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Inventing Cultural Machines

Human history is intertwined with the history of machines. According to some scholars, it is the drive to create machines that makes us unique (Mazlish 1993: 216), and many agree that human evolution began with the invention of tools (Landau, 1993:51, Brooks 2002:5; Taylor, 2010). It seems safe to say that we can think of human evolution only as a co-evolution of humans and machines. They allow us to control and even create our environment, have empowered us to dominate the world, and have become our mirror image in which to study ourselves. This co-evolution is the starting point, context, and experimental playground of our collaborative practice in art and technology. Rather than extending the debate on 'The Singularity' and whether machines will eventually dominate their human inventors, we're interested in the intermingling of the two, and the continuum between what we consider our human life and that of our machines. In a way, our source of inspiration is human inventiveness itself, and our motivation is to invent a reality for the two—humans and their creations—to encounter one another.

Our artwork Zwischenräume (In-between Spaces, 2010-12) develops from an unusual concoction of walls, curious robots and surveillance technology. The work nestles itself into the human environment by embedding robots into the architectural skin of a gallery, sandwiched between the existing wall and a temporary wall that resembles it. Each machine agent is equipped with a motorised hammer or punch, a camera, and a microphone to interact with its environment and communicate with the other machines. Programmed to be curious, the robotic agents are intrinsically motivated to explore their world, and once they have ripped open the wall, they begin to study its human inhabitants. Doing so, they physically manifest and inscribe their perception and communication processes into our built environment. The wall becomes the milieu through which the machines express their desires, leaving behind marks and open wounds.

Inventing a Machinic Assemblage

The starting point of our interdisciplinary collaboration was our common interest in the open-ended potential of creative machines autonomously acting within the human environment. From the computational creativity researcher's point of view, the embodied nature of the agents allows for situating and studying the creative process within a complex material context. For the artist, this collaborative practice opens up the affective potential to materially intervene into our familiar, human-created environment, bringing about a strange force, seemingly with an agenda and beyond our control.

One unique aspect of *Zwischenräume* is that the robots are hidden, at least at first, behind—what audiences believe to be—an existing wall. We are interested in deploying robotics as a medium of intervention to shift the focus from representation to performativity. As such, the robots become part of an affective assemblage entangling human agents and nonhuman agents. Following Broeckmann's definition of the machinic as an aesthetic principle, we were interested in "process rather than object, with dynamics rather than finality, with instability rather than permanence, with communication rather than representation, with action and with play" (1997). This unstable context of invention has challenged our experimental process: we needed to invent embodied agents that we could

control to the extend that they remain operative, while behaving and adapting autonomously in an ever-changing environment; develop a configuration that couples these machine agents with other agents–walls–in ways in which the wall could become an active agent that the machines need to adapt to, while at the same time being transformed and structurally compromised by this material 'play'; and devise a setting that would allow us to inject this dynamic process into our existing, familiar environment. While we have discussed the inner workings of *Zwischenräume* in more detail in other writings[1], here we give preference to the constitutive contextual layers of our inventive process. It is perhaps unnecessary to say that this process wasn't as clear-cut and linear as the above sequence of challenges would suggest. On the contrary, in contrast to technological inventions, the drivers for artistic inventiveness are primarily problem finding, rather than problem solving. Thus, while the above challenges could be seen as both conceptual and technical problems to solve, more often than not, found or identified 'problems' simply open up another set of possible paths, each unfolding a series of discoveries and unforeseen points of departure.

We can imagine that this account of our process of discovery resonates with many scientists. What is fundamentally different is that we didn't start out with a hypothesis, and we didn't have a rigorous set of protocols, neither to adhere to, nor at our disposal. Rather, our experimental process could be described as a kind of material thinking, at points driven by our conceptual desires, and at other times driven by the materials we encountered and assemblages that emerged from the process. In the process, concept—our ideas and motivations for bringing these material actors together—and matter—that is the material agents and their capacities to interact with other agents—mingle to a degree where they become inseparable. Perhaps another significant distinguishing aspect between an artistically driven inventive process and many other creative, inventive processes, is that there is no optimal solution. Even if there was, this isn't the goal; rather it is a process of allowing both the 'goal' and the 'solution' to emerge from a series of iterative conceptual–material negotiations. This requires both collaborators to sometimes abandon what they know, and to allow unexpected or emergent confluences of material behaviours and, for example, programmed behaviours to set the course.

Space of Performative Possibilities

The machinic assemblage as aesthetic principle merges with our motivation to also situate the work in our respective academic research fields: experimental media arts and computational creativity. In both our research practices, we are interested in the ontology of the process, that is, its performative capacities, rather than a representation of the process. Andrew Pickering talks about it as "a decentered perspective that is concerned with agency—doing things in the world—and with the emergent interplay of human and material agency" (2002). To provide an example, it is vital that *Zwischenräume*'s machine agents have the capacity to adapt autonomously and act proactively so that both the material and social encounter happens without us prescribing its course to unfold. As the agents' embodiment evolves based on their interaction with the environment, the robots' creative agency affects processes out of which it itself is emergent.

Gordon Pask's *Musicolour (1953),* processing the sound from musical instruments to control a light show, is a pioneering work with regards to placing human and machine performance in a level playing field setting. The work didn't simply convert sounds in a pre-scripted manner, but adapted its performance in response to how it 'perceived' the musicians' performance. If its inputs from their performance became too continuous, *Musicolour* changed the frequency ranges or rhythms it listened to and responded only when it registered those (Haque 2007:56). As this affected the musicians' improvisation, the machine became a co-performer.

In applying the computational model of curious agents (Saunders 2001), we empowered *Zwischenräume*'s robots to become self-motivated and proactive agents that, once embodied and embedded in our human environment, nestle themselves into our social fabric, even if only temporarily. This is where the encounter happens. The machines are driven to learn by discovering novel elements in their environment, even if this means that they themselves introduce difference by knocking at the wall until it gives way and their 'world' can offer a new, interesting element to study. From the audiences' point of view, the machines' eager engagement and the impact it has on *their* environment brings with it an alien, uncanny force, able to unsettle our sense of control and security. But it's not as simple as a dualist encounter; machines have never been and will never be a force from the outside. The complicit entanglement gets further uncovered, once the machines have opened up the wall and the robots begin to discover the world on the other side of the wall. They don't only respond to the audiences' presence and behaviours, but also have the capacity to perceive the audience with a curious disposition. As the audience peeks into the holes in an attempt to understand what drives these machines, the machines look back at them. The newly discovered human inhabitants bring an insatiable amount of difference to their world. The audience is thus implicitly implicated in the work's unfolding affair, and becomes complicit, rather than being invited to control the course of events. This produces an interesting shift, where the work doesn't only perform for the audiences' eyes, but audience members also perform for the work's voyeuristic gaze.

Machines that act on, what could be thought of as, a 'level playing field' with humans not only open up the cultural potential of creative human-machine collaborations, but also the political potential of human-nonhuman assemblages that unhinge the humans' central and superior position. Pickering romantically describes it as "the dance of human and nonhuman agency", a dance that involves "indefinitely open-ended searches of spaces of agency" (2002). This is also the dance of material thinking, where nonhuman, material performativity becomes an arena of negotiation that expands, diverts and, literally, messes with our doing and thinking. In our experimental practice, we constantly struggle with material agencies, in creative ways, including those that we often assume to be passive and static. The material character of the plasterboard wall in *Zwischenräume*, for example, makes it an active player, whose organic frilling not only visually transforms the machines' actions but also actively affects their perceptions and behaviours.

Coming back to the process of invention, we argue that it is not only the many voices and knowledges from the inventors' cultural and social context that play a significant part, but also the many nonhuman agencies, material and machinic, that are constitutive of the inventive process. Often these agencies only emerge and play themselves out in Pickering's 'dance of human and nonhuman agency'. According to Karen Barad, agency always is an enactment, "not something that someone or something has" (2007:178). In the process of making, eventually the indefinitely open-ended number of searches shrinks to a limited number, constrained by available resources but also the need for the process to eventually gel into one, coherent performance. Importantly, however, our performative environments, never present a final, fixed result, but rather assemble a certain stage in the process or configuration of actors that remains open and dynamic. Thus, embracing the unfixed and unknown in the principle of assemblage not only shapes the authors' iterative, experimental process of developing the work but also the audiences' experiential process as the configuration of players unfolds.

The Artwork as a Cultural Machine

Artistic inventiveness does not only concern the production of an original 'artefact', nor is it the outcome of the experimental technical development in our work. We see it as a strategic intervention into cultural and social discourse, where the artwork is its aesthetic

materialisation and the technology is at once the means of production and the complicated, investigated protagonist. For *Zwischenräume*, assembling itself at the edge of both the human and the nonhuman realm, this conundrum is a source of inspiration itself. *Accomplice* (2013), our latest machine-augmented environment, extends the notion of social agency into the machine realm: the machine inhabitants of our built environment become social agents and the wall becomes a shared territory for them to connect, cooperate and conspire.

As machines become part of our social fabric, the co-evolution of humans and machines is complicated by the increasing agency and autonomy of our machines and our growing intimacy with them. And this is perhaps the first layer of encounter that our works evoke. Yet *Zwischenräume* and *Accomplice* also challenge the confining human–machine dualism by letting the encounter of humans and machines unfold in an unexpected, perhaps slightly precarious scenario that aims to allude to a broader notion of 'machine'. If we had been only interested in creating machines that autonomously destruct walls, we would have placed them inside the gallery space to perform for the audience in plain sight. *Zwischenräume* and *Accomplice* instantiate cultural machines that, as they unfold and become, reach beyond the conceptual bounds of the technological apparatus, and operate as an abstract machine that installs itself transversally to all heterogeneous machine levels, the material, cognitive, affective and social (Guattari, 1995:35). Promoting a politics of change, the artistic inventive act operates like a rupture, disrupting the familiar, habitual assemblage to create a new affective assemblage (O'Sullivan:199). Hence, we argue that the employment of robotics as a medium of intervention to create an affective assemblage that radicalises the human-machine relationship is a significant inventive aspect of our collaborative practice.

Looked at in more pragmatic terms, many parts of this assemblage cannot be bought off-the-shelf, and the act of assembling involves a great deal of experimentation and invention. We don't invent technologies to facilitate the making of the work or to (re)present an experience, but rather the technological invention becomes the artefact itself, or perhaps more precisely, enacts the performance. Simon Penny calls it a 'machine-artwork', where "the embodied affective experience is integrally related to and cannot be separated from the material manifestation of the artefact" (2002:149).

Shannon's *Ultimate Machine* is perhaps also the ultimate machine-artwork. A simple wooden case with the size and shape of a cigar box, the only thing we can see on the outside is a switch. Once switched, one can hear motors buzzing, the lid opens, and a hand emerges—only to turn the switch off. The hand retreats back inside the box, the lid shuts and the machine is an unassuming box again. After Arthur C. Clarke's haunting encounter with the *Ultimate Machine*, he wrote: "There is something unspeakably sinister about a machine that does nothing—absolutely nothing—except switch itself off" (1958). The machine's sole purpose is to subvert the very notion of what a machine is, and, thus, extends what a machine can be.

Collaborative Inventions in Art and Technology

Invention and creation are at the heart of both artistic and engineering processes, albeit creation often has a too unwieldy undertone to be used to describe the engineer's motivation, and invention often mingles too closely with innovation and its corporate baggage to be embraced by artists. Media art, and in particular the area that often is referred to as Art and Technology, has a history of artists and engineers collaborating or individuals who embrace the skills and values of both Cultures. In contrast to the engineering domain, inventing an optimised solution to an already known problem rarely drives an experimental artistic process. Rather, as Jill Bennett succinctly puts it, "experimentality manifests as a disposition, a drive to question, transgress and reinvent

that in turn inflects the particular exploratory processes or 'methods' of art making" (2012:1). To the artist, the world doesn't pose a spectrum of problems that need to be solved or a messiness that needs to be modelled and controlled. This defiance of rigorously formalised and reproducible approaches renders art a more inviting and promising field "to pursue eccentrically motivated research" (Penny, 2002:155).

Much of what separates art and engineering practices is rooted in their institutionalisations and the complex social meshwork they produce, and, arguably, "art is apt to exceed any institutional designation, confounding expectations about what it is and where it belongs" (Bennett, 2012:1). As in any collaboration, in the end, however, it is people with their personal interests, motivations and backgrounds, who meet, engage and work together. This very personal aspect cannot be underestimated, and, inter– or transdisciplinary collaborations are better thought of as collaborations between people coming from different disciplinary backgrounds or driven by different motivations, informed by their disciplines, rather than collaborations between disciplines.

Our collaboration presents a rare constellation of an artist and an engineer, co-creating artworks, that acknowledges both as equal authors of the work. Each of us is involved in the problem–finding and –solving in both arenas, the conceptual–aesthetic and the technical–agential. Despite the long history of artists and engineers collaborating, such a horizontal co-authorship still seems radical. This is where the collaborative practice falls apart into its disciplines and institutions again, and only the artist can claim authorship of the artwork. More often, both Cultures see the engineers' contribution as a service to facilitate the artists' work, rather than as part of a mutual collaboration that transforms each other's work and has the potential to flow back into their respective fields. While, naturally, each collaboration is different, it seems strange that even in the field of experimental art and technology, where the machine-artwork emerges from an intimate mingling of conceptual and technical problem–finding and –solving, the engineer is seen as only enabling the making of the artwork but not its co-creator.

Let's briefly take a closer look at this by going back to an important point in the history of Art and Technology. Experiments in Arts and Technology (E.A.T), founded in 1966 by the engineers Billy Klüver and Fred Waldhauer and artists Robert Rauschenberg and Robert Whitman, was seen as "a tentacular service organisation, whose mission was to facilitate the work of artists in any field or discipline" (Lacerte, 2002: 161). All artworks that came out of E.A.T. have been associated only with the artists, e.g. Robert Rauschenberg's 'Solstice' (1968), which he developed in collaboration with the engineer Robby Robinson. Billy Klüver provides us with a lively, intimate account of their inventive collaborative process: In February 1968, Rauschenberg called Robinson about a new work for the Documenta in Kassel, which opened at the end of June, 1968. In their first meeting about this new work, according to Robinson, Rauschenberg "wanted to try to achieve something that would involve people with his work but not in such a sophisticated way that they were mystified by how it happened, but so they could really see how it happened" (Robinson, 1979, quoted in (Klüver & Martin, 1998). Klüver continues,

> As they talked about what the possibilities were, Robinson told Rauschenberg about going through several sets of sliding doors at Schiphol Airport in Amsterdam to get into the main terminal and that he thought they could put something on the doors to alert you to the next one you would encounter. A few days later, according to Robinson, Rauschenberg called and said: "Robby, I have an idea." ... So I went there and he had a whole plan worked out in his mind for Solstice, a series of sliding doors mounted on a platform. The light would be constant and the only movement would be the mechanical movement of the doors. He explained that he was thinking of an image that you could view either from the front or from the rear. In addition, you could

> actually walk through the layers of the image and find how the total image was derived from the various [colored] overlays." (Robinson, 1979, quoted in Klüver & Martin, 1998).

Robinson's role was to create the physical installation and its pneumatically driven sliding Plexiglas doors, while Rauschenberg composed the screens to became the layers of the image for people to walk through (Klüver & Martin, 1998). This opens up the question: does the artwork come into being by placing Rauschenberg's screens onto the industrially manufactured sliding doors, or is it the environment or experience this installation creates by allowing people to move through the layers of an image? We think, it's the latter, and Robinson's contribution, starting with the familiar experience of the airport's set of sliding doors, can't be reduced to the level of a facilitating service. In addition, it is mainly due to Billy Klüver's passionate accounts that we can engage in these pioneering events in art and technology today. Klüver was interested in finding "new means of expressions for artists … and to find out where they stood in relation to the society that was sending men to the moon" (De Long). But he didn't believe that this was a one-directional transformation. In an interview with Edward Shanken, Klüver said:

> I believed that the artists would influence the engineers and then change the technology. Of course, the point is that the artists would work with engineers and change the engineers (Shanken, 2002:176).

Isn't it this visionary belief, or naïve conviction, that often frames the starting point compelling both artists and researchers to walk down yet unknown paths? We must acknowledge here that collaborations in art and technology are still happening only at the fringe of the art world. Even if accepted, the interactions, transformations and inventions that can only happen in this is specific coming together of people with different disciplinary backgrounds are often not recognised as constitutive of the artistic process, only as enabling[2]. Yet, does engineering value the changes that the engineers may bring back to the field? All too often, the field of engineering is blind to the cultural context that opens up new paths. We need to understand how much of the 'problem solving' happens in the very act of the coming together of different cultural forces, whether these are different disciplinary approaches or human and nonhuman agencies; and that a 'solution' may not be a singular event or an optimised outcome, but rather a new window into the complex interactions and entanglements that every invention is situated within.

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Endnotes:

[1] Please see:
"Other Ways Of Knowing: Embodied Investigations of the Unstable, Slippery and Incomplete" in *Fibreculture Journal* 18, 2011, 9–34

"Creative Machine Performance: Computational Creativity and Robotic Art" in Proceedings of the Fourth International Conference on Computational Creativity (ICCC 2013), University of Sydney, June 12 – 14, 2013.

[2] There are a small number of academic institutions, centres and study programs that are committed to interdisciplinary research in the area of art and technology and that promote the potential of mutual transformations and an emerging Third Culture. Without providing a comprehensive list here, we would like to point to the MIT Media Lab, promoting a unique, anti-disciplinary culture; the Art | Sci Center + Lab at UCLA, California, and its vision of artists working in the lab, and scientists working in the art studio; the Ars Electronica Centre's pioneering exhibition program that seamlessly engages audiences in artistic, engineering and scientific inventions, and Simon Penny's interdisciplinary graduate program in Arts, Computation and Engineering at the University of California, Irvine.