Hypercuíca: Augmenting and Performing with an Afro-Brazilian Friction Drum

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Figure 1: Hypercuíca in performance. Photo by Andreia Parente, 2025.

Abstract

Hypercuíca is an augmented percussion instrument developed from the *cuíca*, an Afro-Brazilian friction drum traditionally associated with *samba carioca*. Aiming to expand the cuíca's sonic affordances, this paper presents a design concept that enables an embodied and dynamic interplay between instrument and performer, mediated through sensors embedded in the cuíca. Hypercuíca's system integrates microphones, gravity-sensor data, hardware, software, and mapping strategies for gesture-based sound modulation, combining the instrument's acoustic properties with digital signal processing (DSP). This paper details the technical implementation created to enable sonic modulation through the movement of both the instrument and the performer's body. The expressive potential of Hypercuíca's sound is explored through its use in live performance contexts. A design-based research approach was adopted to iteratively prototype, test, and analyse the system, which was developed through performance-based experimentation and informal feedback emerging from public presentations and workshops.

Keywords

Augmented percussion instruments, practice-based research, gestural control

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1 Introduction

The cuíca is a Brazilian friction drum whose sound is produced by rubbing an internal stick attached to a membrane, while the membrane itself is manipulated externally. The first author is a practising musician with over ten years of experience performing the cuíca and other percussion instruments in participatory samba contexts (*rodas de samba*), having been introduced to these instruments through formal percussion training at the Conservatório de Música Popular Brasileira de Curitiba (CMPB, Curitiba Conservatoire of Brazilian Popular Music). This sustained practical engagement has informed both the artistic and technical approach of the present work.

Figure 2: A cuíca. Photo by the first author, 2026.

Alongside this context, the first author's interest in experimental and electronic music practices motivated the search for new performative contexts for the cuíca. In this regard, augmenting the instrument aligns with traditions of hyperinstruments

[10] in which acoustic instruments are extended through digital technologies and real-time interaction. The project thus aims to explore how the cuíca's traditional capabilities can be recontextualized in improvisational settings that combine acoustic gesture, digital sound processing, and embodied interaction.

This paper presents an overview of the cuíca, its precursors, sonic characteristics, sound-production methods, traditional playing practices, and the organology of friction drums. Section 3 reviews related work on the cuíca, digital musical instruments (DMIs) based on traditional musical instruments, and gesture-based control of sonic modulation. Hypercuíca's conceptual design, selected hardware, software, and timbral aesthetics are detailed in Section 4, followed by a discussion of its mappings in Section 5. Its musical use and interactions with communities are presented in Section 6.

2 Cuíca

Friction drums of vast organological diversity are found across numerous cultures, predominantly on the African continent. However, the specific subtype with an internal friction stick (a stick positioned inside the cylindrical body of the instrument) is primarily found in Central Africa and in diasporic regions historically linked to it—including Cuba, São Tomé and Príncipe, and Brazil, where it is found from the north to the south of the country according to researcher Rafael Galante.

> Friction drums with an internal friction stick are generally characterized by their extremely low–pitched sound and, in many musical cultures in Central Africa, are symbolically associated with the voice of big cats, as well as the voice of the dead (the "ancestors"). For this reason, in many of these cultures, when they are played ritually in communities, these drums are heard but cannot be seen by ordinary people [6].

Within this organological family, the cuíca—formerly known as *puíta* [6]— is a Brazilian friction drum with a stick—usually made of bamboo—fixed inside its cylindrical body. It is traditionally associated with samba carioca and the percussion ensembles of samba schools in Brazil and worldwide. Sound is produced by rubbing a wet piece of cloth (often a grosgrain ribbon, as preferred by experienced players) along the internal friction stick. This friction creates rapid vibrations that are transmitted to the drumhead membrane, which can be tensioned by the other hand to control pitch. Unlike many unpitched percussion instruments, the cuíca can produce distinct melodic lines spanning an octave or more, depending on finger pressure on the membrane, although producing the desired pitch demands a precise and sensitive connection with the instrument.

The cuíca's history, versatility, peculiar timbre, and potential for inventiveness are key attributes that inspired its choice as the object of this research. Its characteristic friction-based sound, together with the unique haptic feedback generated by rubbing wet cloth against a bamboo stick, offers a distinctive tactile and sonic experience. Moreover, as noted in studies such as that of Paulo de Assis, professionally known as Paulinho Bicolor, the instrument has a range of traditional patterns within samba, yet remains open to exploratory and extended techniques. This duality aligns with the experimental concept of this project.

For historical and organological perspectives on the cuíca, relevant sources include Galante's master's thesis [6]; a documentary featuring Osvaldinho da Cuíca [12]; the *Cuiqueiros* blog[1]; the ongoing book series *Cuícas Imortais* by J. Muniz and Paulinho Bicolor [8], which documents the life trajectories and artistic practices of prominent Brazilian cuíca players (*cuiqueiros*), and Bicolor's master thesis [2], which maps information related to the cuíca available in bibliographic sources. Together, these materials highlight how the cuíca has historically functioned as a source of continuous innovation, with performers developing new techniques, timbral explorations, and performative strategies in response to evolving musical and social contexts. In this sense, both samba and the cuíca can be understood as inherently experimental traditions, in which cuiqueiros have long operated as avant-garde practitioners within performance practice.

3 Related work

Latin American instruments such as the cuíca remain marginal within contemporary solo repertoires [14]. Nevertheless, several percussionists—including Caito Marcondes, Simone Sou, Carlos Stasi, and Marcos Suzano—have engaged with such instruments through unconventional and experimental practices. Within NIME and related research, augmented traditional percussion instruments constitute a well-established field [13, 18], providing a fertile context for projects such as Hypercuíca. Despite this broader interest in instrument augmentation, the cuíca itself has received comparatively little focused exploration.

The integration of culturally rooted instruments with digital technologies is also evident in community-based projects such as Filipe Calegario and João Tragtenberg's *Batebit* and *Bongarbit* [1, 17], as well as in other NIME and artistic research projects that explore the augmentation of traditional instruments in contemporary performance contexts [7, 11]. These projects exemplify bottom-up design processes that engage community members as active participants. In contrast, while Hypercuíca shares an interest in traditional instruments, it was developed through a practice-based process focusing on iterative experimentation for solo performance rather than as a collaborative co-creation.

Hypercuíca's use of accessible technologies aligns it with a broader trend in DMIs that employ mobile phones as sensors for gestural control [9, 15]. Projects such as Tiago Brizolara's *Elemental*[2] [3] and João Tragtenberg and Filipe Calegario's *Giromin* [16] have incorporated smartphone motion sensors among other sensing strategies during their development. Similarly, Hypercuíca adopts a wearable model, with the instrument itself becoming an integrated site for sensing and digitally modulating audio effect parameters.

Although the cuíca remains iconic within samba carioca, Naná Vasconcelos once observed that the instrument was not made for samba alone [5]. Musicians such as Airto Moreira, Cyro Baptista, Edson da Silva, Naná, and Paulinho Bicolor have since pioneered its use in jazz, blues, and free improvisation. Airto, Cyro, Edson, and Naná explored the cuíca's natural sound through collaborations with musicians including Miles Davis, Derek Bailey, Quincy Jones, and B.B. King, respectively. A direct forerunner in the electronic augmentation of the cuíca is Paulinho Bicolor, whose *Cuíca Expandida*[3] project systematically explored amplification, effect pedals, and extended techniques within experimental solo performance. His work extends to free improvisation, including performances with ensembles such as Paal Nilssen-Love's

[1] https://cuiqueiros.blogspot.com
[2] Tiago Brizolara's workshop at *SomaRumor* 2021 nov.
[3] https://cuicaexpandida.wordpress.com/

New Brazilian Funk and collaborations with improvisers such as Antonio Eugenio Taranto Gianfratti, also known as Panda Gianfratti. Building on these unconventional approaches, the Hypercuíca project recontextualizes traditional playing methods and applies digital audio processing to the cuíca's natural sound through a singular intervention: the integration of sensors into the physical structure of the instrument, enabling embodied sound manipulation.

4 Hypercuíca's system

Hypercuíca operates as follows. The cuíca's sound is captured using a clip-on microphone and routed to a computer via an audio interface, where it is digitally processed and reproduced through loudspeakers. Real-time modulation of sound parameters is achieved using a smartphone attached to the body of the cuíca with an armband. The smartphone transmits gravity sensor data to the computer via the Open Sound Control (OSC) protocol, enabling gesture-based control over multiple DSP techniques.

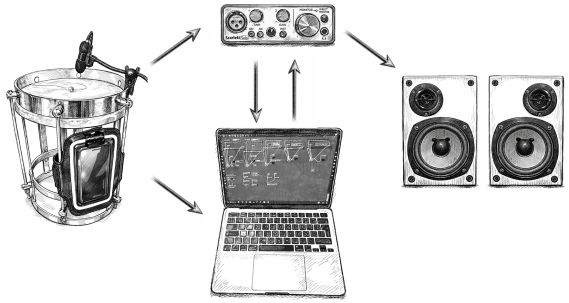

Figure 3: Hypercuíca's system.

4.1 Hardware

Hypercuíca's hardware is compact and portable. Its configuration combines the acoustic cuíca with readily available audio and computing devices to enable real-time sound capture, processing, and gesture-based control. Emphasis was placed on reliability, low latency, and ease of integration in performance contexts, allowing the instrument to function as a self-contained hybrid system. Hypercuíca consists of the following hardware components:

- Cuíca by *TAKTO Instrumentos Musicais LTDA*[4], 8 cm × 30 cm, stainless steel, featuring an open body without a closed resonating shell
- Condenser clip t.bone microphone CC 100
- Android smartphone, Xiaomi POCO X3 GT
- MacBook Air, Apple M2 chip
- Focusrite Scarlett Solo, 3rd-generation USB audio interface

4.2 Software

Hypercuíca's software relies on a combination of music performance software and sensor-based communication systems to enable real-time sound processing and gesture-based control. Ableton Live[5], used together with Max for Live[6], serves as the central environment for audio processing, performance, and custom mapping design between sensor data and sound parameters.

[4]https://www.instagram.com/taktopercussao
[5]https://www.ableton.com/live
[6]https://www.ableton.com/live/max-for-live

The ZIG SIM[7] application accesses the smartphone's gravity sensor, a software sensor that estimates the Earth's gravity vector through sensor fusion based on the device's inertial measurement system, which combines data from built-in accelerometers and gyroscopes. In this context, a software sensor refers to data made available by the operating system through the processing and combination of signals from built-in hardware sensors. While this solution offers practical advantages in terms of portability and ease of integration, it operates as a more closed sensing system than dedicated IMU-based hardware. The resulting data is streamed in real time to the computer via OSC, allowing the instrument's movements in space to be translated into expressive, real-time control of DSP.

4.3 Timbre

In performance settings, the acoustic sound of the cuíca remains audible at all times. However, the sound emitted by the loudspeakers may appear more or less natural depending on the type and intensity of DSP applied.

Following an extensive exploration of timbral possibilities using single or combined Ableton Live stock plugins—chosen for their wide range of processing techniques and low computational cost in live performance contexts—two categories of sound processing were established: conservative and transformative.

The conservative category emphasizes and extends the cuíca's inherent sonic attributes while preserving aspects of its organic character. Examples include:

- Delay to reinforce the cuíca's characteristic rhythmic patterns in samba carioca, which rely on cyclical gestures
- Reverb to enhance the decay of a classic cuíca technique in which the final note is prolonged
- Gain and saturation to accentuate the raspy and guttural qualities intrinsic to the cuíca's friction-based sound production
- Resonators to emphasize metallic and harmonically rich spectral features of the cuíca's steel structure

The transformative category is based on DSP techniques that alter the cuíca's sound more radically, with the aim of situating it closer to the domain of experimental music and live electroacoustic improvisation. For instance, activating the Shifter device enables a range of modulation processes, including LFOs, envelope followers, and internal delay, facilitating dynamic and exploratory sound transformations that can result in robotic or detuned timbral outcomes. Another transformative audio effect employed in this category involves the modulation of the EQ filter, facilitating continuous and gesture-responsive transformations of the cuíca's spectral characteristics.

It is noteworthy that even within the conservative DSP category the cuíca's sound may gradually depart from conventional sonic expectations. This distancing is not only a result of signal processing, it is a consequence of the performer's engagement with unconventional modes of playing and extended techniques, which already challenge traditional uses of the instrument. In particular, increased gain and saturation can induce feedback phenomena, producing noisier and more atmospheric textures that, when combined with non-traditional playing approaches, further expand the cuíca's expressive palette beyond its traditional identity.

[7]https://1-10.github.io/zigsim

5 Mappings

All mappings[8] were implemented in Max for Live, using incoming sensor data to modulate audio parameters within Ableton Live. Discrete gestures are mapped to the activation and deactivation of audio effects, while continuous gestures are mapped to the real-time modulation of effect parameters. This approach facilitates both binary control actions and gradual, expressive sound transformations during performance.

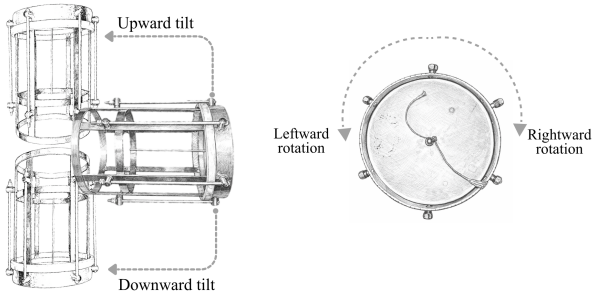

Figure 4: Illustration of Hypercuíca's gestures.

Discrete gestures are used to activate or deactivate entire audio processing modules. For example, a downward tilt of the instrument (90°) toggles the delay effect, while leftward and rightward rotations (90°) are used to activate or deactivate the shifter and resonator modules, respectively. These binary gestures serve as structural controls that determine which sound transformation processes are active at any given moment. Continuous gestures are mapped to macro controls that modulate multiple audio parameters simultaneously. The upward tilt of the instrument progressively adds textural attributes such as reverb, saturation, filtering, gain, and shifter-dependent parameters progressively, while horizontal rotation controls spatial distribution and shifter-dependent parameters. Rather than addressing individual DSP parameters in isolation, these mappings support gradual, expressive transformations driven by embodied motion. A detailed overview of the parameter ranges and mappings can be found in Table 1.

5.1 Macro-Based Mapping Structure

Continuous gesture data are routed to Ableton Live macros, which allow a single control signal to modulate multiple audio parameters simultaneously. This one-to-many mapping strategy enables complex timbral transformations to emerge from simple, physical gestures. The present system uses two primary gesture axes: left–right rotation and up–down tilting of the instrument.

The left–right axis (Y-axis) corresponds to rotational movement of the cuíca. In this mapping, the minimum macro value represents a 90-degree rotation to the left, while the maximum value represents a 90-degree rotation to the right. The up–down axis (X-axis) corresponds to vertical tilting of the instrument, with minimum values associated with a 90-degree downward tilt and maximum values with a 90-degree upward tilt. These macro ranges define the minimum and maximum limits for each mapped parameter, ensuring predictable yet expressive control during performance. Although the mappings presented here represent a functional configuration used in the current system, they are not intended to be fixed or prescriptive. The macro-based structure was deliberately designed to allow mapping ranges, parameter groupings, and gesture-to-DSP relationships to be easily reconfigured. This flexibility supports ongoing experimentation with alternative gestural strategies and sound-processing combinations, enabling the system to adapt to different performance contexts, aesthetic intentions, and exploratory research objectives.

[8]A video explaining Hypercuíca's system as well as its mappings is available as supplementary material and at https://youtu.be/Mt5BYjpB4lA.

5.2 Mapping Design Considerations

For gesture-based sound modulation, movements were selected to avoid restricting natural playing techniques while maintaining the performer's orientation towards the audience in a conventional stage–audience configuration. Empirical observation indicates that vertical tilting of the instrument does not interfere with standard cuíca performance practice.

Rotation of the instrument was also adopted as a control gesture; however, larger rotational angles can restrict pitch control achieved through finger pressure on the membrane. Despite this limitation, playability can be maintained by emphasizing rhythmic articulation through the hand responsible for rubbing the friction stick, allowing expressive continuity during performance. All mappings were refined iteratively through experimentation, prioritizing ergonomic feasibility, gestural clarity, and expressive continuity. All proposed mappings can be seen in action in the videos referenced in the following section (Musical Use), as well as in this paper's presentation video. It should be noted that the delay effect triggered by downward tilting of the instrument was introduced at a later stage of the project and can be observed in the performance at *Binnar* Festival and in the workshop held with traditional cuíca practitioners, as discussed in the following section.

6 Musical use

Hypercuíca was conceived as an instrument for live electroacoustic improvisation, oriented toward experimental performance practices in which timbral transformation, rhythmic flexibility, and embodied interaction play a central role. The instrument emerged through iterative engagement where musical decisions unfold in real time through continuous negotiation between acoustic sound, digital processing, and bodily movement.

In performance, Hypercuíca supports a fluid range of approaches. The performer may engage closely with the cuíca's unprocessed acoustic sound, exploring its friction-based timbre, extended techniques, and rhythmic gestures, or activate gesture-based digital processing by moving the instrument in space. These modes of engagement are not organized into a fixed dramaturgy: performances may favour acoustic sound, heavily processed textures, or oscillate between contrasting sonic states. This flexibility reflects the principles of free improvisation, in which musical form emerges contingently rather than being predetermined.

The musical use of Hypercuíca has occurred mainly in solo performances by the first author, consistent with the project's initial emphasis on embodied control and individual exploratory practice, while also extending into dialogic and collaborative contexts. The four instances discussed in this section document distinct situations in which the instrument was played across

Table 1: Gesture-Based Mappings Between Sensor Input and Audio Parameters

Gesture	Device	Parameter	Min Value	Midpoint	Max Value
Left/Right	Delay	L Delay Time	166 ms	181.5 ms	197 ms
Left/Right	Shifter	LFO Amount (st)	2.47 st	13.24 st	24.00 st
Left/Right	Shifter	Pitch Coarse	-24 st	0 st	24 st
Left/Right	Shifter	Delay Time (s)	16.3 ms	3.15 s	6.28 s
Left/Right	Utility	Balance	50L	Center (0)	50R
Up/Down	Resonators	Decay	5.47	39.09	72.7
Up/Down	Shifter	LFO Rate (Hz)	0.01 Hz	25.01 Hz	50.0 Hz
Up/Down	Shifter	Delay Feedback	6.3 %	71.15 %	136 %
Up/Down	Shifter	Dry/Wet	100 %	50 %	0.0 %
Up/Down	EQ Eight	2 Frequency A	10.0 Hz	487.5 Hz	965 Hz
Up/Down	Reverb	Decay Time	583 ms	9.69 s	18.8 s
Up/Down	Reverb	Dry/Wet	11 %	32.5 %	54 %
Up/Down	Saturator	Drive	-6.75 dB	14.63 dB	36.0 dB
Up/Down	Utility	Gain	4.92 dB	0.82 dB	-3.28 dB

performance, pedagogical, and community-oriented settings, including concerts involving open discussion, educational encounters focusing on the instrument's design and creative processes, participatory media formats centred on improvisation and dialogue, and a workshop performance exchange with a community of traditional cuíca practitioners.

Across these contexts, engagement with listeners and participants was not structured as a formal evaluative study, but rather as an informal, dialogic process. Feedback emerged through conversation, observation, and shared musical experience, thereby contributing to a situated understanding of how the augmented instrument resonates within different cultural and performative environments.

6.1 Performance 1

On 5 and 6 November 2025, Hypercuíca was presented at the *International Colloquium Digital and Technological Performativities*[9], hosted by INET-md and the University of Aveiro, Portugal. The instrument was featured in both an oral presentation and a performance.

The oral presentation provided an overview of Hypercuíca's conceptual design, alongside the historical context of friction drums, including references to African ancestry and the instrument's frequent association with the vocalizations of big cats. These elements framed the instrument not only as a technological artifact but also as a continuation of long-standing sonic imagination.

The performance emphasized timbral exploration and improvisatory processes enabled by the Hypercuíca system, combining unprocessed acoustic sound with gesture-based electronic processing. A strong emphasis was placed on bodily movement and spatial interaction: the performer moved the instrument through space, knelt, and circulated around the performance area, incorporating extended techniques and occasional vocal interventions directed toward the instrument. Visual elements were integrated into the performance, including audio-reactive visual projections pre-programmed in TouchDesigner.

Audience feedback highlighted several aspects of the performance, including the wide range of timbral variation, the use of light as a spatial and dramaturgical element, and the analogy between the sound of the cuíca and the roar of big cats. Commentators also noted the performer's command of the Max for Live patch, emphasizing that the performance did not function as a mere demonstration of audio effects, but rather conveyed a closely integrated relationship between performer, instrument, and digital processing.

Three moments were identified as being particularly compelling: firstly, when the performer vocalized directly into the instrument; secondly, when the visuals began to flicker and strobe in response to sound and gesture; and thirdly, when the cuíca was left alone beneath the floor light, continuing to resonate within the performance space.

A noteworthy observation was offered by the keynote speaker, who highlighted a moment when the performer stopped rubbing the friction stick and instead held and moved the cuíca in space, engaging with feedback alone. This gesture was interpreted as momentarily granting agency to the instrument itself, foregrounding the emergent behaviour of the augmented acoustic–electronic system.

6.2 Performance 2

On 14 November 2025, Hypercuíca was featured in *Play Talk Play*[10], an ongoing video series by Rodrigo Constanzo and Angela Guyton on their YouTube channel *Amplifiers & Explosions*. Dedicated to free improvisation and improvisational thinking, the series combines performance with reflective dialogue in a play–talk–play format, offering insight into the artistic and conceptual processes behind improvisation. This context provided an opportunity to present Hypercuíca in an online, publicly accessible format oriented toward process-based artistic practice.

The session consisted of a free improvisation dialogue between Hypercuíca and another augmented percussion instrument. Two improvisation sets were presented with a conversational segment in between addressing ongoing creative processes, motivations, and technical considerations related to hybrid instrument design. The format emphasized improvisation as both a performative and discursive practice.

In the first set, Hypercuíca was presented in its full configuration, including its sensor-based system. In the second set, a spontaneous decision was made to perform using the cuíca without its sensor system, working instead with its acoustic sound

[9]https://www.youtube.com/watch?v=QnesJvhAXYI

[10]https://www.youtube.com/watch?v=6rxqDa6LD-8&t=470s

amplified by a K&K Sound Hot Spot piezo pickup. This shift facilitated a more focused exploration of extended techniques, including scraping and snapping the membrane and striking the instrument with a drum key—a technique also employed by Paulinho Bicolor. The contrast between the two sets emphasized continuity between acoustic and augmented approaches, highlighting how electronic augmentation extends, rather than replaces, the instrument's existing expressive vocabulary.

The conversational segment unfolded in an informal and dialogic manner, providing space to share contextual information on friction drums, as well as the artistic motivations and technical decisions informing the development of Hypercuíca. Within this setting, the instrument functioned not only as a performance interface but also as a medium for exchange between practitioners engaged in augmented percussion and electroacoustic improvisation practices.

6.3 Performance 3

On 27 November 2025, Hypercuíca was presented in the format of a performance followed by a masterclass as part of the *Binnar Festival*[11]. While most festival activities take place in Vila Nova de Famalicão, this event was held in Caldas da Saúde, Santo Tirso, and addressed students from the multimedia technical course at Oficina – Professional School of Nun'Alvres Institute.

The performance followed an approach similar to that presented at the international colloquium previously described. The discussion that followed the masterclass was marked by active student engagement and a wide range of perceptual, aesthetic, technical, and biographical questions. Several comments addressed the affective qualities of the performance, with students describing the Hypercuíca sound world as evoking horror film soundtracks or animal vocalizations, such as whale song. These observations sparked a brief exchange on discomfort, estrangement, and uniqueness in listening, highlighting how unfamiliar timbres can provoke imaginative responses. This led to a short discussion about experimental music as a parallel practice to more conventional musical forms, emphasizing its role in expanding perceptual, technical, and creative tools, particularly for practitioners working at the intersection of music and technology.

Questions also focused on the performer's relationship with the instrument and the origins of this engagement. Students asked how the first author developed an interest in the cuíca. Other questions addressed the emotional dimension of performance, with students asking whether specific feelings or intentions guide the musical process. In response, the first author described performing as involving instinctual drives and processes of sublimation rather than fixed narratives or representational imagery.

Students also offered critical feedback on the performance, suggesting that moments of silence could provide space for reflection and contrast within the musical flow. This observation contributed to a broader conversation about pacing, listening, and temporal awareness in improvised performance.

Additional questions explored improvisation as a learning process, particularly the role of repetition, exploration, and error in developing instrumental mastery. Error was discussed not as failure, but as an integral component of artistic research, experimentation, and learning. Drawing on pedagogical experience, the first author emphasized the importance of embracing error as a necessary condition for discovery and growth.

[11] https://www.youtube.com/watch?v=WzX_Tmsg1ww

6.4 Workshop with the community

Hypercuíca was presented to a community of cuiqueiros on 24 January 2026 during *Oficina Ronco da Cuíca*[12] Curitiba, a periodic workshop dedicated to the instrument. The event was organized by two experienced practitioners, who opened the session with an overview of the history of the cuíca in Brazil and its role within local samba schools, followed by an introduction to basic cuíca patterns.

During the initial discussion, the organizers referred to a historical account of the prohibition of the cuíca in Curitiba, documented in the book *Colorado: a primeira escola de samba de Curitiba* (Colorado: Curitiba's first samba school) [4], which also identifies Maé da Cuíca as one of its founders. In this context, the restriction of the instrument can be understood in relation to broader forms of social and moral regulation historically imposed on carnival and Afro-Brazilian popular cultural practices. This prompted reflections on the instrument's marginalization and contested status, situating Hypercuíca within a broader narrative of reinvention and recontextualization.

In the final part of the workshop, the first author presented a short solo performance using Hypercuíca, followed by a slide presentation outlining the creative process and technical configuration of the system. The session concluded with an open discussion, during which feedback was offered regarding the performance, the instrument, and its potential applications.

Audience reactions indicated strong engagement, particularly during moments in which pitch-shifting and other effects produced distinctly electronic sonic qualities. Participants described these passages as expanding the cuíca's sonic identity beyond its conventional acoustic associations. Although bodily movement was generally associated with changes in sound, some noted that specific mappings became clearer only after verbal explanation, raising questions about causality, agency, and perceptual transparency.

Participants emphasized that expanding the cuíca's sonic vocabulary through electronic processing could open creative pathways, particularly in experimental and electronic music contexts. One recurring observation was that coupling sound processing directly to bodily movement made the system especially compelling, suggesting that Hypercuíca was perceived not merely as an effects-based extension of the instrument, but as a performance system in which bodily engagement becomes central.

Questions were raised regarding performance duration and form, particularly with regard to how attention shifts over the course of longer performances. It was discussed that the addition of sensors and mappings introduces new modes of practice oriented toward movement exploration and interaction design, which differ from the technical challenges of traditional cuíca techniques. At the same time, it was acknowledged that the acoustic instrument itself offers a vast expressive range, as exemplified by renowned cuíca players such as Índio da Cuíca and Osvaldinho da Cuíca. The discussion also touched on the difficulty of sustaining novelty over extended solo performances, as effects, techniques, and gestural strategies may become exhausted over time.

Finally, one participant proposed introducing greater variability and unpredictability into the system by allowing performance intensity or bodily movement to influence effect selection more autonomously, potentially through artificial intelligence and machine learning techniques. This suggestion echoed ideas already

[12] https://www.youtube.com/watch?v=KxHihmp11mU

under consideration as part of the project, particularly as a means of generating surprise and steering performances towards less predictable trajectories.

7 Conclusion and future work

This paper has presented Hypercuíca as an augmented percussion instrument conceived for live electroacoustic improvisation, combining the physical practice of cuíca playing with real-time digital processing as an open-ended framework for artistic and technical exploration. Rather than proposing a radically new sensing technology, the project investigates how the augmentation of a culturally specific percussion instrument can generate new relationships between gesture, timbre, and embodiment across different performance contexts. The instrument was presented in performances and workshops, suggesting its potential as a tool for artistic inquiry and its capacity to extend the expressive possibilities of the cuíca beyond traditional contexts.

Future work includes further developing the system's mappings and expanding its sonic variability through continued experimentation. This includes exploring alternative gesture-to-sound relationships, as well as machine learning approaches capable of identifying and mapping longer, more complex gesture trajectories, potentially introducing more dynamic and interactive modes of engagement with the instrument. The ongoing performance and dissemination of Hypercuíca will remain essential to the project, allowing the instrument to continue evolving through real-world artistic contexts and inventive practices.

8 Ethical Standards

This research adheres to the ethical standards of the NIME community. Informal audience feedback from public events is reported anonymously, without identifying participants. Generative AI tools were used in a limited manner to support writing revision and visual illustration.

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