Making the Immaterial Material: A Diffractive Approach Toward a Politics of Material Culture Within NIME

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Abstract

Traditional Human-Computer Interaction has often been critiqued for its ostensibly opaque position on ethical, ontological, and epistemological concerns, particularly in relation to completed design artifacts. More recently, similar criticisms have been directed at the New Interfaces for Musical Expression (NIME) community for its relative silence on contemporary political issues. However, it is possible that an implicit ethics of material culture is already embedded within NIME discourse — one that could be critically examined and potentially mobilized as a foundation for a more explicitly political ethics. Inspired by feminist discourse, namely Karen Barad's theory of agential realism, and contextualized through Bruno Latour's remarks regarding the ethics of design, this paper explores the possibilities of entanglement in DMI design. We begin with a discussion of diffraction and entanglement followed by a brief overview of values-oriented and "world-building" theoretical models and methodologies of design research. We continue with our generative "DMI-as-apparatus" approach to diffractive methodology and conclude with a case study BRAIDS_, a digital music instrument based upon the Black American cultural practice of hair braiding, that examines critical design decisions that are otherwise deemed invisible by traditional methods of scientific inquiry.

CCS Concepts

• **Human-centered computing → HCI theory, concepts and models**.

Keywords

Entanglement, Diffraction, Assemblification, Feminist technoscience, Hair braiding, Heritage algorithms

1 Introduction

In recent NIME literature, many scholars have noted NIME's silence as it relates to matters of politics [8, 30, 44]. Some have even gone so far as to chastise NIME for its indeterminate moral alignment. However, "as technical systems of various kinds are deeply interwoven in the conditions of modern politics" [49], it would seem logical that the NIME community's design artifacts are intrinsically political.

Langdon Winner in *Do Artifacts Have Politics?* expresses two possibilities for the nature of politically-imbued artifacts: socio-cultural and inherent; where socio-culturally political artifacts inherit their politics from the "invention, design, or arrangement" norms within a particular community, inherently political artifacts require human actors to arrange themselves in ways that align with specific political systems [49]. For the purposes of this paper, we will focus on Winner's first possibility: the community-driven politics of digital musical instruments (DMIs).

Through an attentive eye toward the complex nature of Bruno Latour's concept of "things," we propose a reframing of new musical instruments as things, such that we can lay the groundwork for more diverse forms of knowledge meaning and making. In order to do so, we explore the design decisions that were encountered, cemented, and rejected through the creation of a new interface for musical expression, BRAIDS_.

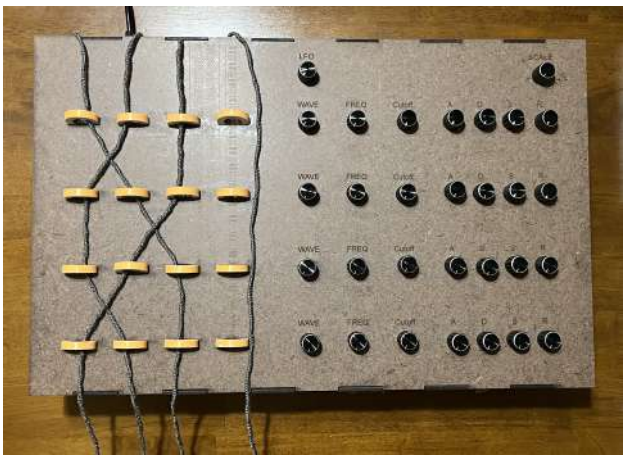

Figure 1: An early BRAIDS_ prototype. Pictured are strands of conductive thread woven into capacitive sensing cores on the left and potentiometers that modify common synthesizer parameters (e.g. pitch control, filter cutoff, etc.) on the right. Later versions remove the potentiometers in favor of a TouchOSC interface.

BRAIDS_ (Figure 1) is a tangible, culturally situated NIME based upon the Black American hair braiding tradition whereby user-placed strands form braided structures that dictate a musical sequence. The many components of BRAIDS_ - capacitive sensing cores, Arduino microcontroller, digital representation,

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TouchOSC interface, and Pure Data synthesizer and sequencer[1] - define a performance practice rooted in cultural diversity and exploration. Within this paper, it serves as our vehicle for exploring the inherent politics within the NIME community [20, 26, 39].

1.1 Entanglement in HCI

Much has been written about entanglement in HCI [13, 31, 33] in recent years. More specifically, much attention has been drawn to a component of Karen Barad's theory of agential realism, diffraction (Section 3). Within the literature, two core components of diffraction are discussed: the troubling of binaries and differencing. Although both are tremendously important, and considering the many references within the literature that call for "attending to difference" [34, 42] that have been made - many of which warn against the dangers of reification [31] - there remains considerable debate regarding what methodologies could meaningfully harness the power of difference.

Critical of postmodernism, bell hooks notes: "... the focus on 'otherness and difference' that is often alluded to in these works seems to have little concrete impact as an analysis or standpoint that might change the nature and direction of postmodern theory" [21]. Although the proposed method described in this paper is provisional and most certainly won't change the direction of postmodern theory writ large, it aims to utilize difference as a powerful tool to help reveal the political nature of DMIs within the NIME community. In the following sections we frame the ethical, epistemological, and ontological considerations that were explored throughout the design process. We then briefly discuss the existing ethics within NIME discourse and introduce our DMI-as-meaning-making-tool approach to diffraction in support of a politics of material culture - i.e. the tangible design artifact (DMI) and its inherent embodiment of designer values (Section 4) - within NIME.

2 Key Terms

The following terms are dispersed throughout the text: :

- *Thing*[2]: tangible manifestation of design decisions impacted by the designer's lived experience (ways of being and knowing as a result of interacting with/within various phenomena) and the state of becoming of the components of the thing itself [23].
- *Object*: an inanimate, determinate entity that is purported to exist within the world free from the constraints of relationality and entanglement.
- *Assemblification*: a transition of thought from things as objects toward a more holistic view of the complexities of the thing's becoming as well as the role of designers within the process [23].

3 Diffraction

Based upon an optical phenomenon whereby light waves emanating from a single source reinforce and cancel one another as they traverse obstacles, diffraction is an integral element of Karen Barad's agential realist framework. Agential realist ideology presumes the entangled nature of our reality's current state of becoming, rejects metaphysical assumptions about the inherent properties of entities, objects, or matter, and presupposes multiple *legitimate* ways of knowing, being, and becoming via separate phenomenologically local "intra-actions[3]" [2].

Barad defines diffraction/intra-action as [3]:

> Cutting together-apart (one move) in the (re)configuring of spacetimemattering; differencing/differing/differancing.

At its simplest, diffraction can be distilled into the following: choice, intentionality, and accountability. Critically, the researcher's use and modification of a particular apparatus makes determinate specific properties deemed useful or important to the researcher and, consequently, renders other properties invisible. In other words, before meaning can occur via measurement, we have an ethical obligation to consider the realities of which we not only aim to make visible, but that we, intend to foreclose.

As DMI designers, the diffraction patterns we're interested in occur not when light waves amplify or cancel one another, but when design decisions imparted by human actors reinforce or reject ways of knowing and being. The entangled nature of the apparatus(DMI)-designer-performer-context relation begets an understanding of each component's "role in a temporally sustained design process" such that particular intra-actions of note can be "investigated within the larger mess of the world" [41]. We believe that "diffraction is a metaphor for inquiry focused on attending to difference, interferences that can be understood as the specific material entanglements which we are part of, our intersecting identities, and the multiple and often conflicting discursive and material practices that constitute our everyday lives" [42].

We propose a method of re-turning matter via the reading of design decisions imparted by the first author through the NIME community's existing DMI-research paper paradigm in order to explore how matter comes to matter and why we, as a design community, should care.

3.1 From Objectification to Assemblification

According to Latour, the inherent value judgment that all design must inevitably reckon with (is it good or bad design?) not only refers to the design of the thing, rather, it trickles down to the very fabric of the thing itself (whose blood was shed in order to bring the thing to fruition?).

Working with the assumption that we live in an entangled reality inhabited by both human and non-human actors and that objects (as independent, non-relational entities) don't exist, it should be of no contest that designers will no longer "be allowed to hide behind the old protection of matters of fact" - for the notion that things can be designed well or badly weaken such matters of fact and strengthen the many matters of concern associated with the thing's becoming [23]. Put more plainly, the assemblification of objects (and the moral implications of such) has, quite aggressively, stripped us of our (re: design researchers) naivety. With the knowledge of our impact on the world, we'd argue that we ought to be careful with the design decisions we make considering the implications may be far greater than we understand or anticipate.

[1]For more information on the technical aspects of the instrument, please visit the companion website: https://brittneyjuliet.github.io/material-culture/

[2]Both Barad and Latour write extensively about "things" and have opposing views; Barad regards things as non-relational objects while Latour references the etymological origin of the term that situates things not as inanimate objects, but as meetings or assemblies. Within this writing, our understanding of things stems from Latourian ideology.

[3]Intra-actions suggest interactions that are phenomena-specific (i.e. that occur *within* phenomena).

4 On Material Culture

The simplest reduction of material culture can be defined as "the tangible yield of human conduct" [15]. Folklorist and ethnomusicologist Henry Glassie understood material culture as the vessel through which humanity could be understood. Glassie viewed works of art as the pinnacle of material culture: "things are works of art when the act is committed, devoted, when people transfer themselves so completely into their works that they stand as accomplishments of human possibility" [15]. But, perhaps, there's a bit more to it (from a designer's perspective). It may be enough for researchers of culture to view cultural materiality as a looking glass of sorts, but what about its purveyors? With our understanding of the entangled nature of things and our obligation as designers to lovingly consider the then-there-now in our decision-making processes, we'd argue that material culture isn't merely a reflection of humanity's accomplishments and possibility, but a physical manifestation of human values. To put it another way, material culture, in addition to being a tangible representation of humanity's ingenuity, is the intra-acting of human (designer) will with other phenomenologically-linked components such that the designer's value judgments regarding *legitimate* ways of becoming are made manifest.

4.1 NIME's Material Culture

In the spirit of the belief of multiple worlds (and truths) being able to coexist [9], the first author noticed a lack of representation of the African diaspora within NIME's material culture(s) and sought to build an instrument that bore witness to alternate materialities within NIME. However, through the exploration of African diasporic identity within NIME, the existence of many, although small (for now), material sub-cultures within NIME repertoire became hard to ignore. A few of the more dominant sub-cultures include the Latinx community [4, 7, 24, 26, 44], a small but mighty feminist presence [14, 39, 43], and a substantial amount of literature regarding accessibility [25, 27–29, 37, 38, 50].

Before we continue, we'd like to explicate our interpretation of NIME's existent material culture to discuss a couple phenomenologically-linked components that contribute to the assemblification of DMIs. As many papers have discussed the role of general human and non-human agency as it relates to DMI creation [32, 41, 51], we'll turn our attention to arguably the two most intrinsic components of new musical instrument research: the musical instrument and the research paper. There's a wide range of thought regarding the epistemological considerations DMI-focused research should prioritize [16, 20], however we view that discrepancy as fertile ground for the interpretation of NIME's material culture. In the same way that an improvising musician may seek out many sources of information when learning a new record (multiple recordings of the same tune, fakebook transcriptions, artist biographies and interviews, etc.), we take the same approach as it relates to material culture; the research paper serves as insight into the mind of the DMI designer. The DMI itself, the tangible assemblage of temporally-situated design decisions, contains in its memory the various states of being it experienced throughout the design process and it is only through the pairing of the design artifact and designer-generated research material that we may uncover truth.

A survey of already-existent-within-NIME material cultures is beyond the scope of this writing, but a quick perusal of the literature makes evident the vast array of "problems" these communities aim to explore as well as their preferred problem-solving methodologies. We'd like to amplify a few of the ethical and moral considerations and stances many of the various material cultures embody:

- The rejection of gender-normative ideology [39].
- The re-unification of mind and body within Western music performance and composition via "queer mind-body relationships" [14].
- Alternative cultural perspectives within NIME discourse and the NIME community's responsibility to make participation more accessible [26].
- Decolonial perspectives within NIME [7].

Although NIME has yet to take a determinate stance on such matters, individual members of the NIME community have - which is made ever more apparent by the tangible artifacts that serve as barometers for the diverse modes of thought encompassed within. We believe that a formalization of the ethics of material cultures that already exist within NIME through diffractive methodology can help solidify NIME as a community that is attentive to a more justice-oriented being-becoming.

5 Diffractive-Adjacent Approaches to Design

Although this paper concerns itself with diffractive approach to DMI design, it does not imply that situated approaches to design research are lacking. Interestingly, many of the approaches share commonalities in ethical and methodological values with entangled ideology. We're not interested in suggesting agential realism as a replacement for other theoretical and methodological approaches; rather, we're interested in a convergence of similar modes of thought: what can we take from all of them to create this diffractive approach that we're so keen to explore?

Sympathetic approaches to diffractive design are as follows:

- Values in Design
- Critical Making
- Material Speculation
- Questionable Concepts

Although we do not have the space to discuss the approaches in detail, we take from values in design [33] the valuable lesson that our neutrality is not a given; critical making [40] not only teaches us to accept non-neutrality in design, but makes the non-neutrality of the maker palpable - and quite literally tangible - through the prioritization of the process of making itself; material speculation [46] posits the "counterfactual" artifact as the primary vehicle of engagement in its commitment to preferential world generation; and questionable concepts [45] reminds us of the latent creativity that can be unleashed via an unlikely source: criticism. As we explore diffraction within DMI design, we utilize the lessons aforementioned as foundational building blocks toward our proposed approach.

5.1 DMI as Apparatus

In previous sections we've briefly discussed the concepts of diffraction (Section 3), assemblification (Section 3.1), and entanglement-aligned approaches to design (Section 5) - all of which culminate in our description of a DMI as a diffractive apparatus.

If we are to accept the assemblification of objects, then with that acceptance and realization we invite accountability into the fold. Throughout the design process, we bring into becoming a reality *between* realities - a reality that exists within the periphery of both our current reality as well as the reality(ies) we hope to create. More specifically, during the DMI creation process - before

the initial design decision begins the process of cementing the DMI into a particular state of being - it, potentially, exists as every conceivable possibility (and as such, belongs to all of the material cultures present within the NIME community); it is because of this neither-here-nor-there space and our role in reinforcing or canceling ways of knowing and being through design decisions that we consider the DMI a diffractive apparatus.

In the following section, we read BRAIDS_' iterative design decisions through NIME's current material culture(s) to better understand its underlying political situatedness (see Figure 2).

Figure 2: A visual representation of "reading through." Exploring a few possibilities from the line's initial state (vertical) to two alternative states of becoming (left or right curvature), with the right-facing curve obscuring the others.

6 Case Study

With the multiple cultures that already exist within NIME, it didn't make sense to ignore their presence as, in a very real way, BRAIDS_ exists(ed) within many of them throughout the various states of its continual becoming.

In our diffractive process, we dissect a few critical decisions that played pivotal roles in the reinforcement and obscuring of modes of being through the process of designing BRAIDS_. Parts of the following sections, where they reflect the lived experience of the first author, are written in a first-person singular voice.

A video and technical information can be found here: https://brittneyjuliet.github.io/material-culture/.

6.1 Performance Practice

> "One ever feels his twoness, — an American, a Negro; two souls, two thoughts, two unreconciled strivings; two warring ideals in one dark body, whose dogged strength alone keeps it from being torn asunder." - W.E.B. Du Bois [10]

BRAIDS_' performance practice is an embodiment of multiple modes of thought/ways of being. In order to manipulate the digital, one must first negotiate and engage with the tangible via a cultural process whose computational potential is critically overlooked. Likewise, the tangible-digital context takes the performer on a journey between two seemingly opposed cultural commitments.

Figure 3: Chronological iteration of strand construction. From left to right: braided yarn wrapped with conductive thread; alternating conductive and non-conductive sections; roped yarn; and roped yarn interwoven with conductive thread.

The first diffraction was the codifying of latent computational potential within cultural art forms, researched extensively by Ron Eglash and Audrey Bennett [5, 11, 12] in the form of heritage algorithms. Bennett describes heritage algorithms as "under-utilized computational potential in cultural arts" through which the generative justice framework can apply [5]. The generative justice framework, in turn, serves as a model to "recirculate value, with as little alienation as possible, back to its communities of origin" [5]. Further, the utilization of heritage algorithms to aid in the recirculation of expressive value is known as ethnocomputational creativity [5].

BRAIDS_ was designed as an interactive system that embodied the philosophy of ethnocomputational creativity. It's important to note that the recirculation of value via ethnocomputationally creative processes does not seek to "upend" the current system, but to mutually coexist; the irony, here, is that traditional methods of computer programming can serve somewhat as the metaphorical system that advocates of ethnocomputational creativity intend to put an end to (i.e. traditional computer programs serve as a framework whereby users must abide by a strict set of rules, otherwise the program may behave unpredictably). By recirculating value via culturally centered artistic practices, the generative justice framework may spark a chain reaction of positive returns that empower and uplift marginalized communities; while ethnocomputational creativity is not an answer to systematic racism and inequality, it is a step toward a more just future.

BRAIDS_' musical output at the time of performance relied on a tonal system that, for all intents and purposes, could be considered Western. Why would an instrument designed within a Black American aesthetic produce music within a cultural tradition that is diametrically opposed to its origin? Therein lies the contradiction of being born the child of chattel slavery in America. As W.E.B. Du Bois famously stated, there is a sort of double consciousness that Black Americans are burdened with - one foot in Africa, one in the West, and fully belonging to neither - and in that sense, BRAIDS_ doesn't purport to "solve" any longstanding socio-cultural issues through its existence, however, it does serve as a powerful, tangible articulation of a centuries-old plight.

6.2 Strands and Sequencer

The braiding of strands provides the first point of interaction for the user as the braiding process dictates step length; each crossing point (one strand over the other) represents a single step. The strands are critically important as they may arguably be the most defining element of BRAIDS_'s material culture in that they not only define a specific cultural aesthetic, but are the tangible representation of my ethical and ontological commitment - to prioritize diverse modes of being-becoming.

There are many options one may enlist when considering step length parameter modification for a synthesizer: buttons, toggle switches, sliders, patch bays, etc. As the NIME community has imagined quite a few sequencers over the years, BRAIDS_ could have existed as a eurorack module [17], a turntable-inspired tangible interface [1], a web-based VR experience [35], or an improvisational machine learning algorithm [47] (to name a few). However, the initial design decision - the implementation of hair braiding as the primary source of interaction and the second diffraction - precluded those possibilities. In a sense the diffraction, here, comes from a place of reconciliation in hopes of healing a certain latent pain that stems from the seemingly futile practice of trying to live, fully, in a society that doesn't seem to recognize my wholeness; the idea being that I can, perhaps, put the pieces of myself together through my tangible engagement with the world around me.

The crossing of strands as an approximation for hair braiding was selected for two reasons: its universal appeal (as many cultures around the world participate in hair braiding rituals) alongside its potential for specificity as different ways/styles of hair braiding are prioritized (which is still an active work-in-progress).

Coupled with the decision to focus on a cultural practice was a deliberate move away from the techno-novel and toward the material/experiential-novel - i.e. the epistemological commitment wasn't to propose any notable technological novelty [16], rather, it was to contribute, via an intentional design philosophy, to the NIME community's pre-existing material culture.

6.3 Cores and Crossing Points

Figure 4: Early core prototype; this iteration includes a 3D-printed inner and outer core with the inner core being lined with copper tape.

The use of cores was inspired by core rope memory - hand woven software that helped humanity land on the moon. Capacitive sensors were ultimately used for aesthetic purposes, but the notion of weaving roped strands through cores is an homage of sorts to the unnamed "little old ladies" [36] that helped make the impossible possible.

The third diffraction - the decision to model core rope memory - suggests a strand-based interaction. The NIME community contains quite a few instruments that rely on string-based interaction [6, 19, 22, 48], although none approximate hair braiding specifically. If the second diffraction concerned itself with placing (a small part of) myself within a community where I remained nonexistent, the third further cemented my particular view of the world (via an abstraction of hair braiding technique) through what Donna Haraway calls "situated knowledges" [18]. In her writings, Haraway calls for a "network of connections, including the ability partially to translate knowledges among very different - and power-differentiated - communities" [18]. In other words, although my perspective most certainly isn't universal, my particular vantage point - when combined with and interrogated against others - can paint a holistic picture of the world our respective DMIs inhabit. Is that not well within our reach as a community of intellectually and culturally diverse researcher-designers? Perhaps the only thing missing is a systematic way of connecting and engaging critically with NIME's existing material culture(s).

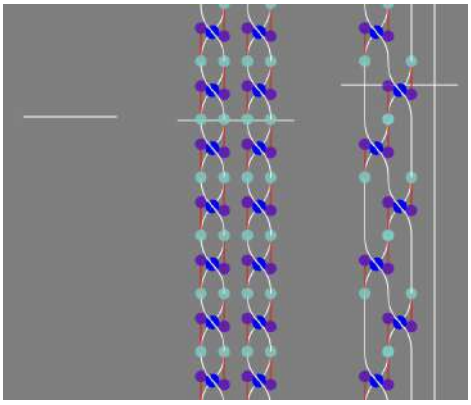

Figure 5: Digital braids and playheads. When a playhead intersects with a crossing point (represented by blue dots), an osc message is sent to the Pure Data synthesizer/sequencer.

7 Conclusion

Throughout NIME's history, as designers have intra-acted (and continue to intra-act) with other actors during the DMI design process, so too, have many distinct material cultures emerged within NIME - all with differing ideas regarding new musical instrument research's ethical, epistemological, and ontological commitments. Although the first author embarked on creating BRAIDS_ as an instrument committed to African ancestral sensibility in an effort to fill a noticed gap, we found community and solidarity - via a diffractive making process - in NIME's material cultures. BRAIDS_, in the various stages of its becoming, belonged(s) to a legacy of sequencers, culturally-situated and ontologically-referent DMIs, Pure Data synthesizers, Arduino-controlled instruments, and so much more.

The primary objective of this writing was to support the growing ethics of material culture that already exists within NIME such that a politics of materially-situated knowledge meaning and making practices can manifest. With an expanding role within production processes, designers carry the burden of designing (for) future humans and must do so lovingly and with extreme care. The proposed politics requires a commitment not only to understanding the entangled nature of our existence but to work exceedingly toward acceptance, accountability, and prevention such that our present and future output leaves the then-there-now in an objectively better place.

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9 Ethical Standards

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