



# The Nalima

Chris Kiefer

Experimental Music Technologies Lab, University of Sussex, UK, [c.kiefer@sussex.ac.uk](mailto:c.kiefer@sussex.ac.uk)

**Abstract—** The Nalima is a membrane-based multistable musical instrument, introducing a new design technique: Integrated Excitation. It invites research questions around the conceptualisation of feedback instruments within complex systems and multistability, and the use of membrane feedback in wider human-computer interaction.

**Index Terms—** feedback, multistability, vibrotactile

## I. THE NALIMA

The Nalima<sup>1</sup> is a new musical instrument, based on the principles of feedback and multistability. It can be classed as a self-resonating vibrotactile instrument [1]. These instruments are characterised by the circulation of signals through resonant acoustic materials, where the resonant materials become both the means of sound production and the interface by which the player influences musical behaviour. In this case, the resonant material is a membrane, which is excited and damped with a drumstick with an inbuilt piezo vibration sensor (a *vibrarod*), and with a voice coil. The instrument is influenced by other feedback membrane instruments such as Neuhaus' *Fontana Mix-Feed* [2] the *Feed-Drum* [3], and by Brandtsegg's plexiglass plate instrument [4].

## II. DESIGN

The Nalima uses a telfon membrane stretched across a metal frame. It takes a novel approach to feedback instrument design: *Integrated Excitation*. Rather than using a secondary source of excitation such as a speaker or exciter, the means of excitation is an integral part of the instrument. The Nalima employs a custom voice coil design that is held in tension against the membrane to create acoustic vibration. This design offers novel interactive affordances, allowing direct manipulation of the sound-producing materials with the vibrarod and the player's hands.

## III. MULTISTABLE MUSICIANSHIP

The Nalima is both an instrument and a platform for research into feedback musicianship, building on discussions from the AHRC Feedback Musicianship Network<sup>2</sup>. Cur-

rent research is focusing on the conceptualisation of feedback musicianship within multistability[5]. Multistability describes systems with multiple co-existent attractors. Through the lens of multistability, the Nalima is parameterised by the coupling between the vibrarod and the instrument, together with the damping from the player's free hand. When the vibrarod touches the instrument, a feedback loop is created, and the instrument moves towards an equilibrium state which creates a particular sound and haptic feel. From this point, variation of the parameters will move the instrument into different attractors, creating varied sounds. Multistability provides a useful metaphor for playing feedback instruments where the player navigates between attractors via unstable states, and also provides a mathematical grounding for analysis of emergent feedback behaviours. More broadly, the project raises questions about how membrane haptics and multistability could be considered in wider interaction design.

## IV. ACKNOWLEDGMENTS

This research was supported by Sussex Digital Humanities Lab

## V. REFERENCES

- [1] A. Eldridge, C. Kiefer, D. Overholt, and H. Ulfarsson, "Self-resonating vibrotactile feedback instruments——: Making, playing, conceptualising:——," 2021.
- [2] M. Saladin, "Electroacoustic feedback and the emergence of sound installation: Remarks on a line of flight in the live electronic music by alvin lucier and max neuhaus," *Organised Sound*, vol. 22, no. 2, pp. 268–275, 2017.
- [3] M. Lupone and L. Seno, "Gran cassa and the adaptive instrument feed-drum," in *International Symposium on Computer Music Modeling and Retrieval*. Springer, 2005, pp. 149–163.
- [4] O. Brandtsegg, "Making a pitch map for a vibrotactile feedback instrument," *Echo*, no. 3, 2020.
- [5] A. N. Pisarchik and U. Feudel, "Control of multistability," *Physics Reports*, vol. 540, no. 4, pp. 167–218, 2014.

<sup>1</sup><https://youtu.be/y3uq0skcnB0>

<sup>2</sup><https://feedback-musicianship.pubpub.org/>