

Hybrid Entanglements: a posthuman dramaturgy for human-robot relationships

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Abstract

This paper discusses our collaborative Machine Movement Lab project harnessing movement to bodily empathize with abstract machines. Bringing together creative robotics, choreographic strategies, and a posthuman dramaturgical frame, the project seeks to trouble our relationships with robots by exploring them as more-than-human entanglements. The paper discusses our transdisciplinary performance-making practice and underlying theoretical concepts and how they are mobilized through emerging diffraction patterns mapping out symbiotic relationships. An improvisational score involving dancers, robot costumes and robots performed in a gallery space aims to engage audiences with hybrid human-machine entanglements in embodied and empathic ways.

Keywords

diffraction, dramaturgy, entanglement, human-robot interaction, hybridity, performance, posthuman.

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Introduction

Hybridity is predicated upon difference—we can only recognize something as hybrid and symbiotic if we acknowledge and recognize the potential of difference. This paper seeks to bring to the fore the aesthetic and social potential of difference in our relationships with machines. It attempts to trouble practices in human-robot interaction that, like many human practices, are invested in deliberately masking difference, grounded in hierarchical and hegemonic beliefs. Stuck in what Barad¹ referred to as the “representationalist trap” of reflection, we look for and fabricate resemblances between what are, essentially, deeply asymmetric entities.² Many of our current human-robot imaginaries thus echo or reaffirm the conservative narratives that validate existing social norms. Yet how we imagine social machines and the future narratives they are embedded is not only a matter of appearance, but literally matters—socially, politically, and ethically. Machines with humanlike facades, for instance, are often presented as more familiar and friendly; but they also serve to confine both bodies and things in mimicry and servitude.^{3, 4, 5}

Our Machine Movement Lab (MML) project attempts to counter this reflection-centered approach by developing a diffractive practice, which foregrounds and aesthetically exploits the differences between humans and machines. MML thus seeks to trouble our relationships with robots that manifest from reductive desires to render the machine as humanlike as possible by investigating creative strategies for reimagining and reconfiguring our relationships with them. This paper focuses on our latest research stage, which draws on Donna Haraway’s⁶ and Karen Barad’s¹ new materialist conception of diffraction to explore the potential of performance-making and posthuman dramaturgy for entangling humans and machines. With the latter we seek to open up ontological boundaries, such as the one delineating subjects and objects, and to reconfigure them or render them porous, the bodily-material way. We believe that such reconfigurings challenge the limited, humancentric ways in which we envision our robotic futures by expanding our bodily ways of knowing and becoming more attentive to the performative potential of this hybrid, more-than-human encounter.

We begin with providing a brief overview of the practices within which our work is situated, along with some key artists whose work has influenced our practice. Following, we introduce our MML project and how it harnesses the generative potential of movement in tandem with dancers’ kinesthetic expertise to become-with and design abstract machine artifacts. We

then take a closer look at our performance-making approach and posthuman dramaturgical framing. Looking at the making of human-robot relationships as a more-than-human entanglement, we outline the feminist concepts that our new materialist practice draws on and seeks to mobilize. Finally, we discuss the making of an improvisational performance score, arising from our experimental studio practice, and how it aims to facilitate the engagement of audiences in embodied and empathic ways.

Situating our Practice

Looking at our relationships with robots from a performance perspective highlights their embodied, socio-cultural, material and, sometimes, codependent nature. We situate our transdisciplinary practice across the practices of machine performance, kinetic sculpture, and robotic art that experiment with movement and its capacity to evoke affective relationships between bodies and things. Artists have long deployed performance concepts to create ‘living’ sculptures or machine performances that both critically and playfully explore intimate couplings between human and machine bodies. Marco Donnarumma, for instance, seeks to highlight the co-dependence of hybrid (human-machine) embodiments rather than a “pairing of two different things.”⁷

Jean Tinguely’s early kinetic sculptures induce a sense of creative machine spirit,⁸ and Robert Breer’s slowly moving *Floats* used motorized wheels to gradually rearrange themselves in space, and thus, almost unnoticeably, reconfigure space.⁹ More recently, *The Table: Childhood (1984–2001)* by Max Dean, Raffaello D’Andrea and Matt Donovan produces surprising relational dynamics between audience members and the familiar object of a table.¹⁰ Kris Verdonck’s *Dancer #3*¹¹ performs the energetic clumsiness of an optimistic clown in empathically accessible yet distinctly machinic ways.

State Grace Machines by Bill Vorn, Emma Howes and Jonathan Villeneuve explores questions of kinaesthesia and perception in a dialogue between abstract machine performers and a dancer.¹² *Eve of Dust*, a collaboration between John McCormick, Adam Nash and Stephanie Hutchison, investigates possibilities of physical collaboration and cocreation between a human dancer and a robot arm¹³. Louis-Philippe Demers’ performance work *The Tiller Girls* foregrounds the whimsey and vulnerability of machine bodies;¹⁴ in line with Paula Gaetano Adi’s poetic embodied entanglements, such as

produced by her works *Becoming With* and *Alexitimia*,¹⁵ promoting the social presence of machines and strange affective capacity of abstract machines.

All these works generate their own dramaturgical frame for exploring the social capacity of non-humanlike machines and complicating our relationships with them; thus, expanding our understanding of how we relate to machines.

Machine Movement Lab (in a nutshell)

Our Machine Movement Lab (MML) project is a collaboration with dancers, choreographers, AI researchers, engineers, and numerous materials (from cardboard, PVC tubes, plywood to aluminum framing, motors, motor controllers, cables, cable binders, and software programs), across robotics labs, dance studios, fab labs, and gallery spaces over the past seven years. MML harnesses the generative potential of movement and its dynamic qualities to explore the aesthetics of entangling and empathy in human-robot encounters.^{14, 3} Rather than human-or animal-like, our robots are abstract, machinelike artefacts, forged from a practice of becoming entangled with the machine morphology and its unique, more-than-human capacities. Our latest research stage is concerned with performance-based inquiries into posthuman, transcorporeal reconfigurings and their potential to expand our possible relationships with abstract, machinelike robots.

Movement as a generative, relational force MML regards movement as a phenomenon or force, capable to make bodies, meanings, and relationships. This contrasts much of the current robotics research where movement is understood as a means of navigation or imbuing an object with a predefined personality. The difference between looking at movement as a productive force rather than an instrument is significant because it allows us to become-with what it generates—its enacted relations, specific to this situation, rather than using it to generate what we already know. This notion of movement mattering, bodying-forth¹⁶ and relation-making, opens-up seemingly limitless opportunities for entangling with more-than-human artefacts.³

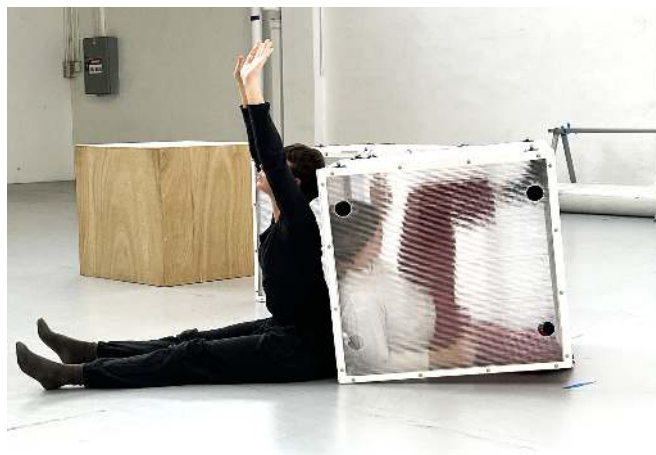


Figure 1. Relational Body-Mapping; with the cube performer, A. Frahn-Starkie and S. McKenna, 2022. © P. Gemeinboeck.

Relational-Body-Mapping (RBM)

Our MML practice revolves around the idea that the kinds of relation-making that movement propels happen in the dynamics of encounter and unfold through “spatial, temporal, and energetic qualities.”¹⁷ This is where meanings and affects get made and distributed across human and nonhuman bodies, rather than being predefined and preformed by certain beliefs about what this more-than-human relationship should be.

Our diffractive approach aims to harness movement’s generative force by enacting situations of close, corporeal encounter that can open-up kinaesthetic experiences of becoming-with the machine artefact and its unique material qualities. In practice, this involves getting entangled with material props, whose material qualities can offer us a corporeal glimpse of the machine’s more-than-human relational possibilities. To enable this becoming-with (i.e., entangling), we ask dance performers to extend themselves into, inhabit, or wrap around a wearable costume whose shape and size resembles that of the robot (see Figures 1 and 2). The costume thus stands in for a becoming-robot design, at the early stages of the design process, and enables dancers to feel into the robot’s material-spatial potential³ as well as the robot’s sensorium (equipped with the becoming-robot’s sensors).

This more-than-human entanglement, which we will refer to as *performer-costume* in the following sections, allows us to experiment with and corporeally probe into a range of human-machine configurings. Our Relational-Body-Mapping (RBM) approach builds on our Performative-Body-Mapping (PBM) method, which focused on single performer-cube entanglements and movement creation.¹⁸ RBM expands PBM to seek more

complex, nested entanglings and the transcorporeal resonances they can effect, e.g., a (human) performer with a (robotic) cube performer; a performer-costume with a cube performer; or a (human) performer with a performer-costume and a cube performer (see Figure 1), and so on.

Cube Performer

The robot costume not only allows the dancers to ‘feel into’ the differences of the machinic embodiment but also to capture the kinetic dynamics that unfold in this more-than-human entanglement. The hybrid motion data, arising from this human-nonhuman enmeshment, informs the robot’s machine learning process, where the machine learns to improvise movements based on its own mechanical embodiment and the patterns it derives from our entangled motion data.¹⁴

Our first robot prototype—the cube performer (see Figure 2)—resulted from a series of corporeal entanglements with a wide range of materials. It is a simple box-shaped artefact, which is transformed by its dynamic movements: suddenly tilting up along one of its edges and gently swaying or thumping onto the ground, the box quickly loses its rootedness and becomes more-than-object¹⁴. The robots’ mechanical design was derived from an extensive analysis of motion capture recordings of the *performer-costume* and the relational motion patterns it produces¹⁹. Instead of relying on googly eyes or pre-packaged personality, the robot cube becomes a performer based on the enactive potential of its movement dynamics [see ²⁰, ¹⁷] and how they can co-shape a meaningful encounter.

A more detailed discussion of our performance-based, embodied robot design stage can be found in ³, ¹⁴, ¹⁸, ¹⁹.



Figure 2. Cube performer #1, robot prototype, at the Games as Performing Arts Festival, AMATA, Falmouth University, UK, 2018. © P. Gemeinboeck.

Diffraction Performance-Making

Our diffractive performance-making practice investigates how corporeal entanglements with machine artefacts and their different material-spatial and affective qualities can open-up modes of transcorporeal empathy. The latter, we believe, is key to meaning making with social machines without relying on fake emotional facades (i.e., a humanlike face).

Robotics practices, in general, often look at humans and machines as two separate, already given or predefined entities (i.e., subject and object). MML, in contrast, attends to how subjects and objects are mutually constituted² by investigating the making of subject-object boundaries as a nested entanglement. Meaning making here is about carefully attending to the possibilities for relations and meanings to emerge.

According to Jon Lee, the alternative landscape of a diffractive dramaturgy is experimental and experiential, “where we feel for and towards (in a tentacular way) a collaborative making process that tilts the optic away from traditional expectations.”²² Our diffractive, posthuman dramaturgy generates an experimental and experiential space, where we feel for possible entanglings, tentacular capacities and hybrid configurings of human performers and nonhuman artefacts. It involves carefully probing into how they matter, couple, interfere, and “undo and redo each other,”²³ and how this difference-in-relation gives rise to transcorporeal meaning-making.

The following outlines some of the core theoretical concepts that our performance-making practice draws on, and then discusses some of the most significant interference patterns whose emergence we have witnessed thus far.

Diffracting Subjects and Objects

Our posthuman dramaturgical approach attends to and aesthetically puts to work difference-in-relation (i.e., humans and machines entangled) by seeking to materially mobilize Haraway’s⁶ and Barad’s¹ concept of diffraction. In contrast to reflection (i.e., rendering machines humanlike), diffraction maps interferences¹⁴ and as such “attends to the relational nature of difference.”²⁴

A diffractive practice embraces and foregrounds differences by attending to the specificity and materiality of entanglements.¹ Diffraction thus not only serves as a figurative lens but can shape a material process, i.e., in our practice the dramaturgical/choreographic methods of interfering, superposing and entangling bodies and things.

From a posthuman perspective, we always already are entangled with the world and its ongoing reconfigurings.²⁵ Barad's notion of a posthumanist performativity calls "into question the givenness of the differential categories of 'human' and 'nonhuman', examining the practices through which these differential boundaries are stabilized and destabilized."²⁶ Diffraction as both a tool and a practice can make manifest the destabilization and stabilization of boundaries.²⁷

In MML, we are particularly interested in the boundary-making that both separates and defines subjects and objects. How can we intermesh (given) subjects and objects, probe into their boundaries and render them more porous or create new hybrid entities? Rather than juxtaposing humans and machines or making them appear to be the same, we seek symbiotic possibilities based on difference patterns that render the boundaries between subjects and objects more elastic. Diffraction and patterns of interference thus become a methodological tool for "attending to and responding to the effects of difference" [17: 72]. The entanglement of bodies and things maps their effects of difference similarly to Barad's description of superposition:

"... waves can overlap at the same point in space. When this happens, their amplitudes combine to form a composite wave form [and] the resultant wave is a sum of the effects of each individual component wave; that is, it is a combination of the disturbances created by each wave individually. This way of combining effects is called superposition".²⁸

A posthuman dramaturgy for diffracting subjects and objects thus troubles engrained dichotomies and, instead, traces the effects of differences that give rise to new forms of more-than-human meaning-making—in MML, a trans-corporeal form of meaning-and experience-making, which we will look at in more detail below.

More-than-human Interference Patterns

Superposing human bodies and cubic things, in practice, requires ongoing attunement to the becoming of bodies and, with it, emerging agencies and differing identities—a moving with and continuous gesturing toward the more-than-human space of a 'thing'—the process of becoming-thing. The empathic resonances brought about by this superposition can be described as a bodying-thinging.⁶ Transcorporeal bodying-thinging is about how bodies and things resonate whilst undoing and redoing each other; at once tracing how subjects and objects constitute each other and at the same time rendering their boundaries elastic.³ It attests to the inherent porosity, relationality and reconfigurability of bodies and things, how they already always extend toward and across each other.

The following explores three of the most significant interference patterns that we have observed thus far and how they mobilize transcorporeal resonances of bodying-thinging. They come about based on different degrees of entanglement, the number of entangled bodies and things, and the emergent effects of ongoing reconfigurings.



Figure 3. Becoming with the cube; with dancer A. Frahn-Starkie, 2022. © P. Gemeinboeck.

Pattern #1: Spatial Superposition, Becoming-with

This interference pattern manifests from the dancers corporeally exploring their entangledness with the cube by bodily listening to its material characteristics and capabilities and the cube responding (talking back) by producing different material sensations (its weight, how it bends, where it resists, etc.). Becoming-with (see ²⁰) the cube then involves dancers reconfiguring their

bodies as well as letting themselves being shaped by these nonhuman qualities and to feel-think-move-with the cube (see Figure 3). Sometimes the two simply interfere, other times they are in-phase, become-with, and are bodying-thinging with each other.

Pattern #2: Stretching the Boundary between Subject and Object

We found that dwelling on the edge (i.e., the subject-object boundary, which may also align with an edge of the cube) and feeling into it, stretches and carefully opens-up the boundary in-between subjects and objects. The threshold of the boundary becomes a zone to linger, to extend into or be extended by, to become familiar, to mingle with (see Figure 4). It is the most symbiotic cube-performer interference pattern with regards to its resulting shape and the entanglement's tentacular capacity (see following section), where body-thing can no longer be separated, nor is one entirely folded into the other. Rather than a barrier, the boundary becomes an access zone—a gateway to bodying-thinging and exploring the symbiotic affordances of this hybrid performer-costume entity.

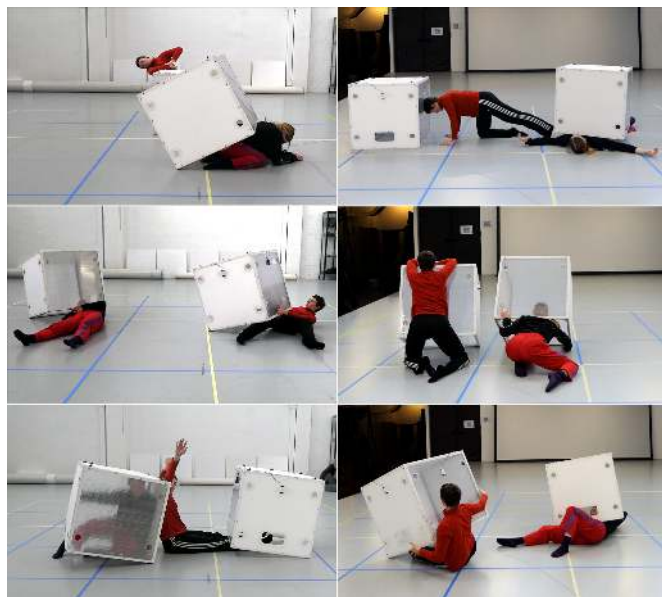


Figure 4. Stretching the Subject-Object Boundary; with A. Frahn-Starkie and F. Palmerson, 2022. © P. Gemeinboeck.

Pattern #3: Nested Entanglings, Becoming-tentacular

Performance-making involving more than one performer and one costume produces a nesting of difference patterns and, with it, the affects that flow across the open seams of each pattern. The nested entanglings unfold in a continual process of attachments and detachments, e.g., the dancers attaching themselves to a corner of the costume, a corner of the space, or to a corner of the other costume, even if only for a glimpse, even with only the tip of the toe (see Figure 5); then detaching again—from the corners, one by one or all at once, to reattach and align with an edge, or a plane, or the other dancer's gaze. These re-/alignments open-up spaces to link/mesh/interweave with other boundary spaces, stretching and extending the lines of the cube to reach into or meet other lines, and performer-costumes become tentacular and intermesh; bodying-thinging here also means to grow tentacles. Haraway speaks of "tentacular ones [and how they] make attachments and detachments; they make cuts and knots; they make a difference; they weave paths and consequences but not determinisms; they are both open and knotted in some ways and not others."²⁹

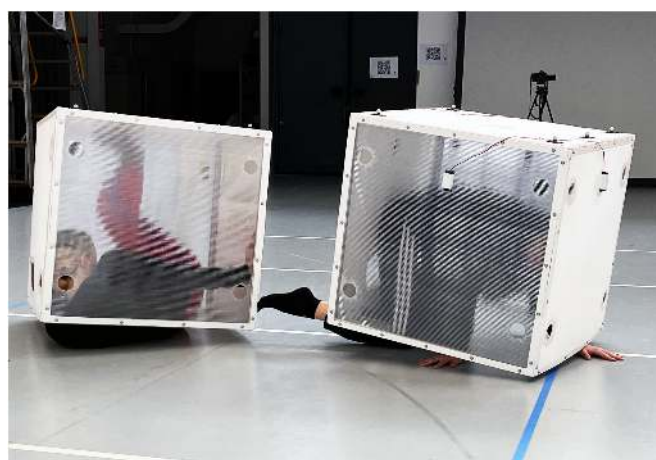


Figure 5. Nested entanglings; with dancers A. Frahn-Starkie and F. Palmerson, 2022. © P. Gemeinboeck.

All three of these symbiotic difference patterns result in movements and dynamic constellations that are irreversibly hybrid: The dancer's body is reconfigured by the costume, and the movements captured with the costume reconfigures the movements learned by the robot.^{6, 18} And when performer-costume and cube performer (robotic artefact) entangle and become tentacular, new motion patterns evolve—movements that neither belong to the machine nor the performers-in-costume.

In the following we explore how our improvisational score builds on these interference patterns and unfolds them as a series of experiential scenarios, each performance anew.

Scoring an Improvisational Performance

Dancing with the Nonhuman is a roughly 20-min performance work, to be performed in gallery spaces rather than a separate stage. Its underlying semi-structured, improvisational score seeks to open-up our diffractive process to the diverse embodied perspectives of audiences by performing human-nonhuman interference patterns and the transcorporeal attunement they produce—each iteration anew.

Arising from our experimental studio practice and observed, emergent-diffractive patterns, the underlying improvisational score shapes different 'lenses' through which the experiential scenarios of human-nonhuman entanglement unfold. The following outlines the four lenses that propel *Dancing with the Nonhuman* [SYD-2-2-1] and how they mobilise differently hybrid and tentacular configurations.

In **(1) 'phantom'**, we witness a series of movements shaped by the dancers' cubic entanglement but reperformed without the cube costume. The performance thus opens with a kind of puzzle as these movements clearly belong to a realm that is both more-than-human and more-than-object.

In **(2) 'threshold'**, dancers feel their way along the boundaries of the cube costume, extend them, entangle with them, and render them elastic; meanwhile the cube performer slowly glides along straight lines, occasionally beginning to twitch out of the grid.

In **(3) 'con-current'**, we witness the dance performers fully inhabiting their cube costumes. The encounter between cube performer and performers-in-cube appears seamless and interferences express themselves along geometric lines. In **(4) 'co-play'**, the encounter becomes a playground, and it gets a bit messy, bodies and things tumble. And so do their boundaries.

Audiences and transcorporeal empathy

At the time of writing, we are yet to perform this work in public. Importantly, audiences are not expected to decipher any of these patterns or lenses. The aim is for them to engage with these alternate, posthuman human-machine configurations not only by looking but also by transcorporeally empathizing with them, based on their own corporeal experiences with tentacular, more-than-human configurations.

As we strive to collapse the distance between subjects and objects, we also seek to render the boundary between performers and audiences more porous. To avoid the distancing effect of a stage, *Dancing with the Nonhuman* is designed to be performed in gallery spaces. The performance area is only marked through a grid on the floor, which assists performers to locate themselves; it also represents the cubic grid that the cubes break loose from (see Figure 6).

To render the boundary more porous, the performance includes transitional intro and outro stages, in which the performance site is gradually established and dissolved again. In the intro, audiences are welcome to stay inside the marked performance area and mingle with both human performers and cube performers (costumes and robot), while they slowly shuffle across the boundary and get settled inside the grid space. At the end of stage 4, the boundary becomes soft again and audiences are welcomed to interact with the performers, both human and nonhuman. While this could be as casual as sitting down and gently leaning against one of the cubic artefacts, we are keen for audiences to bodily explore the performers' perspectives, both human and nonhuman, and to get entangled themselves.



Figure 6. *Dancing with the Nonhuman* [SYD-2-2-1], rehearsal, with A. Frahn-Starkie and F. Palmerson, SHErobots, Tin Sheds Gallery, Sydney, AU, 2022, © P. Gemeinboeck.

This paper introduced our collaborative, diffractive performance-making practice, as part of our ongoing Machine Movement Lab (MML) project, to promote unscripted, playful encounters with strange, non-humanlike machines. Our collaborative project centers around the generative potential of movement to harness dancers' kinesthetic expertise for empathizing with abstract machine artifacts. This performance-making practice and its posthuman dramaturgical frame materially mobilizes the theoretical concept of diffraction and new materialist notions of agential enactment.³⁰ The more-than-human entanglements that our practice attends to produces the diffraction patterns for mapping out alternative human-machine relationships. This difference-in-relation also shapes the making of a semi-structured, improvisational performance score, aiming for audiences to engage with these hybrid entanglings in embodied and empathic ways.

Our diffractive, creative research seeks to open-up new performative strategies for aesthetically attending to and making tangible difference patterns and relational ontologies at work in human-robot encounters. We propose that opening-up a more horizontal playground for dancing with machines requires us to get entangled and resonate with machines, which, in turn, requires collapsing the distance between subjects and objects (rather than masking it). Collapsing distances, the diffractive way, means to stretch and open-up the boundary in-between subjects and objects, to explore the space in-between, and grow tentacles into other boundary spaces. Performance-making here is a mode of generative-diffractive inquiry into the re-/enactment of subject-object boundaries as part of the dynamic exchanges unfolding in human-robot encounters.

Concerned with the relationalities of embodied meaning-making,¹⁴ our choreographic-dramaturgical strategies explore the performative aesthetics of corporeally entangling human bodies and machinelike things and the more-than-human difference pattern this produces. The aesthetic potential of this practice, we believe, results from combining the asymmetries that differentiate human and machine participants² and the physical-dramaturgical entanglements that render them relational, producing seemingly dissonant inter-bodily resonances. Rather than serving to make the strange look more familiar, aesthetics here is about rendering difference more relational.

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Petra Gemeinboeck's and Rob Saunders' collaborative artistic research practice seeks to expand and trouble our relations with machines by exploring questions of embodiment, agency, creativity, and performativity. Petra is currently an Australian Research Council Future Fellow and Associate Professor at the Centre for Transformative Media Technologies (CTMT), Swinburne University, AU. She also leads the 'Dancing with the Nonhuman' FWF research project at the University of Applied Arts Vienna, AT. Rob is Associate Professor at the in the Leiden Institute of Advanced Computer Science (LIACS), University of Leiden, NL. His research focuses on computational models of creativity, using techniques from machine learning and creative robotics. Their artworks have been shown internationally, including the Ars Electronica Festival (Linz, AT); Int. Triennial New Media Art at NAMOC (Beijing, CN); GoMA (Brisbane, AU); OK Center for Contemporary Art (Linz, AT); and FACT (Liverpool, UK).