

# What NIME talks about when it talks about touch

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Figure 1: Sorting codes for thematic analysis.

## Abstract

Touch is a key concept in music performance and interactive music practice, encompassing both physical interactions and metaphorical understandings. Within the NIME archive, however, touch remains largely untheorised as a concept, despite its centrality to computer-mediated musical practice. Although many works mention touch, the term carries multiple, often unexamined meanings. We ask, then: **What does NIME talk about when it talks about touch?**

We answered that question through a reflexive thematic analysis of the NIME archive with a semantic approach. We began by constructing a corpus from the NIME proceedings, coding the mentions of “touch” across 119 works, and iteratively sorting and organising these codes to construct themes. We constructed three major themes (Applied Technology and Design, Historical and Contextual, and Expanded Discussion), and found that operational descriptions dominate NIME’s touch discourse. This paper presents our methodology and results, and argues that without conceptual clarity on touch, important dimensions of musical expression and embodied interaction remain under-explored in NIME. We conclude by highlighting areas for inquiry that bridge music practice and technological design.

## Keywords

touch, embodied interaction, thematic analysis

## 1 Introduction

In the project *Technologies of Touch*, a three-year collaboration between researchers at Universität der Künste Berlin and Goldsmiths University of London, we are exploring the role of touch in musical interactions through wearable design interventions, and by extension expanded definitions and notions of touch. In the first phase of this project we have focused on developing an expanded understanding of “touch” as a multifaceted concept related to both human–computer interaction and music. Touch carries significant conceptual complexity in HCI contexts, and the same is true for musical ones, and we’re interested in understanding touch in this combined context.

Because NIME research lies at the intersection of HCI and music, and as NIME community members ourselves, we looked to the NIME proceedings to understand touch. We were surprised to find little work that investigates an expanded concept of touch, but in searching the corpus we saw that the word “touch” occurs relatively frequently. This prompted our central question: **What does NIME talk about when it talks about touch?**

In this paper we present our process of sorting, coding and constructing themes, and end with a discussion of how “touch” exists within the NIME literature, and implications for future NIME research at the intersection of musical practice and technological design.

## 2 Context and background

### 2.1 Touch in music performance

Touch holds foundational significance in music, both as a mechanism of sound production and as a conceptual anchor for embodied musical expression. In Western classical piano tradition, “touch” describes the biomechanical and expressive relationship



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between fingertip and key, directly influencing tonal quality and encoding personal musical style [15, 20]. Research distinguishes struck touch (initiating attack from a distance, emphasising force efficiency) from pressed touch (initiating from the key surface, enabling tonal control), with each affording distinct expressive affordances [20]. Beyond mechanics, touch encodes articulation, or the character of attack and decay (staccato, legato, tenuto), making it inseparable from musical interpretation [53].

Touch extends beyond the technical to encompass embodied cognition and somatic practice. Movement researchers and music educators in traditions like Dalcroze Eurhythmics recognise touch as relational and communicative: the direct physical contact between partners conveys timing, intensity, and phrasing without explicit instruction, cultivating kinaesthetic empathy and shared musical understanding [22]. Somatic approaches emphasise touch-like dimensions of sound itself, the haptic quality of vibration and resonance that physically and emotionally move the body, building awareness of self, others, and environment through musical participation [31, 42, pg 3].

Contemporary performance research further emphasises the expressive power of touch. In ensemble contexts, musicians use touch and gesture to negotiate timing, entrain with partners, and build interpretive consensus in real-time [18]. For digital musical instruments, scholars note that expression is “inextricably tied” to the performer’s touch; the intimate contact between hand and interface that carries nuance and intent [35].

The challenge in DMI design is preserving this tactile sensitivity. Digitisation risks flattening the embodied detail that performers cultivate across years of practice in favour of resolving the technical complexities to even make touch interaction possible [46]. Collectively, these perspectives reveal touch as a site where technique, embodiment, intention, and social coordination converge in musical meaning-making.

## 2.2 Touch in HCI

Human-computer interaction has developed sophisticated conceptual and technical frameworks for understanding touch across diverse contexts. Interest in touch interaction accelerated with the introduction of multi-touch capabilities and the iPhone, and as smartphones became ubiquitous touch interaction devices that we use every day [24]. In this time, we created (and learned) a new vocabulary of gestures to meaningfully interact with an XY glass plane, and actions like tap, pinch, swipe, and rotate became foundational interaction primitives [47]. HCI research established design principles around touch: target sizing (7–10mm), gesture consistency, multimodal integration, and context-sensitive adaptation across handheld and wall-mounted displays [21].

Beyond functional input, HCI has increasingly explored touch’s affective and relational dimensions in recent years, through what might be called HCI’s Third [6] and Fourth [3] waves. Touch is no longer uni-directional, and haptic feedback systems have evolved to provide the person using them with sensations that convey feedback and information that has emotional valence, such as vibration, force, texture simulation [34, 55]. Research on mediated social touch demonstrates that remote touch (via vibrotactile feedback between distant collaborators) can modulate physiological response, increase trust, and establish bonds between humans and systems [2, 28]. This work bridges neuroscience and interaction design, revealing touch’s capacity for communication with affective and psychological depth, as demonstrated by van Erp et al [52].

This work by van Erp et al is further expanded by Zhang et al [57] to present a framework that distinguishes multiple dimensions of touch: cutaneous (surface sensation, texture), kinesthetic (proprioception, body awareness), and social/affective (emotional bonding, presence). Emerging research on embodied interaction further recognises that touch is not merely functional input but a site where cognition, emotion, and social understanding intertwine [11]. HCI has also investigated touch in specific social situations, such as in health and care practice Zheng et al. [58], or unprompted touch in social robotics [44]. Despite these advances, HCI scholarship on touch remains oriented more toward mediated interaction at a distance or sensory feedback in virtual systems, and less toward sustained, intimate contact between hand and instrument during expressive performance [32]. This positions HCI as a rich conceptual resource for NIME, particularly in theorising affective and relational dimensions of touch that remain under-articulated in musical interface design. This also demonstrates the nuances of HCI touch that NIME is uniquely positioned to offer, due to it being rooted in the embodied practice of music making.

Ubiquitous computing increasingly means that the whole world can be made touch-reactive and mediated by computers, and touch has begun to extend far outside the XY glass plane [4, 49]. However, HCI has been largely concerned with touch as interaction. Though considerable research exists on haptics and communication through touch, Campagna and Chamberlain point out that the affective dimensions of touch, particularly texture, temperature, and material qualities that carry emotional and communicative significance, remain under-explored [10].

## 2.3 Philosophical notions of touch

Along with the role of touch in music and HCI, there are intriguing and useful philosophical ideas of touch that go some way to bridge the technical reality of implementing touch in HCI and its expanded musical meanings. Husserl, for example, details touch’s “double sensation” [29, pg 36-40], that hand touching feels both active (doing the touching) and passive (being touched), localising the body as the “zero-point” of orientation. This is a useful way of understanding the relationship between a musician and their instrument, as it unifies subjective experience with the material world.

Merleau-Ponty takes this idea further. Touch your right hand with your left. Your right hand feels touched (passive) and your left hand touching (active), but swap hands and the roles are reversed [37, pg 93]. In this way, touch is not uni-directional, and the roles are not necessarily separate; on the contrary, the toucher and touched can indeed be the same “flesh”. This suggests that the body and the world are the same intertwined elemental tissue, and we perceive the world as our bodies extend into it – leaving open the question of where the boundaries lie between musician and instrument.

Nancy’s notions of touch add useful dimension. He claims that, through touch, we are constantly in “maximal proximity without fusion” [40, pg 27]. We are not in full contact with the world, but in a state of contiguous sharing, enabling community and togetherness without merging. Derrida tests these claims [16] by tracing a line along notions of touch, beginning with Plato and Aristotle through to Husserl and more recent phenomenology. Derrida suggests that touch always invokes Christian teleology of resurrection and incarnation: for example, Christ’s wounds let you “touch” divine pain, but it remains incorporeal, sensed

but untouchable. In this way he highlights touch's impossibility. Where Nancy sees the world as "pure tangency", Derrida sees no pure contact; instead of continuity, there is always interruption.

More recently, Manning adds a political dimension to touch [36, pg 20], claiming that touch and movement are a way to seize personal freedom. They use tango as an example: there is no fixed leader and follower, the sensing bodies "reach across" imposed boundaries of gender, nation, the self/the other, and generate new non-hierarchical arrangements that resist control.

## 2.4 The Conceptual Gap

Despite the foundational significance of touch in music performance and HCI's sophisticated conceptual frameworks for understanding it, we found little systematic investigation or rigorous engagement with touch as a concept within NIME scholarship. While NIME research frequently engages with touch by exploring multi-touch interfaces, investigating the role of mobile phones in music performance, integrating haptic feedback, and exploring the potential of wearable devices, we found these engagements largely functional and pragmatic, oriented toward solving specific interface or expression challenges rather than interrogating what "touch" actually means in the context of musical interaction.

This gap is curious and consequential. Music performance privileges touch as a site of embodied expression, technique, and social coordination. HCI has developed rich vocabularies for understanding touch across functional, affective, and relational dimensions. Yet NIME, which sits at the intersection of these two domains and fundamentally depends on touch as a primary mode of performer-instrument engagement, has not systematically theorised or mapped how touch is conceived, discussed, or operationalised across its own literature and practice.

The absence is not one of disinterest. The term "touch" appears frequently in NIME conference proceedings, papers, and project descriptions. Rather, it is an absence of explicit conceptual engagement. That made us ask ourselves: When NIME researchers invoke "touch", do they mean gestural input? Tactile sensation? Embodied connection? Material resistance? Social presence? Affective communication? The concept remains under-examined within the field itself, even as it structures much of NIME's creative and technical work [26].

This paper addresses that silence through a reflexive thematic analysis of the NIME archive, asking: What is NIME talking about when it talks about touch?

## 3 Methodology

This reflexive thematic analysis was carried out by 3 investigators.

### 3.1 Reflexivity statement

We approach this review not as impartial observers but as active NIME community members, experienced designers, fabricators, musicians, and theorists. Our interpretation of the literature is inevitably shaped by embodied experience with interface design. As a result, this analysis contains the lived experience of designers who deal with touch as engineering metric, as well as tacit performance knowledge. Further, we acknowledge that our 'hybrid' interface categorisations draw on tacit performance knowledge.

### 3.2 The role of semantics

Semantics played a significant role in this study in two ways.

**3.2.1 Adopting a semantic approach.** We adopted a semantic approach to this analysis, which means that we focused on the explicit language and concepts surrounding "touch" as they appeared in each paper in the corpus. We deliberately did not infer latent meanings to "touch" or impose interpretations based on what we know about the subject, the authors' intentions, or the broader context of the specific work or the NIME field as a whole. This approach privileges what is said over what might be implied, allowing us to map NIME's actual conceptual vocabulary around touch rather than reconstruct it through external frameworks.

**3.2.2 Limiting our inquiry to "touch".** We deliberately constructed our data corpus based solely on the term "touch", and did not include related concepts (tactility, haptics, gesture, and so on). The reasons for this are twofold:

- **Clarifying the conceptual landscape.** Limiting our inquiry to "touch" alone was to clarify this concept within NIME. As no systematic analysis of "touch" within NIME yet exists, a broader search including related terms would risk obscuring the function of this term, rather than providing clarity. Our goal was to understand how the field explicitly invokes touch, not to retroactively assign meanings to work that uses different terminology.
- **"Touch" already has a specific semantic meaning unto itself.** "Touch" carries specific meaning in both music and HCI discourse, referring not just to physical contact but extending to a constellation of meanings around expressivity, control, and embodied connection, and we wanted to understand all the ways in which this specific term was being used. We did not impose any expectation of physicality on mentions of the term; instead, we met mentions of "touch" in the context in which they were presented, and did not exclude discussions of touch that were, for example, metaphorical or did not include physicality (on the contrary, we were keenly interested in these).

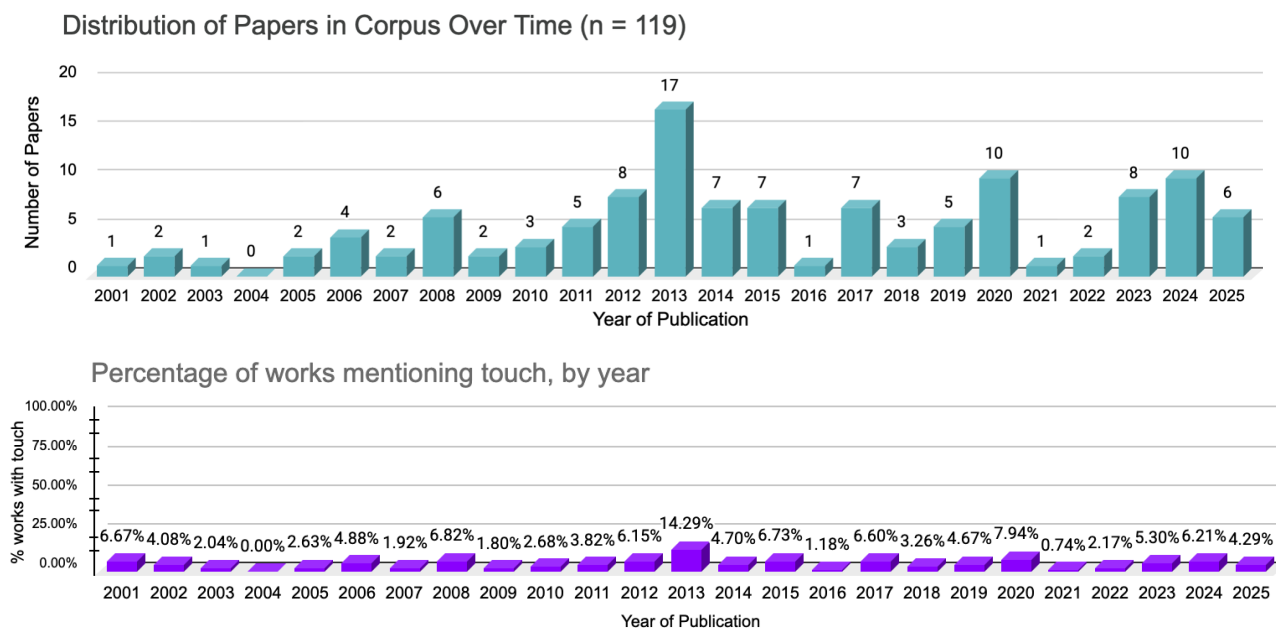
This semantic boundary allows for a focused reflexive analysis. By focusing on "touch" as it appears in NIME's own language - a field that stretches back 25 years, and across all the technological advancement and technical and cultural trends that have taken place in that time - we can trace how the field has understood and employed this concept without imposing external frameworks. Future work might productively examine related terms and their relationship to touch discourse, but that is beyond the scope of this specific investigation.

## 3.3 Corpus Selection

We reviewed the complete NIME proceedings archive (2001–2025) on Zenodo, where it is indexed. We searched titles and abstracts using the wildcard 'touch\*' to capture all permutations, including 'touching', 'touched', 'untouched', 'multi-touch', and related forms. We included all contribution types (full papers, performances, demos, posters) as each represents distinct NIME practices. This initial search yielded 158 papers.

## 3.4 Filtering Stage

From the 158 papers, we conducted a filtering stage to exclude those where "touch" appeared only in passing, lacked substantive discussion, or referred solely to unrelated devices without engaging the term "touch" as a concept or design consideration. Three investigators independently reviewed papers, excluding 30 such cases. This left 125 papers for analysis.



**Figure 2:**  
**Top: Distribution of the corpus over time**  
**Bottom: Percentage of works mentioning “touch” by year of publication**

To ensure alignment, the investigators first sorted the same 10 papers independently and then compared results, resolving differences and agreeing on criteria before proceeding independently.

### 3.5 Coding Process

We adopted a semantic thematic analysis approach, focusing on explicit “touch” mentions. For each of the 125 papers, we searched for “touch” within the work and coded the immediate context of each mention. We copied codes from each work and pasted them into a spreadsheet in Google Sheets.

To avoid redundancy, when papers contained multiple mentions of the same semantic category (e.g., ‘touch screen’ repeated without conceptual variation), we coded only the first representative instance. This preserved context while preventing analytical skew from papers heavy in one particular terminology. We first discussed and aligned our approach as a team, and proceeded individually. Through this coding process a further 6 papers were eliminated from the corpus at this stage as there was no meaningful mention of touch (for instance, simply mentioning the existence of the iPod Touch), bringing the total number of papers in the corpus to 119.

This process produced a total of 526 codes.

### 3.6 Constructing themes

After coding, we assigned each work an ID number to facilitate cross referencing, then printed and physically cut out each coded instance to enable manual sorting. This meant we could move these codes around freely as we sorted and discussed. In familiarising ourselves with the data we also used a highlighter to mark each mention of the word “touch” in the codes. This made quick scanning of each code much easier.

We did this thematic analysis as a team, and went through several rounds of sorting the codes, refining our sorting, and discussing patterns. To begin we each took a portion of the codes and sorted them into ‘buckets’ of meaning, then discussed. Through these discussions we slowly combined our buckets into a central group of buckets, that captured how we all understood patterns across this data. Then, we investigated each of these buckets to begin constructing themes. Each code was included in only one theme, reflecting the main semantic content of the code.

Through this iterative sorting, discussion, and interpretation, we developed three major themes that represent our analytical understanding of how touch is conceptualised across the NIME corpus: Applied Technology and Design, Historical Context, and Expanded Discussions.

## 4 Results and Discussion

Our analysis extracted three themes: Applied Technology and Design, Historical Context, and Expanded Discussion. In this section we discuss each theme, and then finally, their implications.

### 4.1 Distribution of touch discussions over time

Though the number of codes does not automatically indicate a code’s richness or importance, it bears mentioning that the Applied Technology and Design theme was by far the most populated, with 453 of 526 codes (86.1%) grouped under it. Historical Context gathered 40 codes (7.6%), and Expanded Discussions 36 (6.8%). See Figure 3 for a visualisation.

When we counted the number of papers that contained codes mentioning each theme, we saw a similar pattern, with Applied Technology and Design representing codes in 114 out of 119 papers (95.7%); Expanded Discussion representing codes in 16

out of 119 papers (13.4%); and Historical Context representing codes in 27 out of 119 papers (22.6%).

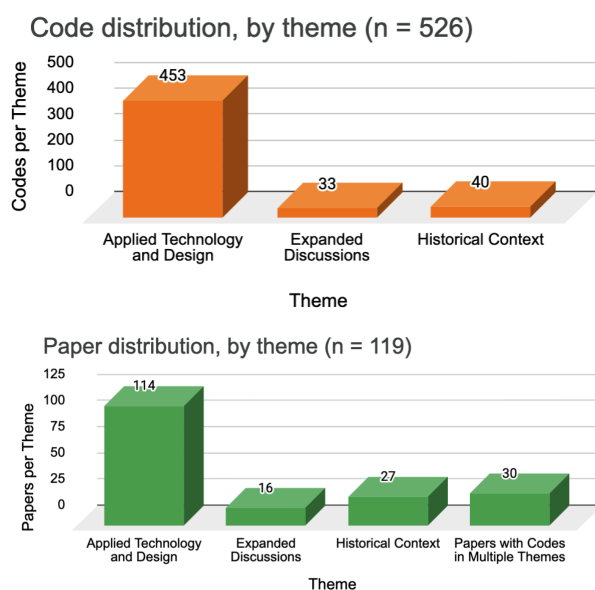
Lastly, we looked at how the corpus of 119 papers was distributed over time (see Figure 2, top). Though we can't draw any firm conclusions for these trends, it's interesting that touch mentions increase after 2007 and in the years following 2010, two time frames that saw the debut of the iPhone (2007), which provided a new realm of touch interaction that became ubiquitous, and iPad (2010) which brought with it high-resolution multi-touch technology. Notable also is the drop in mentions of touch in 2021 and 2022, though this could be attributed to the COVID-19 pandemic which brought with it several years of social distancing. However other trends, such as the increase such as that leading up to 2020 and the dropoffs in 2004, 2009 and 2016, are not interpretable within this scope. It is also interesting to note in Figure 2, bottom that, except for a slight increase in 2013, the percentage of publications mentioning touch have always been relatively rare (average of 4.46% of total publications per year).

We want to emphasise that these trends over time, though interesting to note, don't necessarily indicate anything that can be satisfied by this analysis. There would very likely be other observable trends if the corpus was constructed on a number of related terms along with touch (such as 'tactile' and 'haptic'), so we don't consider these to be definitive results.

## 4.2 Theme 1: Applied Technology and Design

The most dominant theme in this research was Applied Technology and Design. This theme captures hundreds of codes scattered across many small categories that describe the technical aspects of designing and implementing touch interaction.

The main categories of this theme include interface and interaction design, responses to emerging technology, applications in response to emerging technology, technical limitations, musical outcomes/relationship to existing instruments. This theme was also



**Figure 3: Top: Codes distributed across themes. Bottom: Papers distributed across themes. (Note: 30 papers contained codes that pertained to more than one theme.)**

by far the largest; out of 119 papers, 114 contained a code that described how touch interaction was implemented. This indicates that discussions of how touch interaction is implemented has been present since NIME's beginning, and continues today. We can then surmise that there is within NIME a strong interest in touch interaction, and activity around innovation in its implementation in both hardware and software.

Some sub-categories within this theme also point to how NIME deals with different aspects of this research. Some of these sub-categories include the following:

**4.2.1 Interface and interaction design.** By far the largest categories, these contain codes describing details of interface design ("Olly uses one Bare touch board in midi mode and four stretch analog sensors embedded inside four elastic ribbons" [41]), interaction design ("When users touch a surface, their fingers are illuminated by the light plane and become visible to the camera below" [38]), and general descriptions of how the application functions ("The hidden affordances] rely on the exploitation of features of the instrument not necessarily connected to the sensor, such as rubbing on the wooden sides of the box or touching the speaker" [56]). These are categories rich with detail of experiments and implementation.

**4.2.2 Responding to new technology.** Codes here describing how technologies enable explorations in new directions: "[W]e have taken advantage of a new rear-projectable multi-touch sensing technology with unique advantages in scalability and resolution, to create novel musical interfaces for synthesis and control in a large format dynamic workspace" [13]

**4.2.3 Limitations.** Here there were mentions of what couldn't be done with touch interaction ("When applied to touch-based tablets, we find that many apparent touch interactions such as key-press are quite deceptive" [51], "One of the (many?) issues for touchscreen-based MCDs ... is the unavailability of force-feedback" [43]). Yet these remained strictly technical, with no exploration of what touch enables on a human level.

**4.2.4 Musical outcomes/relationship to existing instruments.** In this category codes describe the musical or audio outcomes of a given application ("Whenever the touch sensor is triggered, the FSR pressure values control the velocity of the percussive sound and the cut-off frequency of a low pass filter applied on the drone, allowing for a continuous modulation within a deliberately restricted range" [56]), or talk about how existing instruments inspired the touch interaction at hand ("It is part of normal keyboard technique to use the sense of touch and the morphology of the keyboard to navigate to the right position. When doing this without touch, you have to rely on eyesight to avoid unintended key activations, which might not be possible when playing difficult passages involving both hands" [12]) It was interesting to note that, in a field concerned with musical interaction, this category was considerably smaller than the ones that describe the implementation.

This theme demonstrates that NIME's touch engagement is operational. When NIME talks about touch it describes rich technical detail across a variety of contexts, but scant exploration of its implications for artistic and musical practice.

## 4.3 Theme 2: Historical and Contextual

Historical and Contextual codes appeared in 27 papers (22.6%). Though the codes group around various historical points, they

function primarily as technical justification rather than conceptual grounding. Under this theme codes were clustered into the following categories: Don Buchla; the Theremin; commercial and historical music technology; HCI methods; mainstream media and commercial applications; NIME and NIME-adjacent work.

**4.3.1 Don Buchla.** References to Buchla establish the musical applications of capacitive sensing (*“Don Buchla pioneered the application of both the touch keyboard and the analog sequencer to modular synthesizers”* [50]) but do not engage with what this innovation enabled for synthesizer design, and does not interrogate why Buchla chose this particular paradigm for musical sensing.

**4.3.2 The Theremin.** The theremin also gets a few mentions, but these do not engage with the impact of its innovation (*“The theremin being the first controller in the league of new instruments, is one of the few instrument controllers where people have reached a new level of virtuosity. It is therefore instructional to take a closer look at it and compare it with the touch screen.”* [19]).

**4.3.3 Commercial and historical music technology.** Mentions of music technology seem to ground the work in a context and do not investigate the existence of any of the given examples (*“Touch-screen interfaces have received increased popularity in the last years, being produced commercially (as in the Lemur and the Korg Oasys Workstation)”* [7]; *“With the ubiquity of MCDs and robust multi-touchscreen technology, a great many number of musical apps have appeared in recent years ... and more recently the Ocarina, one of the All-Time Top 20 iOS apps by Smule”* [43]).

**4.3.4 HCI methods.** HCI references were technical rather than theoretical (*“In parallel, computer input peripherals (Wacom tablets, PQ-Labs multi-touch screen overlays, Sensel Morph) or tablet computers (iPad) have appeared and have been used for music performance”* [48]; *“Finally, various methods exist to facilitate fast prototyping of multitouch input devices such as computational fabrics. The most common are capacitive touch sensors”* [14]). We found no codes that referenced existing HCI thinking around these themes such as embodiment, affective experience, and so on.

**4.3.5 Mainstream media and commercial applications.** The few mentions of mainstream touch interaction, such as Disney and Google’s Project Jacquard, are used to delineate the territory and don’t provide any critical orientation (*“The entertainment industry has seen various attempts at integrating the sense of touch with visual and audio media”* [23]).

**4.3.6 NIME and NIME-adjacent work.** Even references to NIME and NIME-adjacent work function as contextualising citations (*“Tingle has a custom built sensor that was adapted from an article published during NIME 2011 ...”* [17]; *“The whole multitouch research community is very familiar with see-through infrared tracking, thanks to projects like the Reactable”* [45]), and rarely go further or adopt a critical stance.

The Historical and Contextual theme reveals an untapped resource for talking about touch: conceptual frameworks embedded in NIME’s own history that remain largely unexplored.

## 4.4 Theme 3: Expanded Discussion

The theme of Expanded Discussion captures codes that present a critical or conceptual viewpoint on what touch means beyond

its technical function. These mentions are relatively rare (only 6.8% of codes), but they reveal important conceptual dimensions that the other two themes do not capture. There are four categories that capture scattered conceptual work: Touch conveying information; instrument design; affective/human experience; and entanglement. These categories capture more isolated but conceptually rich observations across 16 papers, while three papers present more integrated critical perspectives.

**4.4.1 Touch conveying information.** These codes suggest that touch can communicate, not only the present but also the past (*“Through the weaving of knots, the artist takes the position of a contemporary ‘kipukamayug’ (who was the person dedicated to knot the khipu) seeking, from a decolonial perspective to encode with the touch, the gestures and the different kinds of knots, the interrupted legacy of this ancestral practice in a different experience of tangible live coding and computer music, as well as weave the past with the present of the indigenous and people resistance of the Andean territory with their sounds.”* [9]). Additionally, musicians can use tactility to communicate with each other, through the way they handle their instruments (*“In our improvisations, touch takes center stage: we focus on how the tactility of each other’s interactions with our instruments informs and transforms our own.”* [25]). These perspectives suggest that touch can function as a powerful conveyor of cultural memory and interpersonal communication, not simply as a technical control mechanism.

**4.4.2 Instrument design.** Touch, and the way an instrument suggests it can be touched, can bridge the gap between culture and entirely new instruments (*“With a new instrument, there is no history or examples of ways to play it. This makes the threshold for starting to play it very high. ‘Visual-tactility’ ... refers to interfaces that ‘beg to be touched’. We deem this important when making a viable music controller, and it makes it easier to accept for a potential musician”* [17]). There is also the suggestion that not touching is an interactive paradigm: *“A touch-less gestural interface is a type of alternate controller, which neither resembles nor is inspired by any acoustic instrument”* [54]. Together, these observations suggest that touch, as well as its absence, shapes how instruments invite musicianship and cultural acceptance, extending beyond mere physical actuation.

**4.4.3 Affective/human experience.** Other codes speak of the fundamental nature of touch to our experience of what’s around us (*“Touch is the primary interface between the human body and the outside world”* [5]; *“Revolutionary textile artist Anni Albers said, we touch things to assure ourselves of reality”* [33]). Some of these locate the main channels of touch communication in the hands (*“In contrast, this is a new approach with an emphasis on the opposite point of view; touching, treating and rubbing heavily with fingers. As previous research shows, it is well known that human interaction is sensitive and critical with hands, especially fingers”* [39]), and others suggest that touch experience can be mediated by materiality (*“The transience and occasional fragility of assemblages encourages an orientation to performance, and indeed a deportment of the performer’s body, which emphasizes care, deliberation, attentive listening and judicious touching. This form of auditory-tactile exploration makes for a notable performance aesthetic which is often characterized by moments of withholding and hesitating to touch the assemblage”* [8]). These codes position touch as structuring human perception, communication, and performance aesthetics, going beyond merely registering physical contact.

**4.4.4 Entanglement.** There are also considerations of touch as a multi-faceted sense entangled with other kinds of stimuli (*“Inspired by Karen Barad’s concept of touch as an entangled, relational act, we position touch as extending beyond physical interaction to include the mediated interplay of gestures, sounds, visuals, and temporalities in a networked environment”* [25]), as well as with other forms of communication (*“This design approach pairs the expressive potential of physical stretch with the natural expressivity of the human voice, aiming to explore how this dialogue between touch and voice can enhance musical communication”* [1]). These examples frame touch not as isolated contact but as inherently relational, entangled with sound, voice, visuals, and communication in ways that reshape musical interaction.

Three papers dive deep into this question of what touch means beyond implementation. These three works develop these conceptual dimensions more fully across entanglement, touch as relationship, and critical perspectives.

**4.4.5 On touching and not-touching.** In the first of these papers, Bowers and Haas meditate on the meaning of both touching, as well as not-touching, from a material perspective [8]. *“It has been more of a discovery though that different forms of touch/touching need to be considered in performance including the most important possibility of ‘non-touch’, of withholding and letting be, for at least as long as to let a new sonic behaviour emerge ... slowly, then, one begins to explore the different tactile qualities of the materials anew”*. They extend this to instruments, and consider touching an instrument to be separate from other kinds of touch (*“Beyond considering touch as the means by which physical force is transmitted to actuate an instrument or as an expressive gesture, we rather experienced touch as a matter of tension – in particular, a tension between expressive and destructive potentialities”*). Most intriguingly, they consider not-touching to be as musically important as touching, and the difference between these two states to be a specific form of tension (*“[C]lashing objects against each other or bumping the assemblage in a heavily physical and haptic manner appears as a very harsh form of touching that can be contrasted with all the ways in which touch indexes moments of tension between a body and an assemblage, including those moments when contact is withheld”*). Bowers and Haas offer a perspective on materials and instruments that considers them an emergent quality in their own right, brought into being by the touch of the player.

**4.4.6 On touch as an entangled relationship.** In the second paper, Addae and Masuelli offer a unique perspective of touch that comes from considering the relationship between the singer and their voice [1]. They consider touch’s unique ability to convey information: *“While touch itself has a much lower bandwidth of transducing information for perception than vision or audition, it has a unique capacity to transmit emotional information. Consequently, a performer’s tactile relationship with their instrument, often represented through musical gesture, has been shown to play a pivotal role in conveying their musical and emotional intent.”* Instead of locating touch experience only in the musician, they suggest it can also extend to the audience: *“From the perspective of the listener, prior research suggests music perception fundamentally involves a ‘motor-mimetic’ imitation of how the sound was created; as such, the perceived physicality and ‘effort’ from the performer has a significant impact on the audience’s response to musical performance. Tactile metaphors (such as ‘sharp-blunt’, ‘smooth-rough’, and ‘warm-cold’) play a significant role in a listener’s processing and interpretation of musical sound.”* They also draw parallels

between the senses of touch and hearing, a perspective that suggests intriguing lines of inquiry for NIME work in this area: *“Recent research demonstrates a strong correspondence between our senses of touch and hearing: both senses are based on receptors that can analyze amplitude, frequency, and waveform in response to pressure stimuli (albeit with different degrees of subtlety), often within perceptual ranges that are roughly compatible. As such, a great deal of multisensory integration occurs between touch and hearing when playing a musical instrument. Tactile feedback from the instrument (achieved from factors such as the instrument’s material, weight, arrangement of keys, strings, etc.) becomes key in allowing musicians to develop virtuosity and expressive control over their instrument ... it gives the performer a reliable understanding of how their physical gesture translates to sound.”* Addae and Masuelli frame touch as a multi-dimensional communicative channel that connects performer, instrument, and audience, offering rich implications for NIME.

**4.4.7 Critical perspectives.** In the third paper Honigman, Hohenbaum and Kapur [27] emphasise the importance of touch from the perspective of capacitive sensing, and suggest that touch is the vehicle for virtuosity (*“Touch is an integral part of the human experience. It brings with it an intimate and innate knowledge that often times can only be understood through the act itself. Almost all traditional musical instruments require the player to touch them in order for sound to be produced. Indeed it is the physical nature of the instrument that allows a performer to achieve virtuosity through repeated movements and gestures, eventually allowing them to free their minds from the physical movements and focus on higher-level musical ideas such as phrasing, expression, and improvisation”*). They are one of the few examples of placing a distinction between touch interaction and musical interaction: *“Touch, as it is used in technology, lacks a certain subtlety that is readily found in most tools and instruments. In the development of NIMEs touch has focused so much on multi-touch displays and gesture-restricting sensors that the conversation of what touch in other contexts can achieve has been almost forgotten. Some of the flaws with the current trend of new interface development in music are lack of imagination, an over complication of design, or a reliance on novelty”*; *“In computing, touch dominates the interaction between human and computer. However, touch in this context takes on a slightly different meaning, and differs completely from how one touches a musical instrument.”* Even in 2014, they adopted a perspective of touch as it exists on phones and screens to be so commonplace that we take it for granted, and seem to suggest that musical touch is not aligned with this banal kind of functionality: *“Touch capacitance was a novel way of opening a capacitive circuit to allow the introduction of influence from outside conductive objects. Now, touch sensitive electronics have been integrated into the daily fabric of our digital lives. From touch screen phones to track pads, our fingers regularly slide over smooth capacitive surfaces, reaching levels of ubiquity where we no longer are aware of or even impressed by them.”* Honigman et al. demonstrate that NIME can critically interrogate its touch paradigm. They distinguish musical touch from computational touch, and diagnose the field’s tendency to over-rely on multitouch displays. These pointed perspectives make the absence of these perspectives elsewhere in the corpus all the more striking.

## 5 Implications

This thematic analysis demonstrates that touch discourse in NIME is overwhelmingly operational. This isn’t a flaw; this is

NIME's foundational record of our history. It exists because NIME is a community that has deeply considered, experimented, and innovated in this field, producing a huge array of touch interfaces evolved from experimental prototypes to mature technology. Therefore, this predominance of operational and technical discussion reflects NIME's history of hands-on innovation and boundary-pushing engineering.

We now return to our central question. When NIME talks about touch, it talks about how: sensing hardware, interaction design, materials, and applications. Operational discourse constitutes 86% of touch mentions, indicating a grammar of implementation, not interpretation. The other 14% reveals historical contexts mentioned but rarely engaged, plus rare critical perspectives.

The problem with this emphasis on operational factors is that we've reached a plateau. The foundational technical challenges of music technology are not necessarily solved, but the territory is well mapped; touch sensing, multi-touch mapping, and gesture capture are well understood. Yet this maturity obscures richer precedents. While our Historical and Contextual theme connects to figures like Don Buchla, we rarely explore his vision, even though that's now more possible than ever before with our mature capacitive tools.

With mature technology and touch embedded in everyday life, exploring these latent themes has never been more pressing. Big Tech, by which we mean the capitalistic technologies of late Western capitalism, has commodified touch into a simplified and standardised interaction vocabulary of swipe, pinch, and scroll, and trained us all to be fluent in this simplicity, but the Expanded Discussions suggest that touch is much, much more than this simple efficiency for navigating data. NIME excels at experimentation that goes where commercial R&D cannot tread. Rather than incremental how-to refinements, NIME is equipped to tackle touch's why: its phenomenology in performance, its cultural resonances, its emotional bandwidth, its implications for what instruments can be, and its capacity to forge new musical relationships. Yet, our analysis shows that these kind of explorations remain outliers.

When considering touch, we should therefore ask ourselves: How can NIME harness its conceptual resources, such as historical traditions, sensory theories, relational paradigms, to expand touch beyond its current operational limits?

## 6 Conclusion

This analysis answers our central question: NIME talks about touch primarily as operational implementation (86% of discourse). The remaining 14% gestures toward richer possibilities that have yet to find sustained development.

Given NIME's long engineering heritage, this makes sense. But as a music-centred community, this outcome demands action. This work's purpose has been to identify the conceptual gap, and now the methodological paths remain open. Our experimental DNA equips us to expand these latent themes, and push real innovation in the role that touch plays not only in music, but in music made with computers. With mature technology and Big Tech's commodification serving to contrast NIME's potential, this moment calls us to pursue not only the *how* of touch, but the *why*.

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## 7 Ethical Standards

We, the authors, confirm that there are no explicit or implicit conflicts of interest with funders of this research.

This research was performed using the Reflexive Thematic Analysis methodology. As such, the authors acknowledge their explicit presence and participation in the analysis, and though we used the RTA methodology to mitigate and contextualise our bias, we readily accept that due to the nature of RTA our bias exists.

LLMs and AI technologies were not used in the RTA process, in accordance with the guidelines published by Jowsey, Braun, Clarke et al in October 2025 [30].

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