Magnetic Memory Rushnyk:

Embodied Navigation of a Deterministic Electromagnetic Field

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Figure 1: Baby Perednik, a Rushnyk worn on the body, made for Sofy Yuditskaya at the time of her birth

Abstract

This paper introduces Magnetic Memory Rushnyk, a wall-scale textile instrument that reframes the digital musical interface as a habitable sonic environment rather than a controller. Departing from discrete control paradigms often central to NIME, this work embeds magnetic material directly into the weave of a traditional East Slavic *rushnyk*, creating a continuous electromagnetic field that performers navigate rather than manipulate. Sound is extracted via a handheld induction hoop, using ecological mappings in which proximity, velocity, and orientation correspond to spectral saturation, granular density, and harmonic color. We frame the instrument as a score–instrument: a material structure that collapses the distinction between the notation of potential sound and the interface of its generation. By spatializing the harmonic series across a physical textile, the work fosters an attentive mode of performance in which musical form is discovered through embodied traversal and deep listening rather than executed through symbolic instruction.

Keywords

Textile Interfaces, E-Textiles, Spectral Music, Embodied Interaction, Score–Instrument, Feminist Design, Sonic Navigation.

1 Introduction

Recent NIME discourse increasingly interrogates the ontological status of the instrument rather than focusing solely on how an interface is fabricated or mapped. Recent reflection on NIME's material culture argues that interface design is never neutral; it always carries aesthetic, historical, and political commitments embedded in the materials and practices that produce it [1]. In parallel, critical work on timbre at NIME emphasizes that sonic outcomes emerge from entanglements among representation, interaction technique, and aesthetic intention rather than from a single controllable parameter space [24]. Beyond optimizing gestural capture or refining control strategies lies a deeper question: where does the composition reside when an instrument encodes its own constraints, biases, and behaviours? When an electronic interface ceases to function as a neutral conduit for gestural data and instead asserts an opinionated material logic, the boundary between *tool* (execution) and *work* (instruction) becomes unstable.

This paper explores that instability through *Magnetic Memory Rushnyk*, a wall-scale textile instrument that reframes the digital interface as a navigable sonic terrain. Situated within the feminist artistic research project Women's Labor, the work repurposes

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the ritual geometry of an East Slavic *rushnyk* by embedding a composed electromagnetic topology directly into its woven structure. Rather than controlling parameters in a detached synthesis engine, the performer traverses a fixed (for a certain period at least) harmonic landscape using a handheld induction hoop—an approach that displaces musical decision-making from command-style interaction toward embodied search, positioning, and route-making, evealing a harmonic terrain that is spatially fixed yet temporally shaped through traversal movement.

Our design approach aligns with the framework of the instrument's inherent score [32] and with conceptions of instruments as epistemic tools that extend cognition through material engagement [15]. In this work, the compositional logic is not expressed as notation external to the instrument, nor as mapping rules alone, but as the harmonic series distributed across a culturally specific textile pattern. The result is a score–instrument that must be learned through bodily encounter.

Contributions

- A wall-scale electromagnetic textile instrument read via mobile induction.
- A method for spatializing spectral structure (odd harmonics of a 72 Hz fundamental) into a culturally situated textile geometry.
- A mapping approach that treats induction as a constructed ecology, coupling sonic output to physically accountable gesture.
- A theoretical account of the instrument as a score–instrument that reorganizes performance as navigational, materially accountable practice, situated within feminist material discourse.

1.1 Cultural and Technical Framework: Weaving Memory

1.1.1 The rushnyk as ritual score. In East Slavic contexts, the *rushnyk* appears at first glance as a decorative embroidered textile. But it is a ritual object, crafted by womxn and used across rites of passage. Its patterns operate as semantic inscriptions: a vast dictionary of pictographic motifs with established meanings that can encode lineage, protection, and prayer through formal placement and repetition [27]. In *Magnetic Memory Rushnyk*, this patterning is re-created using the materials and techniques of modernity. The surface ornamentation is an organizing logic for the musical encounter. The textile becomes a structured site whose legibility is produced through performance—by learning how specific regions behave sonically and how transitions between them articulate form.

1.1.2 Magnetic memory as woven logic. Magnetic core memory—dominant in early computing for roughly two decades—was literally fabricated as woven grids of wires threaded through ferrite cores, producing addressable storage through physical structure. Rosner et al. foreground the gendered legacies of this labour and its obscured status within engineering histories [22]. *Magnetic Memory Rushnyk* re-materializes this lineage by positioning woven structure as a site of logic, not as a metaphor for digital storage but as a precedent for spatialized addressability. The instrument's "memory" is not symbolic data; it is a fixed distribution of magnetic potential that becomes legible only through the performer's traversal.

This framework also aligns with broader feminist and critical accounts of electronics manufacturing and labour (including racialized and gendered divisions of technical work) [19], which are conceptually consonant with Women's Labor as an artistic research context.

2 Related Work

2.1 Composed instruments, inherent scores, and epistemic DMIs

The notion that an instrument may contain compositional instruction has precedents in experimental electronic music and early interactive systems. NIME formalized this under the concept of the composed instrument [26], and Tomás later reframes this lineage through the instrument's inherent score as a way to relocate compositional authorship into material and behavioural constraints [32]. *Magnetic Memory Rushnyk* extends these ideas by treating spatial organization—not only mapping functions—as compositional writing.

Magnusson's argument that instruments can function as cognitive extensions is particularly relevant here: the performer's knowledge is shaped by what the interface makes available to perception and action [15]. In this sense, the Rushnyk is designed less as a transparent controller and more as an epistemic terrain for learning harmonic structure through movement.

2.2 Textile interfaces and material culture in NIME

Textile and wearable NIME-likes have a long trajectory in interactive music, from embroidered sensor strategies [4] to performative score-like wearables [30]. NIME 2025 further foregrounds textiles as sites where material culture and interface politics become explicit. Lyu and Ikeshiro frame an e-textile interface between garment and prosthesis, emphasizing bodily adjacency and continuous wearability [12]. Ma and Martin foreground tactility and quilting as a material basis for human–AI co-creative practice [13]. Burgess and Gifford repurpose a carpet tufting gun as an electroacoustic performance interface, connecting textile production practices to sonic expression [2]. Needham's account of the *Electronic_Khipu_* similarly situates textile practice within histories of hacking and inscription [20].

Magnetic Memory Rushnyk enters this discourse from a distinct angle: rather than integrating into the body as wearable textile, it constructs a fixed site that performers must approach, inhabit, and traverse—an architectural scale that makes bodily routing central to musical articulation.

2.3 Choreographic fields and navigational performance

Forsythe's choreographic objects propose artifacts that organize movement by instigating constraints rather than by prescribing steps [16]. This framework aligns with field-based instruments that are "read" through navigation. Kubisch's *Electrical Walks* provide a key conceptual precedent in locating sonic experience within electromagnetic environments [11], though *Magnetic Memory Rushnyk* differs by presenting an intentionally composed field rather than contingent urban interference.

Ingold's accounts of making and movement provide an additional lens: knowledge emerges through the ongoing labour of correspondence with materials and environments [9], and through paths rather than points. This supports the paper's emphasis on traversal as a form of musical knowing.

2.4 Spectral spatiality and timbral geography

The Rushnyk's harmonic layout draws on spectral thinking in which timbre and harmony are structurally coupled [6, 18, 31]. The Rushnyk's design extends this tradition by relocating spectral relations into space—rendering harmonic ratios as traversable positions rather than exclusively temporal processes. Work on timbre perception and musical structure further motivates this approach [17].

This spectral design expands on the sound design in Rheostat Rotary Rack [7], the second instrument of Womxn's Labor, that is based on the Risset arpeggio. In Rheostat Rotary Rack, the sound design is easily programmable; in recent compositions such as *Housework Commons,* the 8 strings are mapped to a spectral chord based on C2 and F5. As the Rack is spun faster and faster, frequencies that are incrementally different to the base pitches are added, creating multi-rhythmic beats. While the Rack's spectral design and beats are based on which string is plucked and how fast it is spun, the Rushnyk's spectral sound is activated through malleable spatiality and tactility.

Broadly speaking, the Rushnyk's spectral sound through spatial design approach aligns with James Tenney's understanding of the harmonic series as a way of hearing in which timbre and harmony become inseparable. In this instrument, performers do not learn the harmonic system by reading tables or diagrams. They learn it kinesthetically by discovering how sound changes as they move the hoop across the surface. This connects with Oliveros's idea that listening is a form of attention that transforms perception itself.

Instead of stacking harmonics vertically, the rushnyk renders them horizontally as terrain. Musical knowledge becomes spatial, relational, and embodied rather than symbolic or theoretical.

3 System Design

Magnetic Memory Rushnyk is a wall-scale textile instrument (approx. .3 m × 1 m per unit, 3 units total) that operates as a spatial memory system read by a mobile playhead. The design couples ritual weaving logics with magnetic storage principles. In this iteration it is a static system but its hardware design in no way limits it to be static. This is a hardware instrument that can none-the-less have firmware updates.

3.1 Material Embeddedness and Node Topology

The textile is hand-woven using textile fibers alongside conductive and ferrous materials. Fourty-four magnetic nodes—constructed through embedded ferrous magnets and ferrous thread structures—are arranged into a Tree of Life topology derived from *rushnyk* patterning [27]. While the nodes are discrete, their influence is experienced as a continuous volumetric field: performers encounter gradients, edges, and overlaps rather than isolated "buttons."

3.2 Wall-sized textile installation

Conceived as a wall-sized textile installation, *Magnetic Memory Rushnyk* extends the project's exploration of textile scores by making memory itself the primary site of inscription and interpretation. Oversized magnetic elements are woven into a long textile field, deliberately scaling encoding structures so that patterns normally hidden at electronic or microscopic levels become perceptible to the body. Memory is rendered as structure: something that can be seen, traced, and sonically encountered.

3.3 Material Construction

The textile incorporates bands of ferrous strands woven directly into the natural fiber structure. These bands pass through magnetic rings via the warp and weft of the fabric, creating a memory matrix to be activated with live current pushed from the Arduino into the bands. This construction mimics the logic of magnetic core memory grids but scales them to the human hand and overlaps three grid units to intersect with the embroidery nodes of a traditional Tree of Life motif. By coincidence (or is it?) the base core memory unit grid and the base grid of the Tree of Life motif overlap perfectly.

By weaving these materials, the memory is physically locked into the textile matrix. The "bit" is both a voltage state and a physical presence. The visual pattern of the weave correlates to the magnetic data contained within it, allowing the performer to visually anticipate the sonic density of different regions before they are played.

3.4 Technical Construction

The matrix of *Magnetic Memory Rushnyk* uses basic multiplexing to control the 25 inputs from one Arduino Uno. We default to the Arduino Uno as its larger form factor is easier to work with. Given further development, a more textile-friendly Arduino board may be adapted. Currently the large inputs and higher 5 V voltage are appreciated for prototyping.

We then further extend this multiplexing by reading the output of individual magnets with our hoops. For example , when row 7v and 4h are activated Fig. 1, the magnet in position 10 will have a higher electromagnetic output than any others in its constituent rows. In this fashion we can highlight individual magnets while also incorporating a kind of spectral falloff inherent to the weaving of the *MMR*'s matrix.

The bottom cluster (16h-18h) representing the root of the Tree of Life serves to control the timbre of the overall output. It is played with its own hoop. Unlike the rest of the *rushnyk*, which is an electromagnetic instrument, this cluster's output is used as control voltage to shift the register of the other nodes via a guitar pedal.

The code driving MMR can be found here: https://github.com/timeFliesWhenYoureHavingFun/rushnyk. It is based on an excellent multiplexing tutorial by Yves Pelletier: https://electroniqueamateur.blogspot.com/2019/06/controler-plusieurs-leds-avec-arduino.html.

3.5 Induction Hoop as Mobile Read Head

Sound capture is performed with a handheld induction hoop. As the hoop moves through changing magnetic flux, a voltage is induced in the coil in accordance with Faraday's law, $V = -N\frac{d\Phi}{dt}$. This makes the system static at rest and musically legible only through movement. The hoop functions analogously to a read head: it addresses the textile's stored spatial information through embodied positioning, producing a signal that is then mapped into synthesis parameters.

The design of the hoop is of an archimedian spiral of 0.3mm copper wire hand couched onto an embroidery hoop. It is extensively described in our 2025 paper Women's Labor: Weaving it all Together [29] Underneath the hoop is a neodymium magnet with a hole allowing the hoop to become electromagnetic. The design of the hoop is based on the Sonoflex Speaker [21] and was made in consultation with Jess Rowland [23]

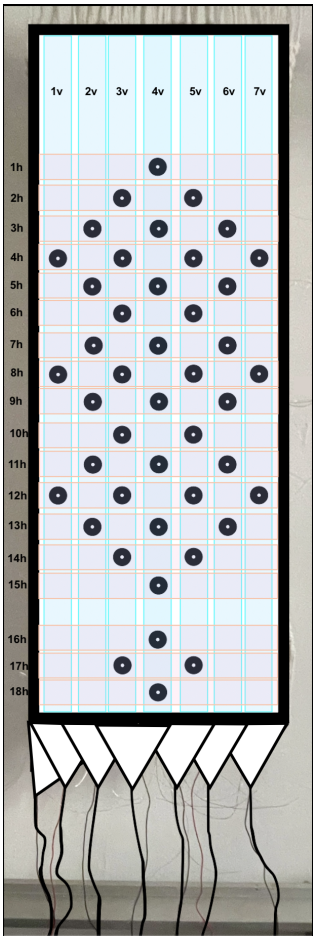

Figure 2: Row mappings start at 1 at the top of the Rushnyk and end at 18 on the bottom, as *rushnyky* themselves are depictions where the top is up and the bottom is down (ground). The columns are numbered from left to right.

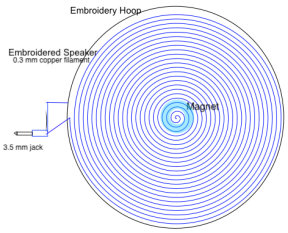

Figure 3: Hardware Map of Embroidery Hoop

3.6 Interaction Constraints as Compositional Conditions

The wall-scale layout distributes musical relations across a distance that cannot be reduced to fingerwork; phrase construction becomes inseparable from reach, stance, and locomotion. These conditions shift performance toward navigational literacy and away from frictionless parameter manipulation.

4 Sonic Architecture and Mapping

The instrument's behavior is shaped by two interlocking logics: a compositional topology (where harmonic materials are placed) and an ecological interaction logic (how energy and proximity shape response) [5]. Together these form a constructed ecology: a curated map traversed under physical law.

4.1 Compositional Topography: The Tree as Harmonic Map

The 44 individual magnets are controlled by 25 nodes via multiplexing. They reside within four clusters that have four octave registers each. Due to the clusters being arranged in a Tree of Life motif, there are areas of overlap where up to 11 octave jumps are possible. These are areas of relative chaos to be explored live. This system is a multiplexing of the controlling chip's already multiplexed output.

The 44 magnets are assigned spectral materials drawn from the odd harmonics of a 72 Hz fundamental. Harmonics are folded into a constrained band and distributed across the Tree of Life pattern, producing regions that function as harmonic zones (e.g., areas of relative stability versus areas designed for friction or saturation). In practice, this makes the *rushnyk* pattern a navigable harmonic diagram: performers learn where certain spectral behaviors reside and how routes between them shape form.

4.2 Ecological Mapping: Proximity, Velocity, Orientation

Mapping is designed so that key sonic changes correspond to physically meaningful actions:

Proximity → intensity and brightness. Approaching nodes increases induced flux magnitude and is mapped to amplitude and spectral centroid (or an analogous brightness measure).

Velocity → granularity and density. Faster motion increases $\left|\frac{d\Phi}{dt}\right|$ and is mapped to granular density and/or noise components; slower motion supports clearer harmonic reading.

Orientation → harmonic colour. Rotating the hoop relative to the magnetic vector changes coupling and is mapped to harmonic emphasis (e.g., spectral tilt, partial selection, or formant-like filtering), allowing nuanced timbral articulation without introducing additional control hardware.

These mappings create an interpretive condition: the same "place" can be rendered with different timbral character depending on how the performer approaches and angles the hoop, while rapid traversal can intentionally blur pitch identity into texture.

Odd-harmonic folding table. Table 1 summarizes the first 44 odd harmonics of a 72 Hz fundamental and the octave-folding used to place them into a constrained register band.

Node Mapping Table. Table 2 shows simultaneous, combined mappings as follows:

(1) A mapping that ignores octave-folding entirely and maps the raw Hz values directly onto the fixed 44 nodes by first mapping to 44 keys by nearest equal-tempered pitch.
(2) A mapping that keeps the true harmonic spacing but lets the hypothetical keyboard choose the octave: taking each raw Hz, shifting it by octaves (÷2 or ×2) until it falls inside the hypothetical keyboard range, then picking the nearest node and then transposing it to 44 nodes.

Table 1: Odd harmonics h of a fundamental $f_0 = 72$ Hz, with octave folding. Raw frequency is $f = hf_0$ and folded frequency is $f' = f/2^n$, where n is the number of octaves shifted down.

Node	h	f (Hz)	n	f' (Hz)
1	1	72.00	0	72.00
2	3	216.00	1	108.00
3	5	360.00	2	90.00
4	7	504.00	2	126.00
5	9	648.00	3	81.00
6	11	792.00	3	99.00
7	13	936.00	3	117.00
8	15	1080.00	3	135.00
9	17	1224.00	3	153.00
10	19	1368.00	3	171.00
11	21	1512.00	3	189.00
12	23	1656.00	3	207.00
13	25	1800.00	3	225.00
14	27	1944.00	3	243.00
15	29	2088.00	3	261.00
16	31	2232.00	3	279.00
17	33	2376.00	3	297.00
18	35	2520.00	3	315.00
19	37	2664.00	3	333.00
20	39	2808.00	3	351.00
21	41	2952.00	3	369.00
22	43	3096.00	3	387.00
23	45	3240.00	3	405.00
24	47	3384.00	3	423.00
25	49	3528.00	3	441.00
26	51	3672.00	3	459.00
27	53	3816.00	3	477.00
28	55	3960.00	3	495.00
29	57	4104.00	3	513.00
30	59	4248.00	3	531.00
31	61	4392.00	3	549.00
32	63	4536.00	3	567.00
33	65	4680.00	3	585.00
34	67	4824.00	3	603.00
35	69	4968.00	3	621.00
36	71	5112.00	3	639.00
37	73	5256.00	3	657.00
38	75	5400.00	3	675.00
39	77	5544.00	3	693.00
40	79	5688.00	3	711.00
41	81	5832.00	3	729.00
42	83	5976.00	3	747.00
43	85	6120.00	3	765.00
44	87	6264.00	3	783.00

(3) A pitch mapping from the adjusted harmonic frequencies to the nearest note in the 44-key hypothetical keyboard, then transposing it to 44 nodes.
(4) A mapping by harmonic number itself, not by frequency: treating the 44 hypothetical keys as a circular 44-step index space and dropping each odd harmonic onto it mathematically, then transposing to 44 nodes.

Wiring repetition and iconography. In our construction of *Magnetic Memory Rushnyk* we followed the wiring diagram from Figure 4 and repeated it three times, creating a standard Tree of Life motif *rushnyk* without the embroidered symbology but preserving the woven nodes and structure of the motif through magnet placement [27]. The colors of wire and magnet chosen are black, white, and red, referencing the figures of Makosh, Dolya and Nedolya, traditional goddesses of weaving, fortune and misfortune, and destiny in Slavic folklore [14]. Figures 5, 6, and 7 show our wiring diagram in layers for clarity.

Nodes are activated by sending current through various combinations of lines on the matrix, allowing us to activate individual magnets through multiplexing of nodes, and nodes directly from the Arduino.

The arduino sends a 5 volt control voltage directly into the wires passing through the magnets. One version of the rushnyk has inline leds for visual feedback which create an added high pitched layer of tone in the system.

Table 2: The mapping of the resulting harmonics to nodes and octave registers on the Rushnyk itself

harmonic	odd	htz raw	adj htz	oct	key nodes	octave nodes
1	1	2	2	0	1,22 / 2,21 / 2,21	0
2	3	17	9	0	2,21 / 7,20 / 4,23	0
3	5	26	6	0	2,23 / 10,21 / 3,24	0
4	7	32	12	0	3,20 / 12,21 / 5,22	0
5	9	37	4	0	3,22 / 12,24 / 3,20	0
6	11	28	7	0	3,24 / 11,22 / 4,19	0
7	13	31	10	0	4,19 / 12,19 / 4,25	0
8	15	34	13	1	4,21 / 12,25 / 5,24	26–29
9	17	36	15	1	4,23 / 12,22 / 6,23	26–29
10	19	38	17	1	4,25 / 14,21 / 7,20	26–29
11	21	40	18	1	5,20 / 15,22 / 7,24	26–29
12	23	29	20	1	5,22 / 11,20 / 8,21	26–29
13	25	30	21	1	5,24 / 11,24 / 8,23	26–29
14	27	31	22	2	6,21 / 12,19 / 8,25	30–33
15	29	33	24	2	6,23 / 12,23 / 9,22	30–33
16	31	34	25	2	7,22 / 12,25 / 9,24	30–33
17	33	35	27	2	7,20 / 13,20 / 10,23	30–33
18	35	36	28	2	7,24 / 12,22 / 11,22	30–33
19	37	37	29	2	8,19 / 12,24 / 11,20	30–33
20	39	38	30	2	8,21 / 14,21 / 11,24	30–33
21	41	39	31	2	8,23 / 14,23 / 12,19	30–33
22	43	41	32	2	8,25 / 16,22 / 12,21	30–33
23	45	29	33	3	9,20 / 11,20 / 12,23	26–33
24	47	29	34	3	9,22 / 11,20 / 12,25	26–33
25	49	30	35	3	9,24 / 11,24 / 13,20	26–33
26	51	30	36	3	10,21 / 11,24 / 12,22	26–33
27	53	31	37	3	10,23 / 12,19 / 12,24	26–33
28	55	32	38	3	11,22 / 12,21 / 14,21	26–33
29	57	33	39	3	11,20 / 12,23 / 14,23	26–33
30	59	34	40	3	11,24 / 12,25 / 15,22	26–33
31	61	34	41	3	12,19 / 12,25 / 16,22	26–33
32	63	35	42	3	12,21 / 13,20 / 17,21	26–33
33	65	35	43	3	12,23 / 13,20 / 17,23	26–33
34	67	36	44	3	12,25 / 12,22 / 18,22	26–33
35	69	36	44	3	13,20 / 12,22 / 18,22	26–33
36	71	37	44	3	12,22 / 12,24 / 18,22	26–33
37	73	37	44	3	12,24 / 12,24 / 18,22	26–33
38	75	38	44	3	14,21 / 14,21 / 18,22	26–33
39	77	38	44	3	14,23 / 14,21 / 18,22	26–33
40	79	39	44	3	15,22 / 14,23 / 18,22	26–33
41	81	39	44	3	16,22 / 14,23 / 18,22	26–33
42	83	40	44	3	17,21 / 15,22 / 18,22	26–33
43	85	40	44	3	17,23 / 15,22 / 18,22	26–33
44	87	41	44	3	18,22 / 16,22 / 18,22	26–33

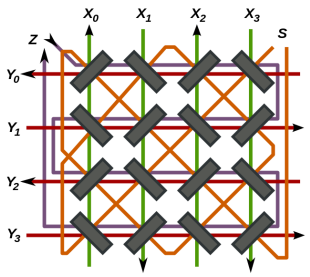

Figure 4: An example of Core Memory Wiring by User Tetromino on Wikipedia (CC BY 3.0) Diagram of a 4×4 plane of magnetic core memory in an X/Y line coincident-current setup. X and Y are drive lines, S is sense, Z is inhibit. Arrows indicate the direction of current for writing. based on [3]

By virtue of the layout of the Tree of Life motif we have four main clusters, through which current can flow via two different polarities, and 44 individual points that become distinguished when current flows in both vertical and horizontal directions through one point. The four clusters have an overall left and right directional activation that can push them into four additional registers, including up to 11 additional registers in the

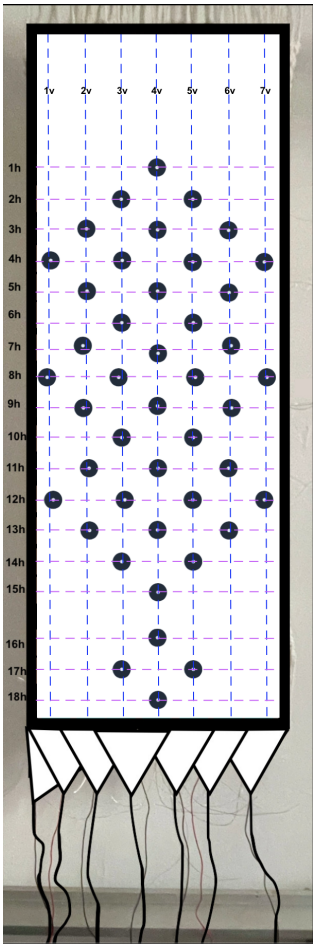

Figure 5: Horizontal and Vertical Wiring Diagram

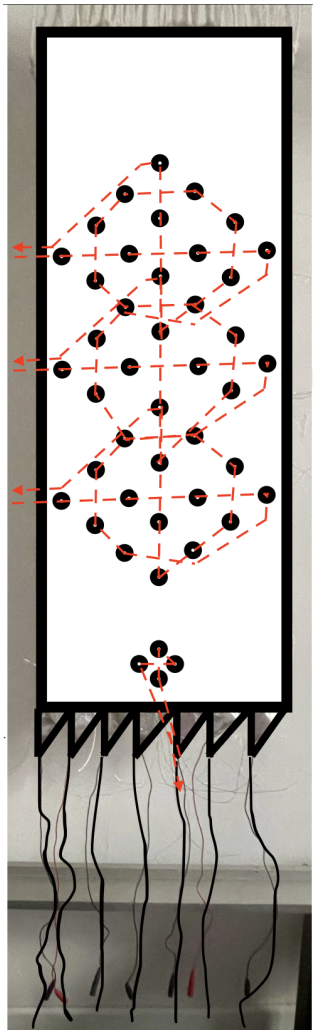

Figure 6: Left Diagonal Wiring Diagram

overlapping zones, assuming we can hear a difference in the current flow direction. This is the structural and visual map of the woven score as instrument as observed by Enrique Tomás [32].

5 Performance Ecologies and Material Agency

The Rushnyk makes a claim about where composition resides: not only in software, but in material arrangement, embodied technique, and the politics of fabrication. The following reflections connect its design to emerging NIME 2025 discourses on material culture, timbre entanglement, and embodied evaluation.

5.1 Situated Authorship: Composing Through Fabrication

Because harmonic organization is installed as a spatial topology, compositional work occurs upstream of mapping, in the design of the textile field itself. This shifts authorship toward fabrication practices: the act of choosing pattern geometry, node placement, and harmonic distribution becomes inseparable from composing musical possibility. Allen et al.'s argument that NIME must grapple with material culture as political and aesthetic infrastructure is directly relevant here [1]. The Rushnyk does not treat textile as interchangeable substrate; it treats a culturally specific textile form as a way to structure musical encounter.

5.2 Learning as Route Knowledge (Embodied Evaluation)

Performance on the Rushnyk is learned as route knowledge rather than as discrete technique: players develop strategies for sustaining tone (micro-oscillation), transitioning between zones (graded speed/angle changes), and interpreting edges (where fields overlap). This makes the instrument a useful case for NIME 2025 work attempting to operationalize embodied experience. Ingebritsen et al. propose metrics for kinesthetic empathy in interactive music performance [8]; the Rushnyk's large gestures and visible negotiation of constraint invite precisely such analysis, since the audience can often infer effort, tension, and intent through bodily traversal.

5.3 Textile Interfaces Beyond Wearable Proximity

NIME 2025 textile work has explored intimacy and bodily extension through garments and prosthesis-like devices [12] and through quilted tactility in co-creative systems [13]. The Rushnyk contributes a different topology of intimacy: instead of attaching the interface to the body, it requires the body to repeatedly approach a fixed site, producing a performative relation that is

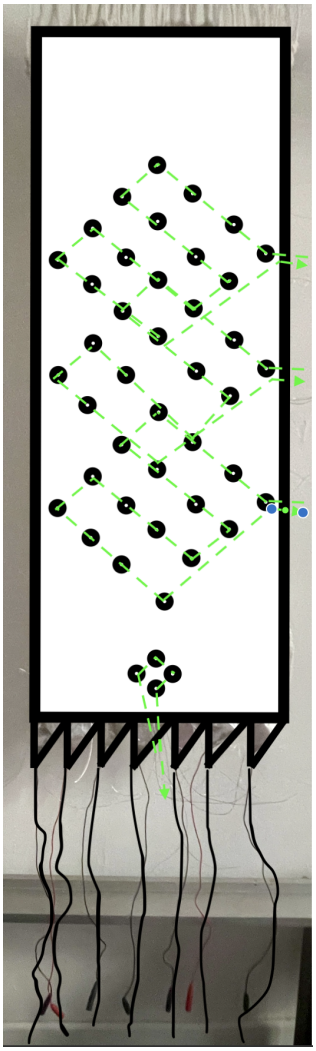

Figure 7: Right Diagonal Wiring Diagram

closer to visiting, dwelling, and returning than to wearing. This distinction matters for how care, labor, and ritual are staged: the instrument can be shared, approached from multiple positions, and interpreted as an environment rather than as personal equipment.

5.4 Electromagnetic Accountability and Timbre Entanglement

Work on electromagnetic actuation and feedback at NIME 2025 highlights how electromechanical specificity produces musical behavior that cannot be fully abstracted into symbolic control [25]. Although the Rushnyk is read through induction rather than actuated through Lorentz force, it similarly insists on electromagnetic accountability: sonic outcomes remain coupled to flux, motion, and orientation. This provides a concrete instantiation of NIME 2025 arguments that timbre is not a secondary parameter but a negotiated domain shaped by design decisions, representations, and performance technique [24, 28]. In the Rushnyk, timbre is inseparable from spatial practice: players construct sound color through trajectories and angles, not only through selecting presets.

5.5 Feminist Material Lineage: Woven Memory as Computation

By explicitly aligning *rushnyk* weaving with the history of core memory fabrication, the instrument locates musical interaction within a gendered legacy of technical labor [22]. Nakamura's account of racialized electronic manufacture further cautions against romanticizing material histories while ignoring the conditions under which "immaterial" computation was physically produced [19]. Read through NIME 2025's material culture discourse [1], this suggests a responsibility for interface research to foreground not only the novelty of materials, but also the labor systems and cultural narratives that those materials invoke.

In the context of Womxn's Labor, prioritising navigational and site-based interaction over parameter control is not only an aesthetic decision but a political one. It resists interface paradigms that privilege speed, optimisation, and fine-grained command, and instead values attentiveness, repetition, care, and situated learning—modes of engagement historically associated with feminised forms of labour and expertise.

5.6 Limitations and Future Directions

MMR's constraint-driven legibility also produces limitations: high-speed gestures can intentionally obscure harmonic structure, and the instrument requires time to learn spatial routes. Future work will explore:

(1) methods for documenting performable routes as reusable repertoires (without reducing the system to symbolic notation),
(2) multi-performer reading strategies (shared traversal and negotiated zones), and
(3) dynamic field reconfiguration through electromagnets to investigate what it means for a score–instrument's topology to be rewritten in performance.
(4) power management to enhance clarity of signal

5.7 Performance Ecology within Women's Labor

Magnetic Memory Rushnyk expands the instrument suite of Womxn's labor, which also includes *Embedded Iron* [10], *Rheostat Rotary Rack* [7], and *EM Embroidery Hoop* [29]. With their repurposing of objects that carry strong and culturally embedded identities, the instruments are used in new theatrically oriented compositions that foreground women's labor, including domestic work and craft, both historically and in the present. *Magnetic Memory Rushnyk* itself is exemplary of a continued, and later industrialized, tradition of women's domestic craft that is imbued with agency and ritual—one that has survived the religious oppressions of the Orthodox Patriarchy and the Soviet Communist Regime.

Magnetic Memory Rushnyk complements the existing instruments spatially, gesturally, and conceptually. Whereas the *Embedded Iron* and the *Rheostat Rotary Rack* are spatially fixed and require performers to orient their bodies toward spotlighted sites of action on stage, the hoop-based instruments and the *MMR* demand continuous bodily navigation through space. Together, these instruments invite fundamentally different modes of engagement, cultivating a diversity of performative gestures, postures, and movement strategies to create rich compositional possibilities.

While the *Embedded Iron* and the *Rheostat Rotary Rack* are performed with textile-based scores that guide interaction, *Magnetic*

Memory Rushnyk combines the score and textile to bring out a different performative logic in which the score and instrument are materially inseparable. Listening is foregrounded through the electromagnetic hoop pickups as performers attend to proximity, movement, and material response, and sound is discovered through embodied and spatial exploration rather than through the interpretation of external notation.

Taken together, these approaches support future compositions that draw on multiple modes of performance, in which gesture, sound, and visuality emerge through distinct but complementary forms of interaction.

6 Conclusion

Magnetic Memory Rushnyk presents a wall-scale textile instrument that stores spectral structure as spatial topology and renders it audible through embodied electromagnetic traversal. By treating the instrument as a score–instrument, the work collapses conventional divisions between composition, interface design, and performance technique. Situated within feminist material inquiry, it also makes explicit the cultural and labor histories embedded in both ritual weaving and early computing memory. More broadly, the project argues for NIME instruments that do not merely sense gesture, but actively structure how musical knowledge is learned—through place, constraint, and attentive listening.

7 Ethical Standards

This project did not involve formal experiments with human participants (e.g., surveys, interviews, or controlled user studies), nor did it collect or store personally identifiable data. Any audio, photo, or video documentation of performances used for dissemination was captured with the informed consent of the documented performers.

The instrument is powered by low-voltage electronics and is operated using standard electrical safety practices; conductive elements and magnetic components are mechanically secured, and the installation is configured to support safe performer movement. As with any electromagnetic apparatus, appropriate precautions should be taken for participants with implanted medical devices.

The work engages with culturally specific Ukrainian and East Slavic *rushnyk* traditions and with histories of gendered technical labor in early computing. We present the instrument as an artistic and research-based reinterpretation rather than an authoritative account of these traditions, and we aim to contextualize this lineage through credited sources and careful framing in performance and publication. The authors declare no competing interests and no external funding for this work.

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