

Ghosts in the Sophtar

Federico Visi*

GEMM))) Gesture Embodiment and Machines in Music
School of Music in Piteå
Luleå University of Technology
Piteå, Sweden
mail@federicovisi.com

Abstract

The Sophtar is a tabletop string instrument with an embedded system for digital signal processing, networking, and machine learning. It features an array of actuators that can be activated algorithmically by the models running on the embedded computer, a pressure-sensitive fretted neck, two sound boxes, and controlled electroacoustic feedback capabilities by means of bespoke interface elements. In this performance, the Sophtar responds to a human player by means of actuators and harmonically filtered electroacoustic feedback controlled by Somax2, a multiagent system for human-machine co-improvisation.

1 BACKGROUND: THE INSTRUMENT

The Sophtar (Figure 1) is an instrument I¹ developed to address my need to consolidate several electroacoustic, signal processing, and machine learning techniques that have been part of my practice for years (Visi, 2024). Core aspects of the instrument are electroacoustic feedback implemented through a transducer housed in the head sound box, and bespoke control elements such as a pressure-sensitive expression block, a pressure-sensitive fretboard, and a touch strip placed on the edge of the neck. Recent developments include a set of solenoids mounted over the strings next to the bridge (Figure 2) and a signal processing method to feed back specific harmonics for each string. These can be seen in the accompanying video (Visi, 2026).

1.1 Actuation: electroacoustic feedback and solenoids

The transducer housed in the head sound box makes it possible to generate electroacoustic feedback that sustains the vibration of the strings. The signal of each string is processed individually, with independent gain stages and filters tuned to that string’s harmonics, allowing specific partials to ring. Harmonics can be selected manually through the touch strip along the neck, or algorithmically.

Eight solenoids are mounted near the bridge, one per string. They are placed so that, when one is activated, the metal rod hits the corresponding string, producing a sound somewhat resembling that of a clavichord.

1.2 Embedded model: Somax2

Feedback and solenoids can be controlled by models and algorithms running on the embedded computer. In this piece, they are both controlled by Somax2—a multiagent system for human-machine co-improvisation that generates stylistically coherent streams while continuously listening and adapting to musicians or other agents (Assayag et al., 2022).

*<https://www.federicovisi.com>

¹I am deliberately adopting a first-person point of view in writing this article as my own perspective and experience as a practitioner and researcher were central in the development of the Sophtar. I will try to avoid the passive voice and other impersonal forms as much as possible.



Figure 1: The author playing the Sophtar at IRCAM’s Studio 6, Paris, April 2026.

An instance of Somax2 is used to tune the bandpass filters in the electroacoustic feedback loop in response to how



Figure 2: The Sophtar: head (left), overview (centre), controls and solenoids mount (right).

the bottom three strings are played. The model receives pitches and onsets of selected strings via MIDI and responds with pitches and onsets following a local stylistic knowledge space, or *corpus* (Assayag et al., 2022). These output pitches are mapped to 12 harmonics, and the onsets are used to activate the solenoids and trigger amplitude envelopes that shape the electroacoustic feedback of the top five strings. This can be seen in the accompanying video (Visi, 2026).

Somax2 relies on a latent space built using a method based on Self-Organising Maps applied to large collections of musical data, encoding general harmonic and textural knowledge. Each Somax2 agent can then access its own model of musical structure based on specific corpora that are segmented and annotated with a set of musical features, and organised into a shallow-learned statistical sequence model (Assayag et al., 2022).

Somax2 responds to the human player by evoking structures of the musical data it is trained on. These are filtered and transformed through the electroacoustic and mechanical properties of the Sophtar. The result is an encounter between the human player and the ghostly traces of the musics that formed the training dataset (Privato and Magnusson, 2024). The strings effectively become a place of contact between human and machine players, and the musical knowledge they encode.

1.3 Timbral manipulation through the pressure-sensitive neck

Each string of the Sophtar has an individual, long pressure sensor sandwiched between its own segment of the fretboard and the neck. The pressure-sensitive fretboard drives per-string effects and neural audio synthesis. In this piece, pressure is used to interact with per-string wavefolding distortion and pitch-shifting delay lines.

2 RESISTING CORPORATE NARRATIVES

I promote a view of generative AI in the arts that resists dystopian-utopian binaries and corporate imperatives to instead make space for collectively developing more diverse AI imaginaries (Saunier et al., 2025). As part of the Wilding AI collective², I am interested in AI systems with a potential “wildness”—an agentic alterity that functions as a collaborator in the production of novel creative work: systems “that can be free—if not to imagine then to generate—speeding through possibilities, junctures that are idiotic until they are not” (Coleman, 2021).

I subscribe to the view that improvisation is a mode of knowledge, critical dialogue, and collaboration across diverse domains (McNeilly and Stapleton, 2017). Improvising can be a way of getting to know that alterity—that

“wildness”—that may lie within artificial agents and machine learning models.

In response to the AIMC 2026 theme “The Generative Turn. Mediated Musicianship in a Hyper-reproductive Age”: this piece is an attempt at building a relationship between instrument, human player, and algorithmic intelligence through co-performance and co-creativity, avoiding logics of automated hyper-reproduction and replacement of human creativity.

AUTHOR DECLARATIONS

This text was drafted by a human being and proofread by a machine. All suggested edits during proofreading were manually reviewed by the human. All em dashes were deliberately added by the human.

ACKNOWLEDGEMENTS

This piece was developed during an artistic residency at IRCAM, Paris. I am grateful to Gérard Assayag, Marco Fiorini, and Vasiliki Zachari for hosting me at IRCAM; and Musikfonds and Culture Moves Europe for supporting my residency. The residency was part of the project “Co-improvising with the Non-human”, supported by a Musikfonds scholarship.

The Sophtar was designed by Federico Visi and built by Sukandar Kartadinata in Berlin, Germany. The solenoids mount was designed and built by Federico Visi and Halldór Úlfarsson in Reykjavik, Iceland.

This work was supported by Helge Ax:son Johnsons Foundation, Swedish Research Council, Boström Fund, Luleå University of Technology, and Intelligent Instruments Lab at University of Iceland.

REFERENCES

- Assayag, G., Bonnasse-Gahot, L., and Borg, J. (2022). Cocreative Interaction: Somax2 and the REACH Project. *Computer Music Journal*, 46(4):7–25.
- Coleman, B. (2021). Technology of the Surround. *Catalyst: Feminism, Theory, Technoscience*, 7(2).
- McNeilly, K. and Stapleton, P. (2017). Judging the Singular: Towards a Contingent Practice of Improvisation in Law. *Critical Studies in Improvisation / Études critiques en improvisation*, 12(1).
- Privato, N. and Magnusson, T. (2024). Querying the Ghost: AI Hauntography in NIME. In *Proceedings of the International Conference on New Interfaces for Musical Expression (NIME)*. Zenodo.
- Saunier, A., Visi, F., and Jones, M. (2025). Large Language Models to generate sonic behaviors: The case of Wilding

²<https://wilding.ai>

AI in exploring creative co-agency. In *The AI Music Creativity Conference (AIMC)*. Zenodo.

Visi, F. (2024). The Sophtar: A networkable feedback string instrument with embedded machine learning. In *NIME 2024 Proceedings of the International Conference on New Interfaces for Musical Expression*, Utrecht, the Netherlands.

Visi, F. (2026). Ghosts in the Sophtar – improvisation with an instrument and embedded algorithms. Video. Zenodo. <https://doi.org/10.5281/zenodo.21955200>.