Turntable-Based Electronic Music and Embodied Audience Interaction

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Figure 1: *Rings… Through Rings* **installation, with audience members interacting with laser-etched discs. ©Tak-Cheung Hui & Xiaoqiao Li**

Abstract

Rings… Through Rings transforms archival maps of Hong Kong's military fortifications into playable surfaces for turntable-based electronic music. Laser-etched discs encode cartographic data, producing sonic textures manipulated through turntables and enhanced by audio techniques like cross-synthesis, concatenative synthesis, and spatialization. Grounded in theories of transcoding, productive agency, and participatory culture, the project reimagines the turntable as a cultural interface, bridging analog heritage with computational sound.

This hybrid system blends pre-composed musical structures with real-time audience interaction, allowing audience members to alter playback, swap discs, and influence spatial audio. By merging cartography, sound, and participatory design, the work offers a collaborative, multisensory approach to intangible heritage. Future developments include expanded spatial configurations, real-time disc fabrication, and AI integration to deepen engagement and cultural reinterpretation.

Keywords

Interactive Installation, Digital Fabrication, Interdisciplinary performance, Historical Reinterpretation

1 Introduction

Urban redevelopment in Hong Kong continues to overshadow the historical traces of military fortifications, including defensive outposts, watchtowers, and walls—structures in areas like Lantau Island, Ha Pak Nai, and the Northern Metropolis, which are poised for significant transformation in the coming decades. While digital heritage and conservation initiatives document these sites, they often prioritize static archival methods that offer limited opportunities for embodied or communal engagement. *Rings. . . Through Rings* addresses this challenge by transforming archival cartographic data into playable surfaces for turntable-based electronic music, merging sonic exploration with participatory heritage reimagination. The project laser-etches historical maps onto discs that yield distinct textural outputs when spun on a turntable. The resulting audio signals feed into real-time processing and spatialization, inviting audience to alter rotation speeds or swap discs. Through this mechanism, the turntable becomes a cultural interface, bridging intangible heritage with live composition in a novel way.

This paper introduces laser-etched discs as interactive scores, demonstrates how audio-processing tools merge heritage-related recordings with turntable outputs, and positions participatory culture at the core of the performance. By combining heritage-driven content, new media theory, and turntable-based performance, *Rings. . . Through Rings* highlights the potential for multisensory, collaborative access to historical data.

2 Related Work

2.1 Turntable as Instrument and Medium

Turntables have been widely repurposed as creative platforms, extending their traditional function beyond basic playback. Research demonstrates their ability to map tactile or visual inputs onto algorithmic sound transformations. Turntable Music in the Digital Era [11] explores how specialized sampling and DSP can heighten gestural responsiveness, while *spinCycle* employs color-based tracking of rotating discs [10]. These projects underscore the turntable's versatility for translating physical interaction into multifaceted sonic output.

Rings. . . Through Rings engraves cartographic data onto discs, embedding historical narratives within the grooves and enabling performers and audience to reanimate the environment of military fortifications through tactile manipulation. This elevates the turntable from an experimental instrument to a heritage interface.

2.2 Visual-Tactile Interfaces for Musical Creation

Studies on visual-tactile interfaces reveal how graphical materials can function as musical inputs. Systems like *onNote* bridge printed scores and MIDI [15], while *Birds on Paper* transforms pencil sketches into melodic structures via capacitive sensing [5]. *Rings. . . Through Rings* laser-etches historical maps onto turntable discs, converting topographical data into an interactive score. These etched lines represent fortifications and terrain, inviting both performers and audiences to reinterpret archived data as sonic performance.

2.3 Embodied Interaction and Participatory Culture

The project aligns with tangible interaction frameworks, where physical artifacts serve as intuitive interfaces for user engagement [9]. By rotating discs, shifting speeds, or exchanging surfaces, audience in *Rings. . . Through Rings* co-create the sonic landscape. This participatory model resonates with approaches in museum exhibitions or augmented reality contexts, where user-driven gestures or manipulations enhance understanding of cultural artifacts. Military heritage becomes a hands-on resource, enabling a collaborative, real-time reinterpretation of intangible narratives through sound.

3 Conceptual and Practical Framework

3.1 Technical Images and Heritage Reinterpretation

Drawing on Manovich's The Language of New Media [12], this project translates static cartographic data into interactive media via variability and modularity. Manovich's concept of transcoding—where cultural representations serve as computational inputs—anchors this transformation. Audience's interactions (e.g., altering rotation speed, swapping discs) dynamically shape the system's output.

Flusser's notion of technical images reframes visual documents as constructs that shape perception rather than passively preserving facts [6]. In this project, engraved discs act as "productive agents", generating sonic reinterpretations whenever the stylus travels over etched lines [3]. Small changes in rotation speed might produce amplitude spikes, while needle repositioning could yield rhythmic deviations, transforming static archival data into a collaborative, performative interface.

The inclusion of specific historical sites, such as Tung Chung Fort and Fan Lau Fort on Lantau Island, situates this framework within Hong Kong's broader cultural narrative. By leveraging these maps as both tangible and interactive elements, the project bridges digital tools with heritage reinterpretation, turning static cartographic outlines into evolving soundscapes.

Figure 2: A laser-etched disc on a turntable, showcasing a processed map of Hong Kong's Northern Metropolis. ©Tak-Cheung Hui & Xiaoqiao Li

3.2 Embodied Performance and Tangible Interfaces

The theory of embodied interaction emphasizes how meaning arises from the synergy between physical actions, environmental context, and digital systems. In this project, performers manipulate laser-etched discs—varying rotation speed, needle placement, and groove traversal—guided by tactile cues such as friction or groove density. Denser grooves can trigger sharp timbral shifts or prompt decreases in speed to manage rhythmic cohesion.

Ishii's Tangible Bits framework underlines how physical artifacts serve as intuitive interfaces bridging analog and digital domains [8]. Here, the etched discs embody historical maps, while computational engines such as CataRT and Spat augment the turntable's sonic output. Performers adopt a structured approach, predicting sonic outcomes based on groove patterns, while audience members engage more improvisationally, introducing real-time unpredictability. This fusion recasts the turntable as a cultural interface, transforming intangible heritage into tactile, multisensory interactions.

3.3 Participatory Culture and Interaction Design

In this project, audience members transition from passive observers to co-creators, reflecting Henry Jenkins' concept of participatory culture, which lowers barriers to creative engagement [9]. Interactions like disc-swapping or adjusting playback speed can spur unexpected changes in tonal textures or rhythmic patterns, fostering improvisation. The project balances structured contributions (e.g., guided disc swaps) with exploratory freedom (e.g., random pitch manipulation), retaining coherence through design constraints encoded in the etched grooves. The audience's interactions also trigger disc images of the piece, captured through a macro lens, as shown in Figure 2.

Nina Simon's participatory design principles inform inclusivity strategies that accommodate varied engagement levels [14]. Some audience actively swap high-density discs to produce harsher, more metallic sounds, while others simply enjoy the resulting spatial audio. Observational feedback from exhibitions shows that these tiered interactions foster a sense of collective authorship, turning historical artifacts into shared, participatory experiences.
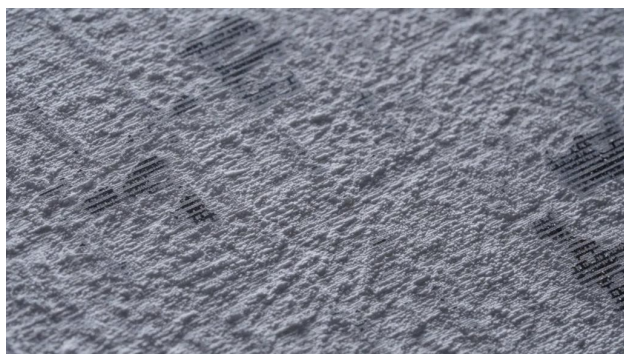

Figure 3: Video documentation excerpt from the improvisation session, captured with a macro lens to reveal detailed disc etchings. ©Tak-Cheung Hui & Xiaoqiao Li

3.4 New Media Materiality and Post-Digital Aesthetics

Berry's post-digital aesthetics describes how analog media and computational processes converge to form a hybrid artistic practice [2]. In *Rings... Through Rings*, laser-etched discs encode physical data, while digital tools such as TouchDesigner, Max, CataRT, and Spat expand their expressive scope. This interplay reframes heritage artifacts as simultaneously historically preserved and creatively mutable.

Audiences perceive heritage as a hybrid construct, where ancient fortifications meet contemporary music technology. The discs serve as relics that, through computational augmentation, invite experimental engagement. By uniting the physical (grooves) and the digital (algorithmic sound), the project spawns new contexts for interpretation, bridging past and present, archive, and performance.

3.5 Multisensory Immersion and Spatial Audio

Spatial audio implementation via Ircam's Spat enriches the project's immersive dimension, linking amplitude-based sound trajectories to the engraved discs' physical properties. Louder signals move faster across the speaker array, while silence halts them. Inspired by Bauck's 3D sound fields [1], this design enhances sensory engagement, giving audio a sense of motion that audience perceive as tangible and responsive.

Site-specific impulse responses captured with HISSools replicate the acoustics of historical forts, embedding the performance in evocative soundscapes reminiscent of corridors or courtyards [7]. System scalability accommodates various speaker arrays, from 5.1-channel setups to hemispheric configurations, underscoring the project's adaptability across venues and reinforcing participatory, multisensory heritage engagement.

4 Implementation and System Architecture

4.1 Materials and Fabrication: Laser-Etched Discs

Archival maps of Hong Kong's fortifications were digitized in TouchDesigner to highlight key topographical lines, then laser-etched onto PVC and wood discs, as depicted in Figure 3. PVC discs tend to accentuate higher frequencies, producing sharper, more metallic timbres, whereas wood provides a mellower, warmer tone. Adjustments to laser depth or etching intensity further diversify groove complexity, allowing performers to select or mix different discs for varied sonic palettes. This process effectively translates geographic contours into a "graphic score," physically embedding historical references into the discs (Figure 4).

4.2 Real-Time Processing: Cross-Synthesis, Concatenative Synthesis, and Spatialization

Earlier prototypes relied on cross-synthesis in Max/MSP to merge the turntable's output with field recordings of heritage sites. The present iteration integrates CataRT to segment audio into granular units for corpus-based concatenative synthesis [13], letting performers trigger or randomize heritage-related fragments in tandem with turntable sounds. Spatialization through Spat disperses these layers across multiple loudspeakers [4]. For instance,
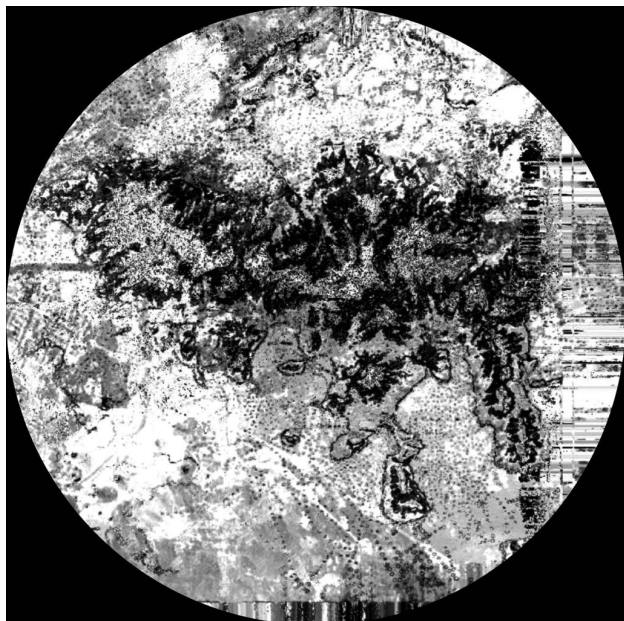
Figure 4: Disc images designed in TouchDesigner/Jitter and printed onto physical discs. This example depicts a map of Hong Kong Island, highlighting historical military activities. ©Tak-Cheung Hui & Xiaoqiao Li

a high-density groove might activate clusters of local choral fragments panned rapidly around the venue, illustrating how physical disc interaction modulates computational processes. Additionally, convolution reverb from on-site impulse responses immerses audiences in the reverberant qualities of historical forts.

4.3 Structured Performance and Visual Integration

The recorded performance bridges composed narratives and audience interaction, integrating two turntables with an acoustic ensemble to reinterpret cartographic data. Presented as a three-movement suite, the work progresses from rhythmic patterns inspired by engraved disc grooves to microtonal harmonies derived from spectral analysis, culminating in a waltz-like movement that metaphorically mirrors the rotation of the turntable while emphasizing performer expressivity. Audience movement triggers pre-recorded musical excerpts, integrating with the live performance setup (Figures 5 and 6).

4.4 Audience as Co-Creator

Audience members actively shape the performance by swapping discs, adjusting rotation speeds, or using auxiliary controls to influence concatenative synthesis or spatial distribution. Some audience choose denser map engravings for more abrasive textures, while others prefer slower rotation speeds for reflective, drone-like soundscapes. These real-time manipulations introduce spontaneity, prompting the performer to adapt compositional decisions on the fly, as illustrated in Figure 7. This format extends participatory culture into live performance, recasting heritage materials as catalysts for improvisational, community-driven reinterpretation [9].

Figure 5: Musical excerpts from the score of *Rings… Through Rings*. ©Tak-Cheung Hui & Xiaoqiao Li

Figure 6: Live concert setup featuring an ensemble interacting with the turntable, accompanied by real-time video projections of the turntable and disc. ©Tak-Cheung Hui & Xiaoqiao Li
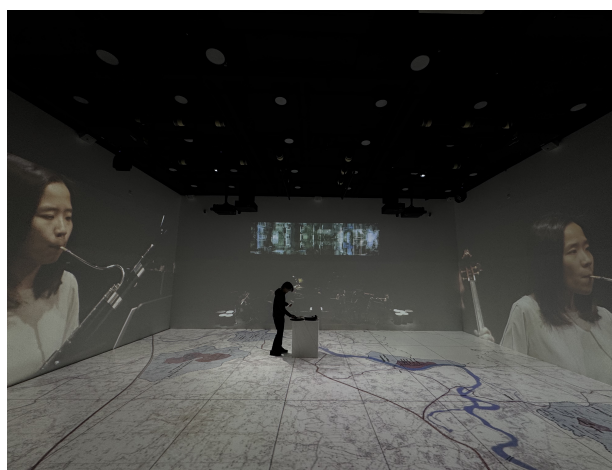

Figure 7: Audience interacts with the turntable, manipulating discs and rotation speeds to shape sonic outputs, fostering improvisation and collective reinterpretation of heritage materials. ©Tak-Cheung Hui & Xiaoqiao Li

5 Discussion - Turntable as Heritage Interface and Embodied Interaction

While earlier turntable research highlights creative experimentation, this project embeds historical cartographies into grooves, aligning intangible knowledge with physical playback [10, 11]. Audience interventions shift the turntable's role from a simple playback medium to a heritage interface, enabling real-time manipulation of archived data. Anecdotal feedback indicates that audience feel more connected to these sites when they can "unlock" historical nuances through tactile, sonic exploration.

This approach spotlights physically manipulated interfaces as a crucial form of embodied engagement. Tactile cues guide the performer's gestures, while live audio transformations spark audience curiosity, illustrating the cyclical interplay between analog input and computational reinterpretation. By reconceptualizing cartographic data as an interactive art practice, the project aligns with HCI-based tangible interaction models, showcasing a sensory-rich framework for interpreting intangible heritage in real time [8].

Although certain compositional cues are premeditated, audience-driven actions and disc swaps demand a flexible structure. Planned passages can diverge when audience introduce new grooves, prompting the composer or performer to apply different cross-synthesis or panning strategies. This balance of structure and emergence resonates with contemporary electronic music practices, ensuring that heritage-driven content remains central while morphing dynamically under collective input. Spat-based spatialization accentuates these spontaneous shifts, enabling each performance iteration to reveal new sonic and interpretive pathways.

6 Conclusion and Future Directions

Rings… Through Rings reconfigures historical cartographies into turntable-readable engravings, evolving intangible narratives into tactile and sonic forms. By merging analog materials, computational augmentation, and participatory frameworks, it uncovers fresh avenues for re-encountering cultural heritage. Performance feedback suggests this approach resonates with a variety of audiences, many of whom report a heightened sense of discovery and emotional investment in reimagined fortifications.

Future expansions include scaling spatial audio to hemispheric or circular speaker arrays for deeper localization and immersion. Collaborations with archaeologists could yield real-time disc fabrication, adding newly uncovered fortifications to the repertoire. Integrating AI or machine learning might further optimize spatial configurations or adjust timbral palettes based on audience engagement, advancing the performative and historical dimensions in tandem. Ultimately, *Rings… Through Rings* demonstrates how hybrid media can rejuvenate cultural heritage through collective, multisensory creation.

Ethics Statement

This project did not involve human participants or personal data collection. Audience interactions occurred in public performance settings without documentation or evaluation. The work adheres to the NIME Principles and Code of Practice by fostering inclusive, accessible, and non-invasive engagement with cultural heritage.

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