or other sounds produced by audience members can redirect the system's subsequent behavior. These interventions do not stand outside the work as external commands; they become part of the same intra-active field that produces the sound. Human action may delay, intensify, interrupt, or redirect collapse, making the installation a shared investigation into how systems listen, remember, reinforce, and possibly remain open to difference.

This framing directly engages the NIME 2026 theme of Communities. Community is not treated simply as a group of human participants, but as a dynamic and distributed formation involving human and non-human actors. The installation proposes community as something that emerges through shared conditions of listening, response, interference, and adaptation. In this sense, Feedforward unChambered asks how a technological system might become less closed, less self-confirming, and more responsive through collective participation.

3 Technical Notes

- A robotic arm with a microphone mounted on the end-effector continuously moves through the loudspeaker field.
- Microphone signals are routed through an audio interface to a control computer running Max/MSP, Node.js, Python, the xArm SDK, and an inverse kinematics library.
- Max/MSP analyzes amplitude, spectral characteristics, resonance behavior, and feedback intensity, then maps these features to amplification behavior and movement parameters.
- Node.js generates and reads movement patterns. Max/MSP communicates with this layer and the Python robot-control layer through OSC.
- Python controls the xArm via the xArm SDK, while inverse kinematics translates target positions and orientations into robot motion.
- Captured sound is amplified and reintroduced through one to four loudspeakers. The resulting feedback/feedforward behavior depends on microphone position, room acoustics, and audience intervention.

4 Media Links

- Video: https://www.grayscale64.com/feedforwardunchambered

Ethical Standards

This work is presented as a public interactive sound installation. It does not involve a human-subject study or the collection of personally identifiable data. Audience sounds may be incidentally present in the acoustic environment, but no audio is recorded or stored as part of the installation operation.

References

[1] Barad, Karen. 2007. *Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning*. Duke University Press.

[2] Shumailov, Ilia, Zakhar Shumaylov, Yiren Zhao, Nicolas Papernot, Ross Anderson, and Yarin Gal. 2024. "AI Models Collapse When Trained on Recursively Generated Data." *Nature* 631 (8022): 755–59.