Material Agency and Performative Dynamics in the Practices of Media Art

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By

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Abstract

This dissertation identifies a strategy of artistic inquiry within contemporary media art practice. It applies the concept of material that acts in an agential capacity, generating performative acts. It argues that the emergent potentials of materials and their interconnectedness with the compositional layers of a work can facilitate modes of effecting change in the artistic system.

Through the theoretical investigation of the production processes of physical structures and environments, the thesis focuses on the compositional dynamics within which materials actively perform. It examines how Lars Spuybroek's architectural design method of Material Machines (2004), and both the tactile potential as well as tactical uses of materials as generators to the form-taking process, might describe an open and active artistic strategy for employing the experimental capacities of such materialization processes.

Building on philosophical and conceptual arguments that trace concepts of agency (Bruno Latour's Actant-Network theory) and enactment (Karen Barad's concept of intra-acting), the thesis introduces the two installation works ANI_MATE (described as a performative pneumatic stage machine) and ON TRACK (described as a mechanic-robotic installation). These apply the introduced artistic strategies. The analyses of these two artworks traces the particular capacities of the materials involved (respectively, their elasticity or viscosity) to negotiate forces of physical movement, which effect the system to transiently or irreversibly transform.

ANI_MATE is a machine that is artist-operated and that explores the relationship between live-animation procedures and the transformability and flexibility of its material environment. In contrast, ON TRACK's performative machine ecology removes human agency. The machines act autonomously, giving rise to chance in the artistic system and allowing agency to emerge from the dynamic interconnectivity between materials, parts, and processes, eventually producing an entropic scenario of spilling resources.

The thesis concludes that, in the context of a post digital paradigm in-development, such artistic practice offers a new strategy for an emergent aesthetics within contemporary physical-digital performance.

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Introduction

[...] think slowly an idea that runs fast through modern heads: the idea of matter as passive stuff, as raw, brute, or inert.[1]

This thesis is a discussion of the experimental and conceptual procedures which undergird the creation processes of two (mixed) media art installations: ANI_MATE (2006) and ON TRACK (2009). This practice-based research aims to identify a mode of artistic inquiry that addresses materials' productive contingencies[2] in the process of creation. It examines how the artworks with which this thesis is concerned can be addressed through their materiality, and identifies how the emergent qualities of materials and their interconnectedness with other compositional and informational layers of the work can effect change and generate performative, and transformative processes.

This research project seeks to expand contemporary media and performance practice by connecting concepts of agency and enactment with the idea of material that performs as an agent within the layered context of an artwork. The thesis argues that *material agency* and materials' performativity emerges through their agential powers to transform and effect changes, as well as being transformed through enactment. Consideration of materials as possessors of their own modes of conditions, trajectories, and tendencies of transformation, and thus as lively materiality, stands counter to the conception of matter as functioning solely in terms of benchmarks and applicability. It also disturbs the common understanding that agents are necessarily human beings, who harness intentionality and possess the freedom to act. The hinge this thesis develops with current discourse on agency and materiality is to broadening the scope of action, taking it into the domain of unintended, accidental, and contingent - yet productive – effects, and to draw material's agential capacities into the complex relationships of the alive world. In terms of the developed artistic strategy described herein, transposing this approach into media art and performance practices means to conceptualize and materialize scenarios, environments and installations that *show* these complex relationships on stage, rather then *representing* them. It is my contention that such an approach to material agency, or to the effectiveness of non-human things, posits a challenge to the existing understanding of anthroprocentric subjects and subjectivities of performance.

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[1] Jane Bennet, *Vibrant Matter: A Political Ecology of Things* (Durham NC: Duke University Press, 2009), p. vii.
[2] The concept of contingency is introduced here as a way to cast doubt on intentionality and individual agency. Though, in the context of this thesis, it does not figure as to signaling lack of causality, but is understood as "productive," yet indeterminate.

Emphasizing the productivity and capacity to effect, as well as the resistance of matter, and thus giving value to material contingent processes, this thesis aligns itself with the re-emergent discourse on materiality within digital culture that is concerned specifically with questions that revolve round the concept of active and agential matter. The relationship between digital technology and materiality has been subject to cultural and media theories for the last few decades. During the 1980s and 90s it was articulated through the technology-orientated discourse concerning the disembodied and immaterial conditions of information.[3] This discursive context was contiguous with the idea of "virtual reality"[4] (VR) and the exploration of virtual environments and immersive technologies in dance and performance contexts.[5] More recently, materialist accounts seek to carve out more dynamic ways of understanding the heterogeneity of digital culture through engagement with the multitude of materialities we encounter in our contemporary technological society. These new materialist accounts that are currently emerging across the social sciences and humanities, bring into focus new thinking about matter and processes of materialization and draw attentions to the existence and experience of intensities, forces and potentialities that are not exclusively human.

As human beings we inhabit a material world, yet for the most part we take for granted, as political theorist Jane Bennett has formulated in the opening page of her recent book *Vibrant Matter,* the "idea of matter as passive stuff, as raw, brute, or inert."[6] Bennett's project is to articulate a vibrant materiality that de-privileges humans without disengaging them from "a political ecology of things." A similar position is taken by Diana Coole and Samantha Frost, who in their editorial introduction to *New Materialisms* suggest that "materiality is always something more than 'mere' matter: an excess, force, vitality, relationality, or difference that renders matter active, self-creative, productive, unpredictable,"[7] claiming that "foregrounding material factors

[3] Immateriality – an influential notion within media culture in the technology-oriented discourse of the last decades refers to the artistic and cultural practices prompted by the condition of the digital. Software, digitized data, and the effective modes of transferring information across networks became artistic mediums in themselves and challenged the physicality of artworks

[4] The term virtual reality refers to computer-simulated environments that enable user interaction and that gives the sensation of presence in the simulated world.

[5] Writer and designer Mary Ann Moser has noted that "when 'virtual reality' was first ballyhooed as the technology to change the world or, better yet, replace it, it was treated as fundamentally different from technologies developed up to that point." According to Moser, the term virtual reality, or virtual environment, delineates an apparent dematerialization of experience. It may be due to the possibility of programming human presence in immaterial "space" that explains much of the hype surrounding this, at that time new medium.
See: Mary Anne Moser with Douglas MacLeod, eds., *Immersed in Technology: Art and Virtual Environments* (Cambridge: MIT Press, 1996), p. xvii.

[6] Jane Bennet, *Vibrant Matter*, p. vii.

[7] Diana Coole and Samantha Frost, ed., *New Materialisms: Ontology, Agency, and Politics* (Durham, NC: Duke University Press, 2010), p. 9.

and reconfiguring our very understanding of matter are prerequisites for any plausible account of coexistence and its conditions in the twenty-first century."[8] Such fundamental and urgent calls for modes of coexistence raise questions of our (i.e. the human) place within a material environment, how we "currently produce, reproduce, and consume our material environment"[9] and how we understand and relate to current shifts in the ecosystem, as well as to current biopolitical and technological developments.

It is fundamentally these questions of global scale that have motivated this research. As an artist, designer, and researcher, this has let me into attending to materials, to questioning materials' ontological status within current culture and society, to foster an artistic sensibility towards the fragility and complexity of environments, including a performative engagement with the forces and processes that act upon them.

Research Objectives and Contribution to Knowledge

This practice-based research combines artistic, technological, material, and theoretical trajectories in interdisciplinary and collaborative ways to emphasize material contextuality and to identify a strategy of artistic inquiry that engages with materials in terms of their performative and agential potentials. The concept of material that acts as an agent emerged from reflections on the creation processes of the artwork presented in this thesis, along with theoretical research into concepts of agency and enactment. In order to develop a relational and dynamic account of materiality, the approach taken has been to examine the scenarios and environments (their structural, material, and technological condition as well as their exhibiting relations to culture and society) within which materials partake.

This thesis asks: What mode or processes of artistic inquiry can be employed in order to create media art installations and scenarios that engage materials' qualities and productive contingencies in the process of creation? Accordingly, how do these contingencies and material agential capacities in turn effect such scenarios (and systems) to transform and change? And specifically, with reference to the artworks with which this thesis is concerned what are the relations between specific materials, their particular tendency of transformation and their role within such created environments (which might include human performance and human co-agency, or not). An

[8] Diana Coole and Samantha Frost, ed., *New Materialism*, p. 2.
[9] Ibid., p. 3.

finally, what do these scenarios *show* when set into motion: what exhibiting relations to culture and society do they make present?

This thesis seeks to engage with media art practices by focusing on the linkages and "transformative instances"[10] (a term suggested by curator and writer Jens Hauser), between (systemic) environments, movements and materials. This focus entails shifting attention away from media art as a field of practice and discourse in its informational accounts. The thesis introduces the concept of material that acts as an agential capacity, and aims to identify a mode of artistic inquiry that addresses materials' contextual and contingent capacities. It seeks to make a contribution to knowledge by offering a strategy for an emergent aesthetics within the genre of contemporary media art performance.

The Methodology: Artistic and Discursive Aspects

This research on material agency and performative dynamics in the practices of media art emerged from artistic practice and theoretical analysis. The thesis draws upon and integrates material research, a study of materialization and creation processes of physical environments, the research process for creating two media art installations, and an analysis of these artworks that includes a selected study of theories and current practical work in the field. As such, the artistic and discursive aspects that together form the methodology are dialogical and have been applied in interlacing trajectories. These aspects are:

Artistic Aspects:

Material research: observing and reflecting upon material phenomena, and staging experiments that "perform" them. This presents a direct experimental method.

Artistic research: engaging in artistic practices that conceptualize and realize media art installations in interdisciplinary and collaborative contexts that engage with material phenomena and transfer aspects of architectural design methods into an artistic context. Two installations ANI_MATE and ON TRACK, are the key examples of this research.

[10] Hauser suggests shifting away from the purely technical modality of interfacing into an instance of transformation and to sidestep "reducing the transformative potential of interfacing to the act of translation." Jens Hauser, ed., *Sk-interfaces: Exploding Borders – Creating Membranes in Art, Technology and Society* (Liverpool: Liverpool University Press, 2008), p. 12. Available at http://technoeticnarcissus.blogspot.com/2010/05/jens-hauser-whos-afraid-of-in-between.html [last accessed August 28, 2010].

Discursive Aspects:

Theoretical investigation: to study materialization processes of built structures and architectural design methods concerned with systems and their complex material and structural becoming. This includes digital simulation techniques of material and digital design practices (Greg Lynn's "Animate Form" 1999), and material practices of form generation (Lars Spuybroek's "Machining Architecture" 2004)

Analysis of the two cases: A close reading[11] of the two artworks created in order to access the matters of practice, the context of making, and the act of doing research, and then to expose issues arising through these processes.[12] This is a retrospective approach that implies an evaluation of the installations' working processes and identifying a set of questions, themes and problems arising through making, in order to examine them against a network of theories and current practices in the field. The aim of the analysis is to identify referrals between structures, movements and materials and their collective potential for transforming and taking effect. The applied theories discuss the active powers issuing from non-subjects (Bruno Latour's Actant-Network theory); present theories of agential enactment (Karen Barad's concept of intra-acting); provide arguments on performativity (Chris Salter's notion of performance as a mode of being in the world); and, examine media ecologies' materiality (Mathew Fuller).

Knowledge Transfer: Multiple Fields of Practice

The research project, concerned with processes of creation uses procedures of transferals between different knowledge areas, predominantly between experimental architecture, and media art and performance practices, as a research method. Therefore, it is motivated and informed by my multidisciplinary background and professional experience in architecture, choreography and media art. The artistic projects preceding this doctoral research ranged widely from my work as an architect, to contemporary performance practice, to the conception and realization of interactive environments, and, currently, to mixed-media art installation. My work tends towards

[11] Close reading, a method of analysis most common to cultural studies, is a close and detailed interpretation of a single work, an individual approach that takes into account the logic of the researcher in whose hands it is executed. The advantage of this method is that it explores and exposes the complex embeddedness of a work; the problem is its highly inductive nature. In that sense it bears similarities to philosopher and semiotician Roland Barthes' seminal notion of *mathesis singularis* – a science for each object, drawing on idiosyncratic methods of inquiry for each. See Roland Barthes, *Camera Lucida: Reflections on Photography* (New York: Hill and Wang, 1982), p.115.

[12] Close reading, as Jonathan Culler says "teaches an interest in the strangeness or distinctiveness of individual works." Jonathan Culler, "The Closeness of Close Reading," *ADE Bulleting*, Number 149, (2010). pp. 20–25.

nomadic conceptualizations and realizations, reflecting the breadth of my professional interests, international collaborations, and the geographic and artistic journeys required by such physical and conceptual research.

Since the early 90s my architectural practice has encompassed the entire architectural design process, from sketch design to site supervision. Throughout my career, I have maintained a core interest in space and materiality, and in design tools and fabrication procedures – which the theoretical contexts, as well as practical works underpinning this thesis testify to. I turned towards dance and performance in the mid-90s, pursuing a persistent interest in temporary and performative space. The body of work I produced during the last decade evolved from and around live environments and mediated stages, threading interactive and performative linkages between spaces, bodies, and movements. I explored camera feeds and the live animation of scale models, and, via sensor interfaces such as motion tracking systems and the haptic interfaces of physical computing, examined the experiential space between physical and virtual realities. I also experimented with translating choreographic sophistication into the kinetic movement of machines and spatial structures.

From nourishing a practice of tool making along with the conception, creation, and fabrication of scenery and machinery in all aspects, I deepened my expertise by including the tools of media technology. The observation of referrals, interferences, and deviations between media as well as cultural systems, code, and actual movement became an almost obsessive activity, and sparked my recent practical work, which leans towards a critical, yet playful interrogation of the nature of the processes when they are set in motion. Both of the artworks central to this thesis derive their dynamic and thematic milieus from referrals between systems, materials, and movements, producing kinships with both sustaining and deteriorating processes of life. Although I have become relatively knowledgeable in information technology, my goal was to acquire the skills that would allow for a practice of collectively developed work, including interdisciplinary research, within the domain of media art. The works submitted for analysis here are examples of both my interdisciplinary and of the nomadic leverage of the work into multiple fields of practice.

For the past several years I have considered media art installation my main art form, focusing on live processes of interaction and transformation. These installations are physically performed, scenographically staged, and situated in theatres and art galleries. In weaving together multiple processes, movements, materials, and media into multi-threaded performances of live processes and tangible compositions, I seek to produce a heterogenic logic, unfolding through and being

enfolded into the collage and collision of procedures that are simultaneously pre-programmed and fixed, performative and emergent. This presents a mode of making this thesis, naturally, draws upon and integrates, seeking to broaden its scope by engaging the productive contingencies of material processes to take part in an artwork's compositional dynamic.

Operative Zones: The Open Production Ground of Interdisciplinary Collaboration

Both of the artistic projects submitted to this thesis use conception and production strategies in interdisciplinary contexts and turn towards the dynamic production ground of collaboration in order to integrate expertise from other fields of knowledge and to define the strategies unique to each project. Within technology-based production schemes, this presents a common practice. However, each collaboration is naturally different: ANI_MATE took shape under my guidance and was developed in an interdisciplinary collaboration with the artist and electronic engineer Jim Ruxton, the sound artist Leon Spek, and the dramaturge Nicola Unger. ON TRACK was developed as a production of the artist collective *in serial*: Linda Dement, Petra Gemeinböck, PRINZGAU/podgorschek, and myself.

The projects' respective paths of research and development informed by both my prior experience and expertise, and the dynamics of the collaborations which were established specifically for each project, can be best described through what media theorist Andreas Broekmann terms "the principle of the machinic," which is "associated with process rather than object, with dynamics rather than finality."[13] "Machinic" according to Broekmann, describes an attitude that aims to facilitate a process within "open, operative zones" during which "temporary events and experiences can take place." Creating and managing such open zones for interdisciplinary collaboration between artists, engineers, and software developers working across the genres of experimental architecture, electronic engineering, digital sound design, arts computing, visual arts, interactive installation, and performance, proved, in this research, a productive procedure through which to create a collaborative composition, similar to the work's own compositional dynamic – a proposition that will be explored at length.

[13] Andreas Broekmann, "Remove the Controls. Machine Aesthetics" (1997). Available at: http://framework.v2.nl/archive/archive/node/text/.xslt/nodenr-70381 [last accessed July 21, 2009].

Performing Materials

The approach to the artistic aspects of this research project entailed doing material research and conducting experiments that engaged with the capacity of various materials to flux, flow, stress, stretch, expand, retract, inflate, deform, mix, and mingle; to take on shape; to flow by themselves. Therefore I define materials as resources, substances, as physical stuff (however unfixed or formless): something that can be worked up, and of which things are composed. During the course of the research process, I have observed material phenomena and experimented with specific materials such as textiles, threads, and different kinds of fluids, aiming to move, release, and stretch them and to test their conditions and constraints and their thresholds of physical performance when moving towards destruction or dissolution. I noted their distinct qualities and abilities for particular material formations, and their potential to transform and to effect change when coupled with other material systems. Drawing on these observations and initial material experiments, I conceived and constructed scenarios that allowed for the trajectories, leakages, and exhaustions to become tangible and performative within a real-time compositional or collective dynamic. These media art installations and performative machines thus originated from singular observations of phenomena, like the coagulation of two fluids, or the shifting topological curvatures of soft fabric, which then were actively "performed" to enlarge, multiply and complicate. The goals was to observe and understand their transformative potential as the materials were pushed, put under stress, pulled out of shape, or stirred up and smudged. The work thus emerges and transfers into concept, action, movement, materials, and technological machinery of bigger structural scale through these small performative gestures. A prevalent analytical thread that weaves through the reading of the finalized installations presented in Chapters Two and Three traces how these installations maintain at their core a kinship with material processes and live performed gestures: the dynamic interactions from which they emerged.

This approach and practical method of attending to effecting capacities of materials and engaging them in dynamic, performative action, hence to "perform materials" is inspired by experiments such as those of natural scientist Hans Jenny in the 1950-60s. Jenny created oscillating and fluctuating fields of forces and revealed "patterned, figurate formations at one pole and kinetic-dynamic processes at the other."[14] He explored the patterning effects of vibration on a range of viscous materials by putting sand, fluids, and powders on plates that vibrated, causing a flow-able

[14] Hans Jenny, *Cymatics: A Study of Wave Phenomena and Vibration* (Newmarket, N.H.: MACROmedia, 2001), p. 121. Available at: http://www.scribd.com/doc/2026983/Cymatics-A-Study-of-Wave-Phenomena-and-Vibration-Volume-1-1967 [last accessed January 17, 2008].

mass to configure and reveal patterns of movements. He called these figurative patterns "cymatics," and was interested in studying sequences of forms in motion, rather than in their static form. Jenny's experiments describe his process of acquiring an intuitive understanding of form morphology by employing deforming forces. These forces were electrical and magnetic, which allowed him to sculpt malleable form through the adjustment and performance of oscillators.

How did Jenny develop a performative sensibility in regards to his manipulation of form morphology through electrical and magnetic forces? What are the relationships between the forces applied and the formations and figurations effected? And what is the particular potential of, in Jenny's case, malleable material? These questions, which emerged and gained relevance through the artistic aspects of this thesis, bring into focus the various relationships between the performance of materials and the systems, or forces, which cause them to transform and to take effect.

As a way to discursively approach these questions and to address the system within which these relationships are enacted in order to generate form, this thesis adopts elements of Lars Spuybroek's architectural design method and theory of "machining."[15] The theoretical analysis centers on the tactile as well as the tactical use of material systems, which Spuybroek terms "Material Machines,"[16] an experimental method to initiate and steer the design and materialization process of physical structures by use of direct material systems. Spuybroek's theory, influential within the architectural community even years after its initial conception in *Machining Architecture* (2004), explores referrals between systems and materials. Spuybroek conceptualizes his methodology of machining with reference to systems theory and specifically the concept of autopoiesis,[17] and provides detailed analysis of the different procedures that collectively, and successively (i.e. stepwise), add "information into a system to generate form,"[18] appropriating materials to function as agents to this process. For him this means developing structures and physical environments in non-hierarchical fashion, bottom-up, decentralized and recursive,

[15] Lars Spuybroek, *NOX: Machining Architecture* (London: Thames & Hudson, 2004), p. 4.
[16] Lars Spuybroek, *NOX*, p. 352. Spuybroek draws on architect and structural engineer Frei Otto's research on lightweight tensile and membrane structures, sharing Otto's interest in a material's structural efficiency to generate form.
[17] The term autopoiesis was introduced in 1972 by the biologists Humberto Manturana and Franscico Varela to describe a system that is autonomous and operationally closed in order to explain the nature of a living system. They have claimed that organisms come into existence through interactive processes that are determined by its own organization and that an autopoietic system is organized so that its compositional elements work towards maintaining its composition. Humberto Maturana and Francisco Varela, *Autopoiesis and Cognition: the Realization of the Living* (Dordrecht: Reidel Publishing Company, 1980), p. 78.
[18] Lars Spuybroek, *NOX,* p. 4.

allowing materials to acquire the state of "being mobile themselves."[19] Spuybroek has developed a rigorous materialist design culture in which he weaves a continuous thread between digital design, material agency, and fabrication processes. What makes Spuybroek's method relevant for this thesis and for the context of media art and performance practices is that "machining" can be regarded an open and active artistic strategy for directing experiments that facilitate the materialization processes of structures and build environments. By exploiting its experimental qualities, this method, I argue, is transferable into other disciplinary fields of practice concerned with materialization processes that integrate the effective and effecting use of materials.

Material Agency

ANI_MATE and ON TRACK, the practical artworks submitted for examination within this thesis, draw on Spuybroek's design methodology and apply some of the experimental procedures involved in "machining" within their artistic system. Their performative scenarios and their material expressions arrived at through experimental strategies are discussed at length in these pages. The analysis traces the particular capacities of the implicated materials to negotiate physical movement forces, causing the systems to transform. The precondition underlying these performances is the inherent capacity of the implicated materials to become performative agents and their efficacy in fluxing and transforming: in doing things. Agency emerges through enactment, and according to theoretician Karen Barad it is "a matter of intra-acting; it is an enactment, not something that someone or something has. [...] Agency is not an attribute whatsoever — it is 'doing'/'being' in its intra-activity."[20] And it is through specific intra-actions that a sense of being is enacted in the "ongoing flow of agency through which 'part' of the world makes itself differentially intelligible to another 'part' of the world and through which local causal structures, boundaries, and properties are stabilized and destabilized."[21] Central to Barad's approach is an account of agency released from the traditional humanist orbit and from human subjectivity and intentionality. Barad explicitly acknowledges capacity of materials to enact changes within specific causal structures.

Calling on the effective and afflictive performance of materials (their enactment), as well as conceptualizing agency as a situated and distributed process emergent through how materials

[19] Lars Spuybroek, *NOX*, p. 7.
[20] Karen Barad, "Posthumanist Performativity: Toward an Understanding of How Matter Comes to Matter," *Signs: Journal of Women in Culture and Socie*ty, vol.28, no3 (2003), p. 826.
[21] Ibid., p. 817.

come into action and act together, is related to what sociologist and anthropologist Bruno Latour calls "actant-network." According to Latour, that which has agency is that what which has power, which can do things, which can produce impact and influence the course of events. But "responsibility for action must be shared among the various actants."[22] These actants are networked in shifting assemblages that include humans and nonhumans in equal importance, able to manifest powers to act with and upon each other in ecologies of changing material formations and emergent relations. Such notions are associated with theoretical positions such as actor-network theory (ANT) and object-oriented ontology, thing-world and an appreciation of the active powers issuing from non-subjects, as opposed to drawing on topics of subjectivity, intentionality and divisions of the world into living being and inert material.

Approaching the compositional dynamics of a work of art in terms of "agential intra-action" (or what things do and what they do to things, and how they communicate beyond a purely technical modality of interfacing), curator and writer Jens Hauser proposes the term "transformative instance"[23] to suggest communication beyond the information paradigm. Hauser's suggestion is a project of "re-materialization," in which he states that "the former fascination with the 'codes of life' in computer art inspired by biology is receding and making way for a phenomenological confrontation with wetwork,"[24] such that the "centrality of code is being confronted with concrete carbon-based physical reality."[25] Defying new media art's[26] emphasis on information-only, binary-networked logical processes, and turning towards biological process (and the "postdigital" paradigm of bioart), Hauser asks whether or not there are "points of interconnection between two entities when parameters are 'programmed' not electronically but chemically, mechanically or biologically?"[27] Media theoretician Anna Munster suggests a different trajectory, although she puts forth a similarly phenomenological point of view. In *Materializing New Media* she defends an embodied sense of information aesthetics by considering the body in physical relationship both with and to information technology. Arguing against utilization of materiality as "the carrier for

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[22] Bruno Latour, *Pandora's Hope: Essays on the Reality of Science Studies* (Cambridge, MA: Harvard University Press,1999), p. 180.
[23] Jens Hauser, *Sk-interfaces,* p. 12.
[24] Jens Hauser, "Observations on an Art of Growing Interest: Toward a Phenomenological Approach to Art involving Biotechnology," in *Tactical Biopolitics: Art, Activism, and Technoscience,* ed. Beatiz da Costa and Kavita Philips (Cambridge, MA: MIT Press, 2008), p. 87.
[25] Ibid.
[26] According to Domenico Quaranta, it "no longer makes sense to distinguish, (...) as the paradigm implicit in the term New Media Art does, between art which uses computers and art which doesn't." New Media Art coming into being in the late 1960s and expanding into a recognized, and distributed art form into the 1980s and 90s, has now, according to Quaranta, taken a turn into a "postmedia condition." This turn reflects "the decline of the concept of medium-specificity" and refers to art that "comes after the affirmation of the media."
See Domenico Quaranta, "The Postmedia Perspective," *Rhizome* (Jan 12th, 2011). Available at http://rhizome.org/editorial/2011/jan/12/the-postmedia-perspective/, [last accessed March 16, 2011].
[27] Jens Hauser, *Sk-interfaces,* p. 13.

what is ultimately more essential: the information it houses,"[28] she develops an argument that seeks to empower the material as a "force of equal strength in relation to virtualization."[29]

Sharing Hauser's and Munster's reluctance to prioritize informational, binary networks, and by inquiring into the capacity of other forms of communication to become productive beyond the purely informational, this thesis engages with the dynamics and forces of movement that explicitly includes the agential movement capacities of materials (in addition to human movement and the mechanical movements of machines). [30] Such an approach also embraces choreographic specificity: what rhythms and qualities of movement, what trajectories of materials and within what dynamic fields can "transformative instances" become activated? How, in the words of media theorist Matthew Fuller, can they "be sensed, made use of, and how it in turn make other elements or compositions tangible."[31] Fuller suggests the conjoined term "media ecologies," through which he views ecologies of media systems and through which their "materiality, the connections and uses made, missed, and implied" [32] can be described. He discusses how they connect and collide with one another and asks what patterns, dangers, and potentials result from these connections and collisions of systems, materials and processes.

Using the historic accounts of Dadaist practice, specifically Kurt Schwitters' *Merzbilder,* Fuller foregrounds these compositions and their "collage life" to suggest that one get busy and to carry out live interactions. Fuller argues: "The only way to find things out about what happens when complex objects such as media systems interact is to carry out such interactions – it has to be done live, with no control sample."[33] This is in fact is an apt description of the experimental mode that led to developing my own vocabulary and artistic interpretations and that relates to the artistic aspects of the research – which are grounded in the proposition of a "performance of materials."

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[28] Munster, Anna (2006), *Materializing New Media: Embodiment in Information Aesthetics* (Hanover, New Hampshire: University Press of New England), p. 114.
[29] Ibid.
[30] Historically, from the mid-1800s the dynamics of human movement and non-human objects became subject to scientific and artistic studies. Researchers and inventors such as Etienne-Jules Marey focused on how to capture movement. Philosopher, visual artist and dancer Erin Manning, examines a philosophy of movement in her book *Relationscapes*, seeking to challenge the common notion of movement as spatial displacement. She examines Étienne-Jules Marey's work as an investment in the machinic, understood as an agglomeration of potential processes. In Marey's work, Manning suggests, movement "was slowly transformed [...] toward the invocation and mapping of forces. As forces that could not be seen (but could be felt) emerged, instead of denouncing them as unviable for quantification, he created new techniques for their measurement." Manning draws attention to the work of Marey in order to "specifically brings to the fore the complexity of mechanisms of perception as linked to movement."
See Erin Manning, *Relationscapes: Movement, Art. Philosophy* (Cambridge, MA: MIT Press, 2009), pp. 84-85.
[31] Matthew Fuller, *Media Ecologies: Materialist Energies in Art and Technoculture* (Cambridge, London: The MIT Press, 2005), p. 2.
[32] Ibid., p. 10.
[33] Ibid., p. 1.

The Cases of Elasticity and Viscosity: The Performativity of Resisting Materials

This doctoral research makes central two heterogeneously composed media art installations that combine new and "old" media: the pneumatic stage machine ANI_MATE (November 16, 2006, *Gasthuis* Theatre Amsterdam) and the performative mechanic-robotic installation ON TRACK (May 20, 2009, Thessaloniki Biennale). Their respective contexts, working processes and actual performances will be discussed in length in Chapter Two and Three. Here is a brief synopsis:

ANI_MATE, the first case study analyzed in this thesis, involves the interaction between a computational system, a pneumatic apparatus, a tensile screen, a series of projected still images and a collection of threads, and is operated by me onstage during the performance. The machine effortfully performs processes of animation, testing the liminal thresholds of a living state. The tensile screen flexes through reversible patterns of pushing and pulling (extruding and receding) and the antagonistic forces of motion and non-motion – life and death – are negotiated as movements of life itself. It is a system that "lives" under constant stress and performs the dynamics of a process that seeks to sustain its equilibrium of forces.

ON TRACK, the second case study, emerges through the interactions between a mechanical mop, a pack of robotic brushes, and a collection of viscous fluids, staging an ecology driven by a desire, or the need for accumulation. Processes act on top of processes: in the attempt to solve one problem, another is produced. Materials get lost, they leak, they are then mixed and diluted. ON TRACK performs a system in continuous crisis and with it the performative dynamic of a process slowly going out of control.

These two scenarios gain their performative momentum through resistances that are incorporated into each system of materiality. The analysis in the following chapters centers on two claims regarding materials' potentialities and agential capacities: First, the elasticity of ANI_MATE's tensile screen, which allows for a continuously fluctuating movement that both keeps the image in motion and maintains the impression of life, while resisting (i.e. delaying) its eventual ripping and breaking. Second, the viscosity of ON TRACK's materials, which allows the fluids to slowly leak out of their confining containers, which causes the loss and spill of materials – metonymically pointing at humanity's wasteful exploitation of resources,

Both of these machines share an enabling yet resistant materiality, and show the effects of effort and slowness. Effort is engaged both mechanically and systemically, by complicating and exaggerating the machine's performative task, and through working out the conceptual imperative that the machines exhaust the materials they are engaged with. Slowness is descriptive of the viscous flow of fluids and the slow-motion of mechanics and allows for access to the state of the in-between, the process of being mixed or animated, rather then the actual state itself. It focuses a lens on the "how" of transformation. Media artist Chris Salter proposes that technology in performance art reveals itself not only in the machines but also in "how [...] it orders the world"[34] and says that such a "world is continuously enacted or actively performed anew."[35] Salter, by noting the referrals between the world, us, and technology, suggests that "[d]evices, machines, and tools may perform in terms of their *efficiency* or benchmark, but they perform through expressing things through material transformation that do things to the world. It makes sense that we can put the artifice of technology on the stage to show the workings of the world."[36] The definition of "performative" offered by Salter and adopted by this thesis, implies that this world (and thus also that which is put on stage in order to perform the workings of the world) "emerges over time, continually transformed through our interactions with it."[37] Performance, accordingly, is "a mode of being in the world"[38] and takes part in the active creation of a reality. Under this light, what then *is* the performative potential of resisting materials and *how* can it made to be effective and effecting?

[34] Chris Salter, *Entangled: Technology and the Transformation of Performance* (Massachusetts, London: The MIT Press, 2010), p. xxii.
[35] Ibid., p. xxii.
[36] Ibid., p. xxiii.
[37] Ibid., p. xxvii.
[38] Ibid., p. xxvi.

Structure and Organisation

Chapter One: *Material Machines* lays the thesis' theoretical ground and investigates practical methods of materialization processes of physical structures. It presents architect Lars Spuybroek's design methodology of "machining," that engages with systems and their complex material and structural becoming. The chapter focuses on "material machines," one of the procedures involved in machining. These are material systems for form generation, which process form through transformation and appropriate materials to function as agents to that process. It concludes with a brief case study of one of Spuybroek's urban projects, the *D-Tower*, a media art installation itself, which exemplifies his methodology.

The chapter highlights the concept of material potentiality, and the capacity of material machines to describe a tendential outcome; these material machines embody possibilities without pre-describing a particular form. Machining, I argue, therefore can be regarded as an open and active process of making, described through the potentials of materials (their agency), and the capacities of material machines (the system or environment within which they become active agents). It is proposed that Spuybroek's design methodology, situated in architectural practice, facilitates the directing of experiments that allow materials to perform and to become active and relational. This leverages his methodology into other disciplinary fields of practice.

Chapter Two: A Performance of Materials provides an analysis of the first practice-based example submitted with this thesis:, ANI_MATE, a machine that stages processes of animation as a live, theatrical event. It develops the thread introduced in Chapter One regarding the concept of material potentiality and materialization processes, by applying elements of Spuybroek's methodology within the project's artistic concepts and contexts.

The chapter investigates, through an analysis of ANI_MATE's performance, the relationship between animation procedures and the transformability and flexibility of its material system. It traces the particular capacities of the involved materials, their elasticity, to negotiate physical movement forces and to physically effect the animation of still images. It draws reference to animation theory and refers to W.J.T. Mitchell's concept of the "living image"[39] as an animated being or life-form that supports considering the parsing concepts of living and non-living, motion

[39] The notion of the "living image" refers to W.J.T. Mitchell's picture theory, where he examines "the analogy between images and living organisms (a double connection, both metaphoric and metonymic)" and its insertion into the new context of biological science. W.J.T. Mitchell, *What do pictures want: The Lives and Loves of Images* (Chicago and London: The University of Chicago Press, 2005), p 89.

and inertness, active life and dull matter from a perspective of entanglement. Three key animation procedures (or material form-generation procedures) are identified: first, the design of ANI_MATE's system, the structure and environment within which the animation is performed: second, the movement instructions that describe its performance, and third, the potential of the material (the elasticity of the image surface) that allows a movement force to transform the image.

The chapter proceeds via a detailed and systematic re-tracing of ANI_MATE's working process and five phases of research and development (material experiments, machine design, animation, construction and live performance). It draws on James Edward Gordon's argument from material science stating that structures only delay the material's eventual failure, supporting an understanding of the performative potential of materials "under stress" giving rise to risk in the artistic system. Based on Gordon's arguments, both a term and a method are derived, leading the way through the working process and progress towards its actual performance. This term is the *"Zerreißprobe"* i.e. a way of measuring the strength of materials, and the potential that lies within the act of their resistance to destruction. This German term translates literally as the "tear strength test of materials," but also more metaphorically as a powerful and "tearing" dilemma, associated in this context with the questions of whether to accept or reject the illusion presented.

Inserted in the textual flow of this chapter are full-color photographs from the working process, a set of drawings and data schemes, and a series of photomontages from the final design and performance of ANI_MATE. Brief discussions of related[40] works in the field include machines that transfer tactile stimuli (FoAM, *Lyt_A*, Scott Snibbe, *Blow Up*) and machines that exhaust themselves (Kris Verdonck, *Dancer*, Jonathan Schipper, *The Slow Inevitable Death of American Muscle*, Jana Linke*, Click & Glue, a system, that locks itself In,* Fischli & Weiss, *The Way of Things*).

Chapter Three: *A Materials Ecology* provides an analysis of the second arts-based example submitted: the performative mechanic-robotic installation ON TRACK. Thematically revolving around the performance of lost materials and humanity's wasteful exploitation of resources, it investigates autonomous machine performance as an ecology of potentials, processes, and materials. This approach adopts media theorist Matthew Fuller's project of *Media Ecologies* and

[40] The works referenced have influenced and inspired the development of my work in concrete and actual ways. Consequently, the reviews also trace a work's influence at a particular moment in ANI_MATE's process of development. The discussion shed light on a singular, individual process of artistic making, rather than delineating, or representing, a tendency within a field of practice. Nevertheless, the works described are affiliated with each other and with this research through their adherence to the genre of performative machines.

his analysis of heterogeneous media systems, which he developed in order to map the "dynamic interrelation[s] of processes and objects, beings and things, patterns and matter."[41]

The chapter examines the entropic dynamics that play within the ecology of ON TRACK, reading this against cultural scenarios of crisis and the tendency of such scenarios to progress through accumulation. Providing detailed descriptions of all parts of the installation, the analysis dives in to each different informational and material capacity and investigates their connections and linkages. It is concluded that these connections emerge through how the individual systems perform, as well as how they establish distinct movement patterns and rhythms. The part's individual and autonomous performances lead to emergent cooperation, which in turn causes them to change and transform.

The chapter concludes by investigating the nature of a process that is irreversible: that causes materials to mix and mingle through a dispersive and largely indeterminable process that cannot be undone, nor repeated. Exposing the agglomeration of mixed materials as a consequence of the concerted efforts of the machine allows the realization that actions have consequences – causing irreversible impacts on the world we live in, effects that cannot be undone.

There are photographs from the actual exhibit in this chapter, providing an overview to ON TRACK as well as being a record of its prototype development. It includes a collage sketching the relationships established within this materials ecology. The chapter includes the following discussions of related works: a machine that destroy materials (Kris Vleeshouwer, *Glassworks II*), a machine that create portraits of a material process (Roxy Paine, *SCUMAK*), and UBERMORGEN.COM's real-life oil paintings *DEEPHORIZON*.

Conclusion: summarizes the concepts and practices discussed, claiming that a more differentiated comprehension of the coupling of systems, movements, and materials has been achieved as an outcome of the research process. As a contribution to the field of performance and media arts practices, the analyses of the various couplings and machining architectures demonstrate a more vivid understanding of how they are made to be present and situated, and how they can either involve human co-agency or perform on their own. In the context of the still-developing post-digital paradigm, this research suggests a (re)examination of physical agential materiality, avoiding essentialism and the siting of human subjectivity at centre stage. It proposes a wider range of performance aesthetics within contemporary media art and performance practice.

[41] Fuller, *Media Ecologies,* p. 2.

Appendix: provides a record of ANI_MATE and ON TRACK in terms of public exhibitions and performances. It lists catalogue entries, conference presentations, and artist talks, and credits all collaborators, partners, and funding agencies. The appendix includes abbreviated video excerpts of both projects. These do not document the artworks in full performance; rather they complement in sound and movement the text and images provided with this thesis. It is through a collage of textual analysis, a collection of images, and video excerpts that each project's multi-facetted nature is presented.

CHAPTER ONE

MATERIAL MACHINES

Architectural Design Practices

In this opening chapter, the discussion on material agency and the idea of active, agential and morphogenetic matter, focuses on architectural design methods. This discussion will be framed by the design practice of Dutch architect Lars Spuybroek (and his office NOX) and explore ways in which materials take part in the design process: how they can become active and "mobile themselves."[42] It engages with a practice of making that emerges out of a transaction with materials wherein they are understood as relational. This position is described by architect and theorist Katie Lloyd Thomas as a "refusal to consider materials in purely visual (and static) terms and an insistence on examining materials as part of a network of forces and actions."[43] Emphasis on the performance of materials, their active and generative nature is reflected, according to Thomas, in the work of "practitioners such as NOX [that] use the emergent behaviors of materials in their design process."[44] The primary motivation for turning towards the experimental architectural practice of Spuybroek is that he places the concept of material agency within a design methodology rooted in and derived through practice. Spuybroek has developed a rigorously materialist design culture in which he weaves a continuous thread between digital design, material agency, and fabrication. His practice embraces both theoretical design methodology and an extended body of work. This thesis adopts his attentiveness to materials and expertise in generating a practice of designing and directing experiments that allow materials to perform: i.e. to become relational, and to take on shape.

The chapter continues by opposing the approach of Spuybroek with another thread in architectural thinking and mode of making: in other words, by distinguishing (in a brief comparison) between design practices that are materially discrete and digital design practices that are materially concrete. Design practices that are materially discrete will be discussed by providing a brief introduction to the design of virtual architectures, based on the work of architect Grey Lynn. Lynn represents a stream of architecture that exploits emergent computational modeling technologies to incorporate calculus-based mathematics of forms in order to generate relationships and geometrical, autonomous structures within the realm of the purely virtual. Lynn terms his approach "animate form." Digital design methods that are materially concrete will be exemplified by Spuybroek's processual design strategy of machining. Machining is a strategy positioned at the intersection of a system and physical space that, in the words of architect Detlef Mertins, "enables

[42] Lars Spuybroek, *NOX: Machining Architecture* (London: Thames & Hudson, 2004), p. 7.
[43] Katie Lloyd Thomas, *Material Matters: Architecture and Material Practice* (London and New York: Routledge, 2007), p. 5.
[44] Ibid., p.7.

complex geometries that can also be enacted in materials [...], either before or after their life in the computer."[45] As a design method, machining does not remain within the computational, but reaches across, and establishes relations between, the digital and the material. This comparison identifies two influential voices in architecture, taking clear positions towards the implications that are posited by the information paradigm and the ubiquitous characteristics of the digital on design practice. It draws attention to how form systems can be coupled with computational systems (Lynn), as well as with material systems (Spuybroek), and how those couplings produce geometries that are reflective of their respective conceptions (i.e. materially discrete, or concrete).

There are three primary reasons why this initial discussion has relevance for the later discussion of my working process and artistic work within a media arts practice that revolves around the actions and interaction between its compositional parts (whether material or immaterial). First, it presents architectural objects as compositions of form, material, and movement that are connected on the level of forces. Second, it shows how architectural design procedures (i.e. machining or animate form) allow materials to negotiate these forces and to maintain relationships amongst the compositional elements and systems. Third, it provides a definition of agency that considers materials as, to again quote Spuybroek, "mobile themselves," which is important because having mobility in an agent-based sense is of particular relevance for my work, as it allows materials to perform different states and to move and shift between these. Spuybroek's practice suggests that the concept of agency, understood as a capacity to act as well as to provide the context for action, extends beyond its sole attribution to anthropocentric conceptions and draws materials into the dynamic field of forces and interactions.

[45] Lars Spuybroek, *The Architecture of Continuity, Essays and Conversations* (Rotterdam: V2_Publishing/NAi Publishers, 2008); my reference is to Detlef Mertins's "Foreword," p. 7.

Animate Form: The Virtual Design Practice of Greg Lynn

Architecture as a discipline is concerned with form, materiality, and structure as well as with the cultural imprints of built form that live in the fabric of our cities and proximate environments. Currently, designers are challenged by conceptions of the digital and of the rapidly developing computational practices as well as challenged by the ontological fixity of architecture's disciplinary dimension. Digital technologies are considered as a necessary and auxiliary tool for representing architectural forms by means of drawing, modeling, presenting, calculating and manufacturing or, more profoundly, as a vital means through which architectures can shape and take on form. In his introduction to *Animate Form* (1999), a monograph of his architectural projects, Lynn states: "What makes animation so problematic for architects is that they maintained an ethics of statics in their discipline."[46] The notion that architecture is constrained by the desire for permanence and structural logic connects Lynn to a stream of architectural practice popularly known in the 1990's as "cyber-architecture." During this time practitioners and architectural theorists (among them Greg Lynn, Markos Novak, Stephen Perrella and Kas Oosterhuis) began to conceptualize and construct space within the realm of the purely virtual. This preoccupation was contiguous with the moment when the idea of "virtual reality" was high-profile in popular culture and hyped in the mass media.

Space within Non-Space

Virtual architecture, the architecture of imagery within computer generated environments, revolves around the concept of form evolution, appropriating various graphic design strategies and digital tools to generate "liquid"[47] topological formations and investigate design decisions dynamically through animation. High-end animation software such as *Form Z*, *Rhino, Wavefront, SoftImage* and *Maya* subsequently became part of the digital toolbox of cyberspace architects. In this context it is important to note that these special effects software programs, appropriated by architects, were first developed by film industries[48] and still are used primarily by special-effects animators. The fact that they have been translated into creative tools for architectural design has

[46] Greg Lynn, *Animate Form* (New York: Princeton Architectural Press, 1999), p. 9.
[47] *Liquid architectures in Cyberspace* was a term used in the mid-1980s by architect Markus Novak. It refers to his extended genealogy of "liquid" and differentiated forms, created within the abstract space of the computer.
[48] Pixar Animation Studios, founded in 1986 as a subsidiary of The Walt Disney Company, is one of the most prominent producers of animation films. The first 3D feature animation feature film was *Toy Stories* (1995). Both Pixar and DreamWorks (1994), another major animation studio, develop their own animation software (*Marionette*, *PDI*) and renderers (*RenderMan*) in order to produce special effects.

implications for the alliances formed between architectural topological design strategies and procedures of 3D digital animation. Animation software differs from common computer-aided design (*CAD*) software, as such software programs do not operate, at least not exclusively, within the Cartesian grid space of the x,y,z coordinate axis, but allow the creation of 3-D topologies and enable manipulation of their surface grids and meshes. Design within non-Euclidean screen space thus becomes feasible. Perhaps even more critically, the appropriation of animation software allows a reversion of design processes, a change of order in how a design proceeds and develops. Canadian political philosopher Brian Massumi, whose work focuses on perception, affect and the virtual has pointed out that animation software mobilizes digital environments and virtual spaces within which designs can be initiated by modeling and programming sets of modifications, even before there is an object to modify. A project begins by programming forces rather than forms.[49] Massumi has identified this critical appropriation of software as a reversion of procedures, a tactical misapplication to architectural design.[50]

Virtual architecture has not made many built or "materialized" appearances, but the concepts have been significant to and influential on architectural thinking. Greg Lynn has claimed that "animate design"[51] strategies result in the instigation of new alliances between space, geometry, and body, describing topological form-folding techniques that make architecture adaptable to environmental forces, almost like a living organism. Employing high-end animation and special effects software, Lynn transforms virtual spaces into highly flexible entities and establishes a practice of digitally conceived "animated" architectures. He understands animation as a formal quality distinctly related to, yet different from, motion: "While motion implies movement and action, animation implies the evolution of a form and its shaping forces; it suggests animalism, animism, growth, actuation, vitality, and virtuality."[52] According to Lynn, abstract forces and relations have the capacity to proliferate and to enable limitless possibilities of form variations, a proposition stemming from his animate design strategy. Lynn's designs, however, remain in the digital domain and the "animate" relations between physical space and virtual space are thought of as purely analogical and abstract in nature.

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[49] Brian Massumi in an interview with Thomas Markussen and Thomas Birch, "Transforming Digital Architecture from Virtual to Neuro: An Interview with Brian Massumi," http://www.intelligentagent.com/archive/Vol5_No2_massumi_markussen+birch.htm, [last accessed July 3, 2010].
[50] Brian Massumi, "Interface and Active Space: Human-Machine Design," http://www.anu.edu.au/hrc/first_and_last/works/interface.htm, [last accessed January 3, 2009].
[51] Greg Lynn, *Animate Form*, p. 11. Lynn defines animate design as a "co-presence of motion and force at the moment of formal conception."
[52] Brian Massumi, "Interface and Active Space: Human-Machine Design," http://www.anu.edu.au/hrc/first_and_last/works/interface.htm, [last accessed January 3, 2009].

Greg Lynn's often-cited *Embryological House Project* (2002), developed through the exploration of parts-to-whole relations, is an emblematic example of how conceptualizations of virtual space and digital animation tools conjoin. A prototype of a house was successively animated in 3-dimensional space, selecting new forms and variations at each stage of the animation and thus creating an extended series of differentiated forms. The animations were generated by impacting and thereby, deforming forces. The effects of these manipulations were programmed to be responsive to both the assigned quasi-material properties of the forms themselves and to external, quasi-environmental variables. As the series of houses unfolded via differentiated inflictions from one to the other, they maintained a measure of evolutionary continuity across the modulations of their varying formations. Limitless form generation and variability is based on volumetric modeling techniques, and by geometric Bezier curve formation. When selecting and impacting spline control points (around which the wire-frame mesh of the form is constructed), the 3-D image space is transformed at the level of pure geometric surface manipulation, while remaining volumetric.[53] Investigating the purpose or nature of the forces impacting the surfaces and meshes of the 3-D models, the media theoretician Anna Munster has interpreted them as a kind of "environmental pressure."[54] Evidently, these forces are not understood and calculated as forces located within real-world constraints and obviously they do not reflect worldly realities such as gravitational forces or the laws of physicals.

In other words: digitally animated designs do not engage with or reflect how materials perform physically. Instead, the inventory of material parameters set out to in-form the 3-D models is materially detached from physical reality. However they are nevertheless formally and conceptually related. The nature of such 3-D image spaces may therefore best be described as an aesthetic and formal conversion of physical space.

This abbreviated introduction to digital design practices that appropriate digital animation softwares in order to create differentiated topological and morphological forms references a conception of design practice that renders the digital and the physical as materially discrete and detached from each other. This practice thus brings forth a process of delineation and abstraction of environmental forces and real-world conditions, and seperates information from matter. It posits a gap between the digital and the physical and detaches the digital domain from real-world constraints. Such efforts leave each sphere seperately performing its own set of relationalities.

[53] Munster, *Materializing New Media,* p. 51.
[54] Ibid., p. 52.

Form Generation: The Material Design Practice of Lars Spuybroek

Unlike Lynn, Spuybroek never addresses animation directly, and such a concept does not occur within his theoretical vocabulary. However Spuybroek, like Lynn, makes use of animation software[55] to initiate his designs and both Lynn's and Spuybroek's design practices and methods are rooted in topological design procedures, which Lynn refers to as "animate form" and Spuybroek as a procedure of "form generation."[56] Spuybroek addresses his work and design methodology through the theoretical lens of systems theory.

Machining Architecture (2004) is an extensive compendium featuring the bandwidth of architectural projects designed by Spuybroek's office NOX. The book contains detailed notes on design procedures, as well as underlying theoretical threads provided by himself and other theorists and writers. As a how-to book or a manual, it aims for transparency regarding his methodologies and provides techniques and recipes that together formulate an open invitation that his ideas and methods "be tested, developed or rejected."[57] This book is a rare occasion of a practitioner not only presenting work as an end product of a finished design, but also of making accessible its process of research and development. The recurring and prominent concept woven throughout the book is the design methodology of "machining," with related discussions regarding procedures for form generation and the relationship to material processes. Spuybroek argues that form generation is dependent on organizational systems and material processes that are linked through forces. These forces, he argues, must be deforming and transformative such that an actual (not abstract) material can be mobilized, changed, and finally consolidated into form. This describes how form can actualize through "machining" and "material machines," an organizational principle which functions as a direct material system within this process.

This thesis' arguments elaborate on these production procedures of physical structures in great detail because Spuybroek's work offers insight into how materials become performative in actual and relational ways. I argue that Spuybroek's work and methodology facilitates an open process of directing experiments that allow materials to perform and become relational within their larger environmental field of actions and forces. This is the hinge that provides leverage of Spuybroek's methodology into fields of artistic practice. As I myself have moved from my original background and work in architecture towards performing and media arts, and thus currently speak from an

[55] Spuybroek provides an account of his use of animation software in his interview with Arjen Mulder and Maaike Post, "Lars Spuybroek," http://www.vividvormgeving.nl/vormgeverpagina/spuybroeknrc.htm [last accessed, June 4, 2010].
[56] Spuybroek, *NOX*, p. 8.
[57] Ibid., p. 5.

artistic perspective, such disciplinary transferrals are of particular interest to me. In Chapter Two, which centers on the artistic project and performative machine ANI_MATE, staged as a "play" in a theatre context, I will trace such leverages and referrals between disciplines by examining the experimental capacities of such materialization processes.

The following sections provide a step-by-step analysis of Spuybroek's design strategy of machining and conclude with a brief discussion of how this methodology "takes on shape" in one of Spuybroek's projects (discussed within *Machining Architecture):* the *D-Tower*. The aim of such detailed analysis is to trace the entire range of procedures involved, and provide an introduction to what I have termed the "performance of materials," explored in the subsequent chapters. This analysis is central to the procedures and processes underpinning the case studies of ANI_MATE and ON TRACK.

Machining Architecture

Spuybroek argues that spatial formation can emerge out of a non-hierarchical process, in other words, bottom-up strategies. Within the architectural field, this approach is in contrast to top-down design, or the conception of space that originates with the basic plan drawing of the overall design, with an overarching idea about the space, a "parti." Bottom-up design engages first with the organizational system that successively combines partial designs (sub-systems) into an interconnected fabric of distinct architectural scope. This strategy resembles a model, whereby the beginnings are small but eventually gain complexity and completeness. Bottom-up strategies focus on providing a base for an emergent formation of architecture, rather then exposing the design intention though which architecture arises. Spuybroek has adopted aspects of this approach and developed the design strategy of machining as a methodology arising in a non-hierarchical fashion, bottom-up and decentralized, and concerned with the paradigm of organization[58] rather than with design intentionality. It is a processual strategy positioned at the intersection of system and physical space. Throughout *Machining Architecture* Spuybroek gives numerous accounts of and references to dynamic systems theory and design procedures that fluctuate between determination and fuzziness[59] in order to ground his conception of machining.

[58] Spuybroek's understanding of organization is related to computing, as he sees the computer as a model of organization. But even more so, he refers to the organization of natural phenomena, life as well as matter.
[59] The mathematical system of fuzzy logic is a multivalued logic, which enables ambiguous (environmental) data input in order to process what has to deal with reasoning. It presents a system that can handle ambiguity in a meaningful way.

Spuybroek defines machining as a methodology that combines "stepwise procedures of adding information into a system to generate form."[60] His notion of system within the context of architecture originates in biology and refers to the theory of autopoiesis. The term autopoiesis is defined by Humberto Maturana and Francisco Varela as a system description of "self-producing" mechanisms and explores the condition of being and becoming of living systems:

> An autopoietic machine is a machine organized (defined as a unity) as a network of processes of production (transformation and destruction) of components which: (i) through their interactions and transformations continuously regenerate and realize the network of processes (relations) that produced them; and (ii) constitute it (the machine) as a concrete unity in space in which they (the components) exist by specifying the topological domain of its realization as such a network.[61]

The premise for such a machine-system is its fundamental dialectic between function and structure, between the organization of the machine and its actual structure (or components). What constitutes the autopoietic machine as a concrete entity in space is first the specification of the desired relationships by the organizing part of the machine, and secondly the generation of those relationships by the actual mechanical components.

Spuybroek's machining methodology incorporates this distinction between function and structure, organization and components, and distinguishes between two design phases. First, a convergent, organizational phase wherein all information is gathered and arranged within one digital machine-system. Second, a structural, divergent phase wherein the information becomes formative and spreads into actual and physical components. A strategy of machining thus approaches processual design as a series of transformative steps, which transfer directly – that is machinically – into the actual construction.[62] Throughout *Machining Architecture* Spuybroek makes perfectly clear that machining does not imply that any information can be connected to any material. This would just produce arbitrary forms and the method of machining would turn into a generator for the production of limitless indifference. Spuybroek's main interest lies in the how of connecting or transferring the first convergent designs phase to the second divergent phase. In Spuybroek's words:

> [...] how can there be real communication, a physical correspondence instead of a metaphysical one. How can there be discrete organizations (like objects, which they are not); how can they be selected; how do they, when selected, become a structure; and when there is structure, why is it different from the others that fit the same discrete set?

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[60] Spuybroek, *NOX*, p. 4.
[61] Humberto Maturana and Francisco Varela, *Autopoiesis and Cognition: the Realization of the Living*, p. 89.
[62] Brian Massumi, "Building Experience: The Architecture of Perception," in *NOX: Machining Architecture* (London: Thames & Hudson, 2004), p. 328.

> These theories have always needed an external body (God, architects) to activate the process, to enable the shift from the one side to the other, because matter was considered passive and incapable of passing through itself. But let us begin to consider things as being mobile themselves [...], a notion involving the now well-known concept of self-organization, in which materials are active agents that seek nothing but agency, that seek an order that is not transcendentally established but emerges from the bottom up."[63]

I argue that it is precisely at this point that Spuybroek's main intervention resides: at the connecting point between organization and materialization. He states that form generation is dependent on material processes that are linked on the level of forces. These forces need to be deforming and transformative so that a material can be mobilized and become active. It is in the forceful field of action and through the coupling of materials and organizing systems that materials gain agency. This situated definition forms the underpinning conception of material agency adopted by this thesis and informed the working process of the practical artworks submitted here.

Analog Computing

Spuybroek further develops design methodology and strategy of form mobilization by reference to analog computing, a modeling technique used in science technology to simulate computation by employing physical processes. Mechanical or hydraulic parts are employed to model the interactions.[64] Spuybroek aligns the techniques of analog computing to research within the field of structural engineering. He specifically refers to the work of German architect and structural engineer Frei Otto, who started experimenting with the construction of lightweight tensile and membrane structures in the 1960s at Stuttgart's *Institute for Leightweight Structures (IL)*.[65] Otto was concerned with structural efficiency and developed material systems for calculating form.[66] He studied how material systems - over a defined time-span and under specific conditions - operate on their own initiative, able to restructure and find their most efficient form.[67] Materials thus function as agents to that form-finding process. Spuybroek qualifies:

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[63] Spuybroek, *NOX,* p. 7.
[64] A prominent example is the MONIAC (Monetary National Income Analogue Computer) created in the postwar United Kingdom to model the national economic processes. As an analog computer, the MONIAC made use of fluidic logic to simulate the workings of an economy.
[65] Otto founded the *Institute for Lightweight Structures* at the University of Stuttgart in 1964 as a research institute combining the fields of architecture, civil engineering, and material technology.
[66] The materials Otto used for his experiments are primarily "soft" materials: sand, balloons, paper, soap film, glue. These materials share geometric properties and a particular ability to merge and to bifurcate.
[67] A well-known and often cited example is the chain modeling technique used by Antoni Gaudi for Sagrada Familia.

> Most of them consist of materials that process forces by transformation, which is a special form of *analog computing.*Since the materials function as "agents," it is essential that they have a certain flexibility, a certain amount of freedom to act. It is also essential, however, that this freedom is limited to a certain degree by the structure of the machine itself. In classic analog computing most of the movement is contained in gears, pistons or slots, or often in liquids held by rigid containers, but in Otto's machines nearly all materials are mixtures of liquids and solids, or begin as liquid and end up rigid. The interactions frequently result in a geometry that is based on complex material behaviour of elasticity and variability [...]. [68]

Material Machines

Spuybroek initiates a design by programming abstract forces of deformation into the computer. Vertices are attached to virtual objects; virtual objects then resist or deform in relation to the induced forces. Spuybroek thus starts his process in the same way Lynn does: in the computer, using animation software to design abstract forces that impact the design.[69] Where these approaches essentially differ is that Lynn's designs proliferate and are made complex in the virtual: his designs never leave the computer. Spuybroek instead furthers the process by taking the virtual model out of the computer and into contact with the constraints as well as capacities of actual materials. Spuybroek calls this the "material *potential*,"[70] which allows a force to materially transfer into the actual design. Potential, Spuybroek qualifies, "means indeterminate yet capable of determination."[71] It holds the capacity for a tendential (design) development that allows one to set a goal for an "as-yet undetermined action."[72]

In the virtual model, Spuybroek observes occurrences of distortions and deformations and then materializes these deformations in an actual model with materials analogous to the parameters assigned to the materials in the computer simulation. He maps virtual material parameters onto actual materials and turns to Otto's extensive research[73], as well as to his own expertise gathered through experimentation, to determine within which material machine and which analogical model a specific design problem can be approached most effectively. Once the materials and

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[68] Spuybroek, *NOX,* p. 352.
[69] Spuybroek provides an account of his use of animation software in his interview with Arjen Mulder and Maaike Post, "Lars Spuybroek." Available at: http://www.vividvormgeving.nl/vormgeverpagina/spuybroeknrc.htm [last accessed, June 4, 2010].
[70] Spuybroek, *NOX,* p. 354.
[71] Ibid., p. 357.
[72] Ibid., p. 357.
[73] Spuybroek particularly makes reference to the IL-Publications series, published at the Institute for Lightweight Structures (IL1-IL 41). Each issue chronicles the work of Frei Otto and his team, and deals with one topic of lightweight construction. The series represents essential research in the areas of natural structures, bionics, forming processes, and textures.

machine are chosen, manipulations (Massumi refers to them as "manual algorithms"[74]) further the process of deformation and change the initial model into reasonable architectural elements. In this stage of the design process Spuybroek interprets and actively manipulates the model into reasonable architectural elements.

The following exemplifies the relevance of the "right" choice for a material machine at the initial stage of the design process. When horizontal architectural structures are demanded (i.e. by the client), Spuybroek might turn towards paper-strip models to discover their logic of bifurcation, which predicts their unique process of merging towards a material and structural network that indicates concavities, openings, and enclosures. For vertical structures such as a tower, the branching system of wet woolen threads arranged between a bottom and top grid that incorporate varying amounts of flexibility and slack might be studied. This design phase is thus characterized by both a transmission into a new material, amplifying and materializing what began in the abstract, computational realm and as an architectural interpretation of how these machines can transform into an actual design. The next iterative procedure takes the machine, e.g. the agglomerated paper strips, back into the computer. The design finishes under consideration of all parameters an actual architectural design has to take account for. In the final phase of the design process, the digital design is transferred into a physical object at scale 1:1, often by use of rapid prototyping.[75]

Employing "material machines" to mobilize form is a method that privileges the generation of material transformative information by the very operational rules that assure transfer of stimuli. This engages the abstract as well as the concrete in-formation of materials. This transfer of stimuli or forces is potentially bi-directional: from the virtual into the actual, and from the actual into the virtual. Material machines thereby carry a double specification. On the one hand they enable transfer through an ability to bear traces of digital materiality: they abstract. Conversely they also induce their very concrete material potential into the final design and shaped material expression of what Massumi refers to as the "form-taking process."[76] I therefore suggest that material machines can be understood as intermediaries that need to be coupled with a particular system and forces to become operational. In Spuybroek's words:

> The organizational and informational stage is material, not immaterial, as it is so often put forth. It is the material *potential*, the material's distributed intelligence that sets the

[74] Massumi, "Building Experience," p. 329.
[75] Rapid Prototyping is a procedure whereby from the virtual design thin horizontal cross-sections are generated and each of these layers is then created in physical space, one after the other. As such, it makes possible to directly link the conception of a design with its production.
[76] Massumi, "Building Experience," p. 329.

> machine in motion, a transfer of water-turbulence to wool-curvatures. Then it is the stickiness, the hairiness and the curvability of the wool thread, together with the cohesive forces on the water surface that bring it to a halt and inform the end result.[77]

Material machines are thus form-finding machines, or material systems for calculating form. Analogical models activate the potential of materials and enable them to perform and take on form, which is a procedure distinctly different form imposing geometrical concepts on form. Architect Detlef Mertins has noted that "Spuybroek solves the problem of form with techniques that are not formal but rather material."[78] This approach to form-finding processes, and, more conceptually, to "open" and emergent processes, need to be controlled to a degree in order to allow these processes to tendentially proliferate in a desired direction, without predetermining the result. Throughout *Machining Architecture* and in numerous interviews,[79] Spuybroek gives generous and detailed records of how he employs various kinds of material machines in order to generate form. These describe him navigating and controlling the process. Mertins observes: "Spuybroek directs his experiments toward attaining ever greater control with which to achieve desired qualities and capacities, be they aesthetic or performative."[80]

Initial choices matter, as Spuybroek says, and the selection of an initial system and material machine is relevant as each machine embodies, or tendentially describes, a different potentiality for a particular outcome, without either pre-defining its form and or determining and how a project will look in the end. Knowledge of materials and expertise in how to couple materials with systems therefore is important to a material design practice that seeks to keep a measure of control over its experimental setting and direction of development. Spuybroek particularly emphasizes the relevance of knowing and to some degree controlling the workings of particular systems (topologies) in order to craft their synthesis with organizational faculties (typologies):

> [...] type is relevant, not just only in biology but also in architecture. When we set out to design a tower, for instance, we are not going to establish a machine with a horizontal configuration. And though we need a topological technique to generate designs, it will always be necessary to topologize type (in case of the tower topologize verticality), and not just bring in a topological figure or system from any source. There has been too much emphasis on the divergent, proliferative capacities of intensive design techniques and not enough on the initial selective procedures. In what systems are we going to mobilize elements and relations?[81]

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[77] Spuybroek, *NOX,* p. 354.
[78] Mertins's, "Foreword," in Spuybroek, *The Architecture of Continuity,* p. 8.
[79] Interview with Arjen Mulder and Maaike Post (2000) regarding his installation at the Musée des Beaux-Arts in Nantes for Vision Machine. Arjen Mulder and Maaike Post, "Lars Spuybroek." Available at http://www.vividvormgeving.nl/vormgeverpagina/spuybroeknrc.htm [last accessed, June 4, 2010].
[80] Mertins's, "Foreword," in Spuybroek, *The Architecture of Continuity,* p. 9.
[81] Spuybroek, *NOX*, p. 9.

The study of building typologies is an architectural convention and involves the taxonomic classification of characteristics of groups of buildings such as organization of parts, shape, construction, symbolic meaning, and use. Typology is situated within the contextual and has been regarded as a tool for the distinction between the general and the particular. Typologies are cultural constructs. Topology in architecture, on the other hand, refers to the geometrical variables of form and involves procedures that deal with continuity of transformation. It is these topological procedures that render form dynamic. The synthesis between topology and typology suggested by Spuybroek, i.e. an oscillation between the dialectics of variability and fixity, dynamic form and stasis, and consequently nature and culture, requires a fluctuating negotiation of these synthesized formations (for example tectonic expression and proportional elasticity). The resulting complex geometries are entangled by the nature of the process they derived from which, I suggest, allows for their associative reading and interpretation.

NOX's *D-Tower* Project

As a way to explore Spuybroek's design method and use of material machines, I now turn to the *D-Tower* project, a *NOX*'s project discussed within *Machining Architecture*. The tower is in Doetinchem, a small city in the Netherlands, and was developed during 1998-2004 in collaboration with the visual artist Q.S. Serafijn. The *D-Tower* is an urban media object serving as a promoter for social and mediated communication and interaction.[82] It is a complex, interactive mingling of different media and networked systems.[83] I want to draw attention to how initial experimentation with and choices made regarding a material machine, together with a set of forces and gestures, injected friction into the analogical model and thus informed the further creative design process. This directly relates to processes of creation and experimentation of both the case study media art installations discussed in Chapter One and Two.
For *D-Towe*r, Spuybroek employed one of Otto's methods for generating a system that has the potential to develop into vertical structures: i.e. the balloon option, a procedure for turning a sphere into a vertical topological formation. Through a series of iterative inflations, and by using a rubber balloon that was partially inflated, taped at certain areas, and then inflated further, the sphere's symmetry was inflicted so as to deform and de-shape. Spuybroek describes this iterative

[82] The website www.d-toren.nl is a networked aspect of the project, one of the different media applied that was designed to interrelate and co-operate. The website serves as a platform for communication amongst the inhabitants of Doetinchem. It also serves as an archive of these communal exchanges and as such, is an excellent source and ongoing survey of the *D-Tower* project.
[83] Spuybroek., *NOX,* p. 158. For a further discussion of the project see also Arjen Mulder's article: "The Object of Interactivity," which is part of the compendium *Machining Architecture,* pp. 332-40.

process of form taking and the breaking of the symmetry of the sphere as "a choreography of alternating contracting and expanding forces – it inflates as much as it collapses."[84] Furthermore, the rubber balloon was hung upside down, such that gravitational forces impacted the process of "taking form" of the tower's model. When the obtruded, deformed, and hung model was digitized, it was again rotated upside-down, so that in the final design the tower came to stand on apparently unstable legs. In the further process of design and development of the digital model, an array of variations of leg positions were explored for their ability to morph gradually into the surfaces of the top part of the tower. Such an iterative, machining process brings up the question of the nature of creative processes. Evidently, Spuybroek's machining design method does not intend to simplify, automate, nor supplement the design process; it rather provides a base from which the creative process can depart and through which the variability of the rules that govern the processes of in-formation can be explored. The question is thus what features of the analogue balloon model are "seen" by the creator (artist, architect) and subsequently selected to enter the further transformative process, and which characteristics, features, and parameters are suppressed. The use of the analogical model (the balloon holding a potentiality for verticality) and the material machine (friction, tape) effected the incremental deformation of the balloon. In that sense, it can be said that the act of manipulation and deformation was in-formed, but not determined, by the rubbery material quality of the balloon itself.

The actual architectural design and outcome of these processes presents the tower as an enigmatic figure. It is a tower that hovers above the ground and stands on strangely entangled legs that barely seem able to carry its weight. It makes the viewer, and passers-by, experience its design departure point (a rubbery quality) in many ways. The tower, as type and topos alike, acts as a signifier, but the signs transmitted by *D-Tower* do not subscribe to the idea of a stable point of orientation, of an empowering, hierarchical, overview. What is the purpose of such rubbery instability in an architectural point of reference? Spuybroek set out on a form-taking process that abstracted the material into the process, and did not, as Massumi has pointed out, abstract from it.[85] The end result is an architectural figure that seems to hover in mid-air and is composed of complex, bending surfaces made from epoxy and formed via a computer-generated mould. The tower is a hollow shell illuminated from within (using networked LED lighting technology). As an interactive media object the *D-Tower* can, as Spuybroek describes, "change colour according to the emotions of a town's inhabitants, questioned in a daily survey. An urban object that shows

[84] Spuybroek., *NOX,* p. 158.
[85] Massumi, "Building Experience," p. 323.

the hidden feelings of a whole city."[86] Blue for happiness, green for hatred, yellow for fear and red for love. This is a tower you do not look out of,from a superior and elevated position. It is rather a tower you look *at*, gaining multi-sighted constantly colour-shifting viewpoints of a landscape of bent and morphed surfaces.

This introductory chapter has attempted to lay the theoretical ground from which an artistic engagement with the concept of material agency can develop, building on an analysis of architect Lars Spuybroek's method of machining and use of material machines (direct material systems for form generation). It has paid particular attention to Spuybroek's practice of designing and directing experiments that allow materials to perform and take on shape themselves, thus taking on agency within, as Thomas suggests, a larger "network of forces and actions."[87]

In the chapters that follow, this focus on Spuybroek's engagement with materials is transferred into the field of media art and performance practice and the conception and realization of media art installations. Chapters Two and Three draw upon practice- based research and the analysis of the two artworks submitted with this thesis: ANI_MATE and ON TRACK. Drawing upon Spuybroek's material machines, the following detailed analysis of these artworks trace how a "collaged" media art installation (consisting of multiple processes, movements, materials, and media) can generate a sustaining environment (ANI_MATE) or entropic ecology (ON TRACK) within which materials perform to become relational. These projects are concerned with the potential of materials to negotiate force and to initiate and maintain relationships within the field of action generated by the system. Most significantly, both projects derive their dynamics as well as their thematic milieus from the interaction between systems, materials and movements, producing kinships with processes of life (movement, inertia, living forms, and images). These kinships spin threads between procedures of animation, or better, the production of animated entities: entanglements of moving, animate, and "living" forms.

Sharing Spuybroek's and, respectively, Frei Otto's concerns about the relevance of choosing the "right" material, that is, as Spuybroek's design philosophy suggests, materials that "have a certain flexibility, a certain amount of freedom to act" that is nevertheless "limited to a certain degree by the structure of the machine itself,"[88] the following analysis examines two materials for their capability of producing patterns of referrals between dynamic movement and associative meanings. It focuses on the potentiality and capacity of, first, the elasticity of a fabric

[86] Spuybroek., *NOX,* p. 158.
[87] Thomas, *Material Matters,* p. 5.
[88] Spuybroek, *NOX,* p. 352.

(ANI_MATE) that allows for a continuously fluctuating movement that keeps the image in motion and the illusion (of life) alive; and secondly, the viscosity of fluids (ON TRACK) that allows a slow flow towards their continuous and irreversible mixture, referencing humanity's wasteful exploitation of resources. These projects aim to show, as anthropologist Tim Ingold states, that "focus on life-processes requires us to attend not to materiality as such but to the fluxes and flows of materials."[89]

Another reoccurring theme that will link later discussion back to this introductory chapter is the notion of creative design processes, or, for that matter, creative artistic processes. Spuybroek makes perfectly clear that his method does not imply handing over all vital parts of a design processes to material machines, but rather invites a rigorous directorial choice making and interpretative selection procedure as part of the process. "Choice making" therefore is closely tied to a practice of designing and directing experiments and is based on extensive expertise with the systems, or a material machine's tendency of development. That expertise leads him, according to Mertins, to "direct his experiments toward attaining ever greater control with which to achieve desired qualities and capacities."[90] Experimentation and an engagement with "open" processes is a continuous concern within the following analyses (though it is not always the focus of analytical attention), since the issue of control versus openness is also of an ongoing concern to design processes of interactive system and analog/digital feedback environments.

The next chapter examines ANI_MATE, a pneumatic stage machine that performs life processes and examines the liminal thresholds of a living state. The chapter opens with a framing of animation in terms of a "live force" that physically and directly impacts, and transiently transforms an image.

[89] Tim Ingold, "Bringing Things to Life: Creative Entanglements in a World of Materials" (NCRM Working Paper. Realities / Morgan Centre, University of Manchester, 2010), p. 3. Available at: http://eprints.ncrm.ac.uk/1306/ [last accessed: March 2, 2010].
[90] Mertins's, "Foreword," in Spuybroek, *The Architecture of Continuity,* p. 9.

CHAPTER TWO

A PERFORMANCE OF MATERIALS

ANI_MATE: A Pneumatic Stage Machine

We also now live in a culture in which our 'humanity' is increasingly (to use a phrase familiar to animators) 'squashed and stretched' by forces beyond our control; and thus it often seems that our lives no longer quite belong to us, that we have become increasingly powerless and, however frenzied, increasingly inert.[91]

This chapter focuses on ANI_MATE (2006), a performative pneumatic stage machine. ANI_MATE researches procedures of animation and their relationship to materiality, agency and movement, thereby creating a dynamic, live scenario of powerful forces. The machine was conceptualized and designed in several intensive work periods during 2005-2006 in Toronto and Amsterdam and first performed November 2006 at the *Gasthuis* Theatre in Amsterdam. The planning and conceiving of the machine's operational system provided the starting-point for my doctoral research. This chapter presents a detailed study of the research method and working process through which the parts, procedures and materials that together comprised ANI_MATE came to exist, and how the machine was performed as a "play"[92] and theatrical event.

The machine is operated by me, performing onstage, and involves a computational system, a pneumatic apparatus, a tensile screen, a series of projected still images (depicting my body) and a collection of threads. These components provide the means through which the animation machine produces linkages that enable interactions. When set in motion, these systems and elements cooperate in order to create movement and screen depth, injecting a vital flexibility into the still images, and continuously morphing and transforming them. The machine is conceived and designed to be a performance that can be viewed by an audience as a "play" with the liminal thresholds of a living state, exploring, as Salter suggests, the "performativity of different material enunciations, both human and non."[93]

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[91] Vivian Sobchack, "Animation and automation, or, the incredible effortfulness of being," *Screen* 50:4 (2009), p. 375.
[92] The term "play" is chosen here because of its multiple references. The obvious reference would be to the notion of the theatrical play, but the secondary reference is to the playfulness of machine sculptures (i.e. Jean Tinguely's kinetic sculptural machines, the "metamechanics"). More conceptually spoken, the reference is also to the computational machine's capacity to enable interactive interface performativity and engage the user (or performer) to play and therewith interact with the machine. Transposing the term into the musical realm, ANI_MATE can also be said to qualify as a musical instrument, played by mechanical as well as electronical manipulation and the "tuning" of its strings (the collection of threads).
[93] Chris Salter, "Environments, Interactions and Beings: The Ecology of Performativity and Technics," in *Interfaces of Performance*, ed. Maria Chatzchristodoulou, Janis Jefferis, and Rachel Zerihan (Farnham: Ashgate, 2009), p. 30.

As a kinetic structure and architectural object ANI_MATE is a spacious contraption that barely holds itself in fragile balance. The large, high, and tilted tensile screen hovers above a low and elongated platform. The thin threads punctuate the fabric screen and connect the flexible membrane to the field of pneumatic actuators at the other end of the platform. Operating on exhaust air, the powerful machine takes the risks of "exhausting" itself in its delicate, yet frantic attempt to metamorphize a still image into life. Pneumatic forces move the tensile screen and with it the projected images of my body, amplifying the material action of stretching and distorting in an effort to make these performative and material dynamics tangible to the audience. Wrestling with the messy domain of material beings and living images, the play unfolds as a shuttling between animation and stillness. The machine acts only in order to have the chance to return to its initial, motionless state

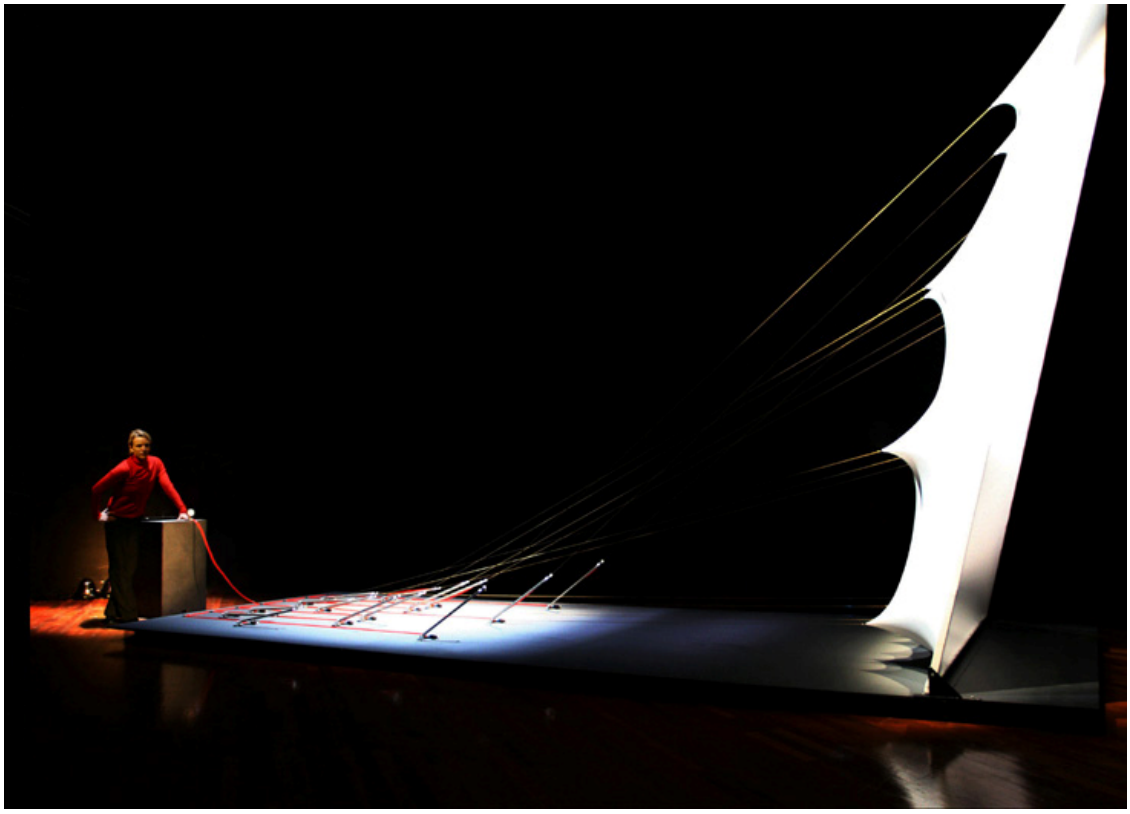

Fig. 2.1: Total view of the ANI_MATE pneumatic stage machine and kinetic structure. Photo © Annette Kamerich.

Fig. 2.2: ANI_MATE's screen under tension (convex) Photo © Annette Kamerich.

Fig. 2.3: ANI_MATE's screen under tension (concave) Photo © Annette Kamerich.

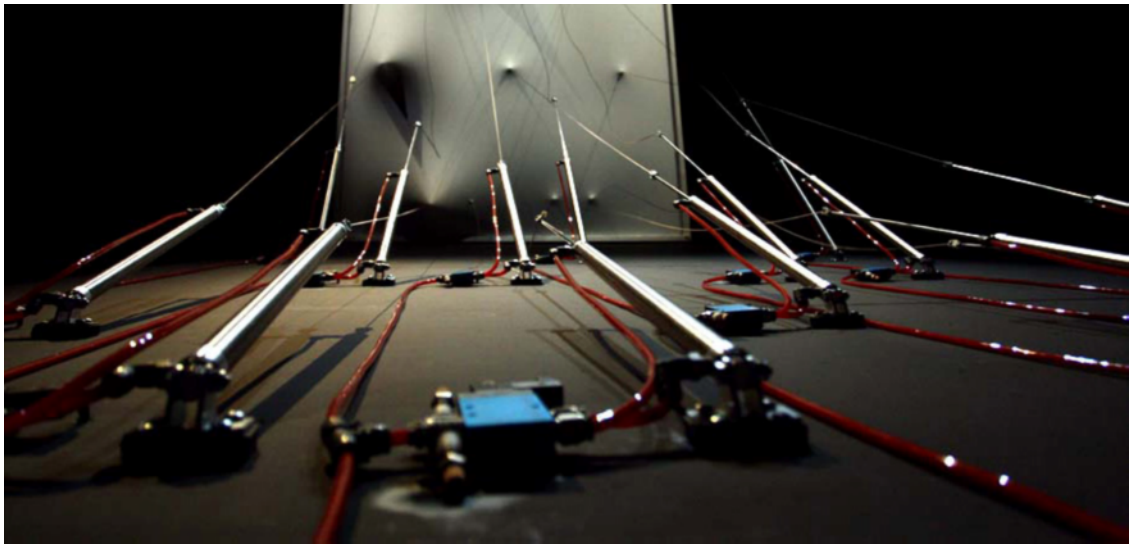

Fig. 2.4: ANI_MATE's pneumatic apparatus. Photo © Annette Kamerich.

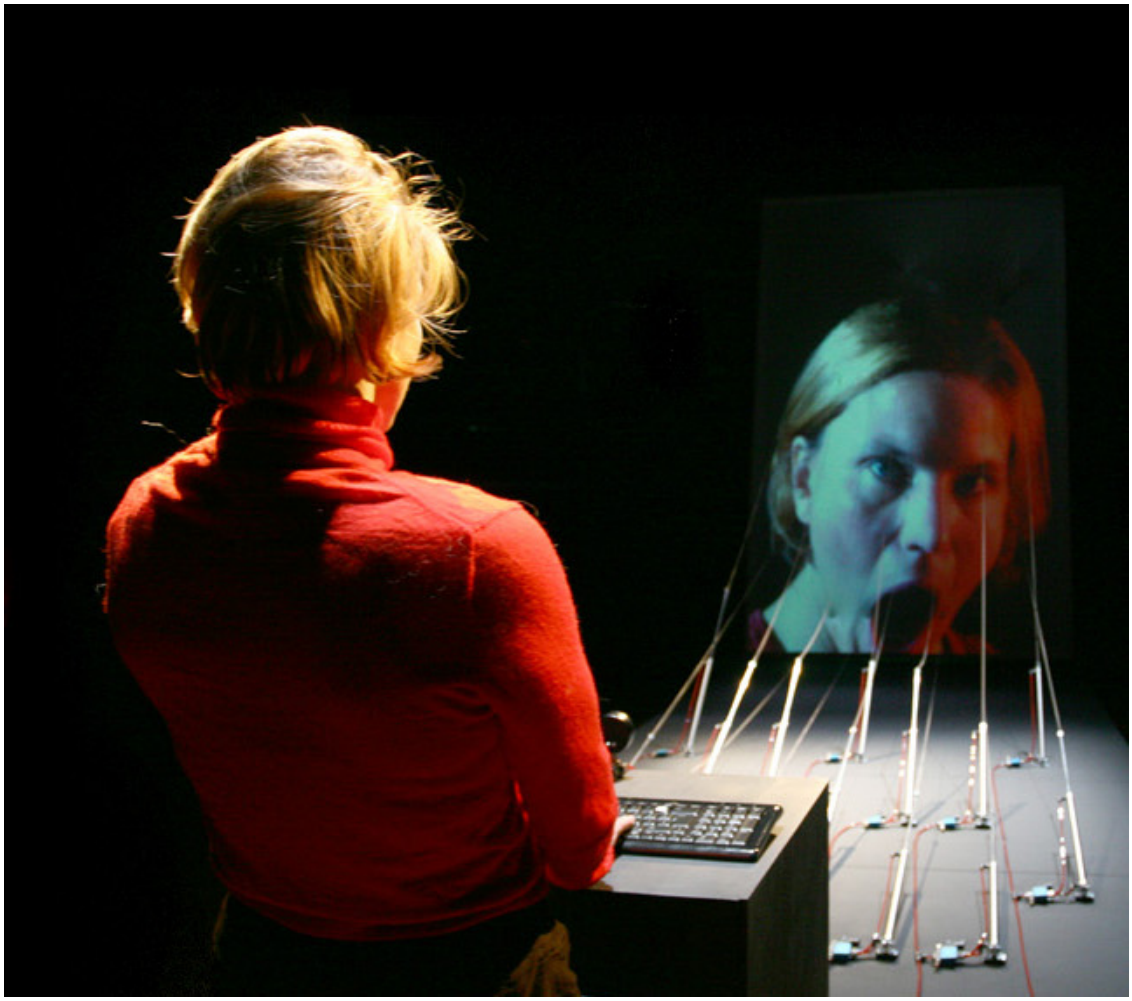

Fig. 2.5: ANI_MATE's performance is a continuous dialogue between dynamic movements, processes, materials, inflected images, and actual bodies. Photo © Annette Kamerich.

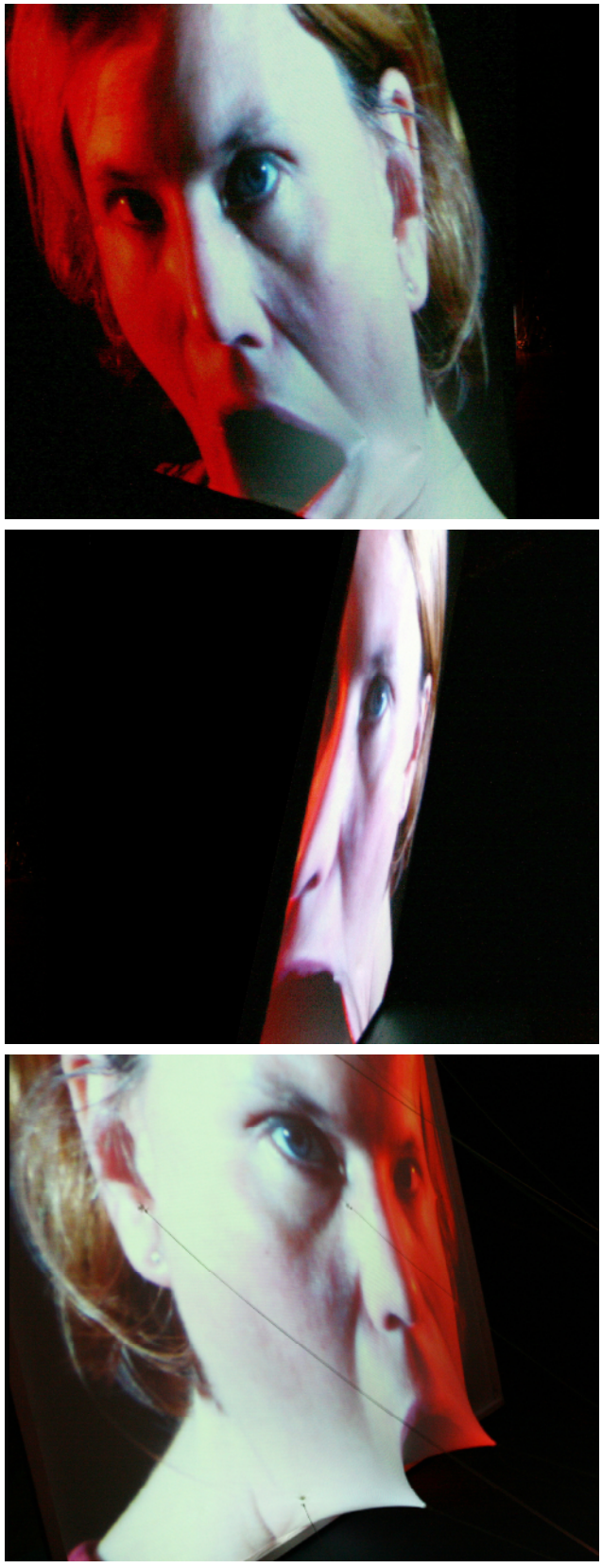

Fig. 2.6: ANI_MATE combines multiple perspectives within one image frame in order to confuse and inhibit coherent vision. (The same “stretched” and inflected image viewed from different perspectives).
Photo © Annette Kamerich.

As a performative stage machine, ANI_MATE embodies the deliberate confusion of the concepts of motion and non-motion, and respectively, living and non-living. It mingles the material associations of mesh, fabric and skin and produces constantly fluctuating points of contact between human movement and machine momentum, and between flat image and deep body. ANI_MATE offers constantly shifting visions of the life and death of, what American theorist W.J.T. Mitchell terms a "living image,"[94] and performs an interplay between animation and automation which articulates the complex entanglements of moving images, animate entities, and machinic agencies at the basis of the work.[95] ANI_MATE uses pneumatics to force still digital images of my human body into becoming a "moving" and "breathing" material beings, exposing, in the words of American cinema and media theorist Vivian Sobchack, the "very labour of living" as a momentum that distinguishes "real life" from the "plasmatically eased" life, animated and known through our latest technologies:

> That is, in real life – human life – to be animate is not merely a continuous and plasmatic given. And, even for the young among us, both movement and becoming have themselves become increasingly difficult – and this despite (although also because of) our latest technologies. We encounter friction, obstacles; we are forestalled; we experience fatigue, desire, and secretly seek not more momentum but less. [...] There is, of course, a paradox in our weary longing for and elation at watching plasmatic ease, and this is that the very labour of living is our most primal work and that which most enlivens us.[96]

ANI_MATE seeks to address the ways in which being human is to be, as Sobchack implies, "squashed and stretched by forces beyond our control."[97] We come to a stop, stalled by the wear and tear of real life, and driven to acquire the plasmatic ease that drips out of our virtual lives. Driving the research that lead ANI_MATE was the quest for how to expose some of the motives and dynamic qualities of liveness. It was an investigation into how these motives might be actively materialized through animation and physical effort, rather than through computer-generated "realistic" representations of life. Throuh this insistence upon establishing relations between digital image, human body and material agency, the work partly corresponds to Munster's theoretical debate regarding the "materializing"[98] of digital culture. This line of debate considers the body within a physical relationship to digital technology, and is concerned, as

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[94] W.J.T. Mitchell, *What do pictures want: The Lives and Loves of Images* (Chicago and London: The University of Chicago Press, 2005), p 89.
[95] Cf. the symposium call for "Animation and Automation," held at The University of Manchester and Lancaster University, March 26-27, 2009, which uses a similar language for such articulated interplays. Available at: http://www.lancs.ac.uk/fass/sociology/event/2727/ [last accessed, January 30, 2011].
[96] Sobchack, "Animation and automation," p. 391.
[97] Ibid. p. 375.
[98] In Materializing New Media, Munster sets out to "materialize" digital culture and argues that its contemporary information aesthetics does not exclude embodied experience and reconceived materiality. Anna Munster, *Materializing New Media: Embodiment in Information Aesthetics* (Hanover, New Hampshire: University Press of New England, 2006), p. 8.

Munster affirms, with the "specificities of living and breathing informatic bodies and with the processes of embodying information."[99] This process works both ways, and Munster claims that "the question of what constitutes a digital machine correlates to the issue of what bodies have, and what they might become."[100] With the conception and realization of the ANI_MATE stage machine, I sought to focus on (paraphrasing Munster), "what bodies become." Finding a mechanism through which to perform this process meant reflecting on what constitutes a living image, or material being, and what it entails to have such animated bodies on stage. Exploring forceful machine dynamics and material actions and exposing their effect on the image, I propose to think through the performance of such becoming in terms of concrete material, rather than abstract form.

The research approached procedures of animation by turning to and examining dynamic motifs of aliveness such as motion, action, agency, autonomy, and relationality, and exploring them in relationship to images. These motifs are, as Mitchell notes, "symptoms that make pictures into 'vital signs' by which I mean not merely signs for living things but signs as living things."[101] Over the course of the working process, the notion of the "living image"[102] became pivotal in understanding the underpinning conceptions of animating the inanimate with self-moving mechanical systems and live performed machine environments. ANI_MATE draws to some extent on Mitchell's picture theory, wherein images are understood not only as inert objects that convey meaning, but also as animated beings or "life-forms, driven by desire and appetites"[103] that take on "lives of their own."[104] I follow Mitchell's notion that the desire to create a living image is not related to creating a perfect digital animation able to move with Sobchack's plasmatic ease but instead to create a "viable simulacrum of a living organism"[105] which exposes a struggle to become and stay alive. ANI_MATE investigates the concepts, systems, materials and performative strategies[106] that are involved in creating and maintaining (and thus controlling) a dynamic environment within which such living images can come into being, become active, and gain agency, as well as being engaged with and acted upon.

[99] Munster, *Materializing New Media*, p. 186.
[100] Munster, *Materializing New Media,* p. 9.
[101] Mitchell, *What do pictures want*, p 6.
[102] Ibid., p. 12.
[103] Ibid., p. 6.
[104] Ibid., p. 2.
[105] Ibid., p. 13.
[106] With performative strategies I refer to artistic systems such as improvisation as a performance practice, or interactivity as model for articulating transactions between events and environments, used to fundamentally shape the process of making, and arguably, the reception of a work of art.

The following section takes a first, brief look at the three key aspects that surfaced through the research and support the performance of a living image.It at first examines how, on a systemic, material and technological level, relations can be established such that the image becomes part of a larger composition of linked elements, or field of action, within which it participates and thereby becomes relational. The notion of "meshed systems" alludes to a viable confusion comprised of mesh, fabric and skin, tissues of threads, and the pneumatic-breathing performance of stretching and extruding: a texture of dynamic qualities within which the image can gain an active state. Second, I will discuss how the illusion of a living image is expressed via a specific relation between the static image and fluctuating movement. This illusion of life is related to the distinction, most familiar in cinematic terms, between that which moves and that which is still. Within the environment constructed by ANI_MATE, however, this distinction indicates the curious liminal threshold between image and body, between the two-dimensional flat image and the anamorphic figure that is animated and kept lively through continuously fluctuating and reversing movement, carried – within a single frame – from image to topological body. Third I will look at the tensed dynamism and lines of interaction between movement, the anamorphic figure, and the actual material used, specifically how the elasticity of the screen allows a tangible physical force to inform and deform the image, effecting meaning that evolves through the tremendous effort of its performance.

Meshed Systems

As mentioned before, ANI_MATE is comprised of five linked components: a computational system, a pneumatic apparatus, a tensile screen, a series of projected still images and a collection of threads. The machine combines images, mechanics and sound on both an informational and material level: it is a "meshed" dependence and correspondence. The pneumatic apparatus consists of a field of fourteen valves, cylinders, two air compressors and a system of branching air tubes, mounted on top of a long floating platform and choreographed to perform mechanical movements. These movements are at times explosive and powerful pushes and pulls, and at others delicate and caressing articulations. Pressurized exhaust air extends and retracts the cylinders, creating a sound score due to the fluctuations of released and redeemed power. The tilted tensile screen and four-meter high flexible membrane is mounted on the platform situated opposite the field of pneumatics. The prerecorded color stills of my face and body, shot against a black background, are projected onto this screen. They are shot both wide and close-up and are carefully situated to either occupy a particular portion of the screen, or entirely fill the surface.

The gap between the flexible membrane of the screen and the field of pneumatic actuators is bridged by thin threads, hooked into the screen and linked to the pneumatic cylinders. The screen and the cylinders are five meters apart. When the pneumatics pull the screen the images form and deform in fluctuating patterns. The flow between cause and effect, movement and image hinges on the thin, elongated and tensed threads. The motivating patterns of the pneumatic apparatus are meticulously choreographed to pull the two-dimensional images at vital points of their surfaces (or "skins") so as to deform them into morphological shapes and three-dimensional figures, composed of inflected surface topologies. The projected body begins to fluctuate, to rhythmically deform. It is captured, restlessly rotating in the cone of the fabric; it is stressed and tensed into shifting expressions. The face appears to move, speak, or to breathe. Opposite the screen, about eight meters away and next to the field of pneumatics, there is a small pedestal. The pedestal is where I stand to operate and perform the machine. Activating the pneumatics and monitor, and steering the system's air pressure, I am able to manipulate and "play" the image-portraits. This play was a structured improvisation. I called up the images and movements in recombinant arrangements, and I was able to alter the machines performance through dynamic modulations of the system's air pressure as well as through my direct operational and performative manipulation of different machine parts. The ANI_MATE machine was constructed to perform a series of linkages and lines of interaction as just described in order to engage the image with its material, information and perceptual environment. The image thus becomes complicit with its milieu, participating in dynamics that describe its (material) and actual becoming.

From Screen Image to Topological Body

The threshold to illusions of life, and that what passes for a living state, is commonly expressed in the terms of and in relation to movement. This is the differentiation between that which moves, and that which is still, which, as I suggest, is most commonly found in cinematic animations of the still image. Animation has, in Mitchell's words, "routinely been articulated as a question of life"[107]:

> Why is the moving image invariably characterized with vitalist metaphors such as 'animation' and 'live action'? Why is it not enough to say that the images move, the actions are depicted? Familiarity blinds us to the strange life of these figures; it makes them dead metaphors at the same time it asserts their vitality.[108]

[107] Mitchell, *What do pictures want?*, p. 53.
[108] Ibid.

Cinematic and filmic conceptions pertaining to the moving image are based on the persistence of vision[109] and on creating an illusion of movement through the images' animation across their frames. Whereas this filmic illusion of movement is dependent on the continuity of transformation across an extended succession of images, ANI_MATE does something distinctly different: it explores the possibility of image animation within a single frame. The conceptual difference between animation across frames versus animation within a single frame also situates ANI_MATE it in proximity to single-framed visual art experiments, such as the avant-garde practices of the Cubists (i.e. Georges Braque, Marcel Duchamp) and their critique of the culturally determined system of linear perspective and the geometric rendering of lived experience on a flat surface. I refer here to the energetic impetus with which the Cubists broke the image apart into simultaneous depictions of different possible viewpoints, and their refusal to give any clue as to of how to decipher their relationship. The lack of visual coherence demanded an active viewer, and an engaged process of viewing. Something similar can be said about the completely transparent yet disruptive possibilities of anamorphosis: it is a distorted representation of the image, combining multiple perspectives within one image plane and demanding from the viewer an active deciphering of the perspective riddle. An example of this are Renaissance paintings such as Hans Holbein's 1533 portrait of *The Ambassadors*, in which an anamorphosis, camouflaging a skull, "comments" on the material surface of the painting and the multiple spaces of representation alluded to. These examples from visual art reveal the potential of images to demand from the viewer an extra-perceptual awareness of the active, and subjective, nature of vision. Delaying the image, suspending recognition of it, and encoding a determinate content through building ambiguity and amorphousness into the situation – all these allow for an open and associative reading of what is being looked at.

Robert Lazzarini's installation *skulls* (2000), composed of four anamorphically distorted skull sculptures, allows transfer of this discussion regarding the potential of the image to transform into a site for multi-sighted vision, moving it from painting into the intertwined domain of the digital-analogue. In his analysis, media philosopher Mark Hansen describes Lazzarini's *skulls* as "catalyzing a perspectival crisis"[110] generated through the disorientating ambiguity of a procedure that transfers digital deformation processes onto a physical object. A laser scan of a scull was scanned into a three-dimensional digital drawing and extremely distorted within the digital space. Sculptures where modeled from these digital drawings and then cast in bone. Lazzarini thus, in

[109] Persistence of vision refers to the idea that images can be linked together in the eye of the spectator if still images appear in succession for very brief intervals, thus creating the illusion of movement. This illusion is activated through cinematic projection with a film speed of 24 frames per second.
[110] Mark B. N. Hansen, *New Philosophy for New Media* (Cambridge and London: MIT Press, 2004), p. 200.

Hansen's words, utilizes "two-dimensional distortion techniques in order to model three-dimensional objects."[111] The results of such a transaction are protracted yet indeterminate objects, as their own depth interferes with the illusionary potential of two-dimensional perspectival distortion. Hansen goes on to say that Lazzarini's *skulls* do not represent traditional anamorphosis but rather an anamorphic distortion and a "warped topological space."[112] The method employed in the "process of embodied form-giving" is that of "deploying the capacities proper to the digital image – or, better, to the process of digital modulation."[113] The digitally distorted image, catalyzed as object (the skull), thus becomes a process that encompasses the processes of perceiving. Hansen describes how procedures of information processing can include instances of embodiment, however radically distorted.

Hansen's argument regarding the informed topological space that enables and provokes an embodied process of perception is complemented by Andreas Broekmann's foregrounding of the image as event. Broekmann, in his curatorial statement for *Deep Screen – Art in Digital Culture* exhibited in the summer of 2008 at the Stedelijk Museum CS Amsterdam, refers, like Hansen, to the legacy of traditional anamorphic representations. Broekmann does this in order to introduce the term "deep screen." He alludes to "the fluidity with which we can today imagine virtual spaces as physical ones, and physical spaces as virtual ones"[114] to provide context for this statement: "While the deep screen has distinct art historical precursors, it is a phenomenon that has become more complex in the age of electronic and digital media."[115] With this deep screen curatorial lens, he engages with artistic works that: "probe 'screen depth' in relation to the construction and deconstruction of space: in relation to the screen as a space of action and interaction: and as a complex field of perception."[116] He is therefore able to "reflect on the image as process, or event"[117] and explain that "the underlying idea was that contemporary images, whether digital or analogue, are neither static, nor fixed once and for all. [...] In digital environments, even still images are performed and experienced as events."[118] Turning towards the image as event implies for Broekmann "a transgression of the illuminated image surface; it is a

[111] Hansen, *New Philosophy for New Media*, p. 202.
[112] Hansen, *New Philosophy for New Media*, p. 202.
[113] Ibid., p. 203.
[114] Andreas Broekmann, "Deep Screen – Art in Digital Culture: An Introduction" in *Deep Screen Art in Digital Culture: Proposal for Municipal Art Acquisitions 2008*, ed. Broekmann, A., Hemmes, E., Jongema, M., Tates, S. (Breda: NPN drukkers, 2008), p. 152.
[115] Ibid., p. 151.
[116] Ibid., p. 152.
[117] Ibid., p. 150.
[118] Ibid., p. 150.

dynamic, spatial and temporal field which connects the presence of the artwork to the process of perception and interaction."[119]

Such transgressions as explicated by Hansen and Broekmann, and of which I have given only a very short version, put the image surface into close proximity with it being read as a distinct dynamic, spatial, and temporal entity inflected by instances of embodiment and processes of perception. In the case of ANI_MATE, however, these inflections are actual, physical, and dynamic movements that directly impact and transform the image. The movement vector that acts upon the image moves into a tangible three-dimensionality. ANI_MATE sets out to release the flat image plane into depth and thereby animate the image in an ongoing, continuous flow of distortive physical motion. This keeps the image in constant flux (instead of making it entirely fluid which is a trademark of purely digital transformation). The performance of the mechanical pneumatics acting upon the elastic tensile screen moves the image through a reversible process, a palindrome that causes a fluctuation between flat representation (pictorial space) and three-dimensional figure. These movements confuse coherent vision and enable the tangible transgression of image to body, or to be more precise, of image into some kind of anamorphic (and following Hansen), topological and lifelike form. It is a transient figure synthetically modulating between its living (moving) and its non-living (inert) state.

Tension Forces and Transient Transformations

The interaction of image, of the material of the tensile screen, and of actual movement, challenges the tangible relationship between the moved image and its material surface. A similar interaction is found in David Cronenbergs *Videodrome* (1983), specifically in the scene where Max Wren, the protagonist, approaches the bulging screen of a television set showing the lips and teeth of his lover, Nicki Brand, are depicted. In this scene, the television set has come to life. Distended veins are pulsing under the plasticine surface, and as Mitchell has pointed out, "not just the image of Nicki Brand, but the material support in which she appears vibrates with desire."[120] The television set throbs and pants for air, calling to Max "come to me." The TV offers him the possibility of merging with and being swallowed by the beloved image. This scene obviously presents a male fantasy of annihilation by seductive female power; however it also points at the attraction wielded by images when they are coupled with a dynamic material. It is important to note that this scene

[119] Broekmann, "Deep Screen – Art in Digital Culture," p. 151.
[120] Mitchell, *What do pictures want?,* p. xvi.

was never conceived as something to be animated digitally. The "breathing television," as Cronenberg called this construction, was a physical contraption animated by air hoses, bellows, and stretched fabrics that were acted upon physically – i.e. played – during the film shoot.[121]

Cronenberg's breathing television provides an introduction to the material logic of ANI_MATE. Both are animation machines which, rather than animating digital representations into aliveness, allow materials to become active and take agency, enlivening the link between the actual machine's components - within which the image also comes to live. The particular environment of ANI_MATE allows the physical forces of tension generated by the pneumatic system to pass through the material (i.e. the threads and the flexible membrane) so as to inform and transiently transform the image directly. With ANI_MATE, specific attention is drawn to the material's potential to evoke, maintain and alter movement. It is the elasticity of the textile screen that allows animation of the image through oscillating patterns of extruding and receding, establishing a movement pattern that is "like" breathing and thus "like" a living image. Motion and inertia are negotiated along a scale between breath and no breath: life and death.

In conclusion, ANI_MATE's animation procedures are contained, firstly, within the conception and design of its enmeshed system: the conceptual, systemic and material environment within which the animation is performed, and secondly, within the gestural movement instructions that describe its performance. Finally, it is within the material potential of the elastic, flexible screen that force dynamics can be negotiated, and that relationships within the field of action performed by the machine can be initialized and maintained. In the next section, which focuses on the research and development and is a methodic tracing of the working process of ANI_MATE, I expand particularly upon this last aspect of material agency. The section traces the performance and potential of material as negotiated within the environment of ANI_MATE, and on how materials can activate the illusion of life. This ties back to Spuybroek's method of "material machines" discussed initially within the context of architectural material design practice. The following section describes the research into the performance of materials placed into the theatrical context of exhibition-performance as a working method through which a concept may materialize. The "*Zerreißprobe*" (as stated in the introduction, this is a German term for "tensile test" or "tensile tear test") is offered as both a term and a procedure: a way of navigating the working process as it moved towards the actual performance and public presentation of ANI_MATE.

[121] For a description of Cronenberg's apparatus and breathing television see http://www.criterion.com/current/posts/676 [last accessed: August 11, 2010].

Working Process: "*Zerreißproben*"

Introducing the performative installation ON TRACK in the spring of 2010, curator Martin Sturm of Linz's *Offenes Kulturhaus Oberösterreich* refered to the work as "...not just a sculptural arrangement but also a (quite) real experimental attempt" [122] (a full analysis of ON TRACK appears in Chapter Three). I argue that ANI_MATE also falls into this category of being "not just sculpture" (or architectural form), but presents a performance machine that primarily draws attention to the material itself.[123] "Being ultimately the material itself,"[124] is a qualitative description for work that makes use of materials in ways that according to Sturm, go beyond the exposure of an "indicative function" or "modeling mass," to an actual performing of "the material itself, with its specific qualities, its cultural meanings that cling to it."[125]

Putting emphasis on the performance of materials requires understanding their physical properties as much as their associative meanings. How do materials function within the design process of physical environments, and how do they relate to other systems, for instance mechanical systems, interactive linkages and systems of performative and perceptive meanings? How is their performance controlled, influenced and exploited? How do materials act, and how do they behave when put under the pressure and tension forces of a "*Zerreißprobe*"? How do they resist when at the verge of ripping and breaking (e.g. the tensile screen in ANI_MATE) and what actually gets torn when the material fails? Understanding materials as "agents of the stage," means to contextualize materials as relational. With regard to Katie Lloyd Thomas's theories, (Chapter One), and within the context of this thesis, materials cannot be understood only as visual, functional and aesthetic terms, they are also a part of a network of dynamic forces and performative activities. Spuybroek, referring to autopoiesis and the notion of self-organization, considers that materials take part in the design's form-taking process, being "mobile themselves."[126] What Spuybroek suggests is that the concept of agency, expressed simply as a capacity to act as well as to provide the context for action, extends beyond the margins of a narrow anthropocentric perspectives and humanistic determinations and draws materials into the dynamic field of action.

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[122] Martin Sturm, "Introduction" to *Biennale Cuvee 2010,* ed. Fischer-Schreiber, I., Unterberger-Probst, C., Rückert, G. (Linz: Ok offenes Kulturhaus, 2010), p. 3.
[123] Ibid. p.3.
[124] Ibid. p.3.
[125] Ibid., p. 3.
[126] Spuybroek., *NOX,* p. 7.

Stepwise Working Processes

Taking Spuybroek's definition of material agency as a departure point, the following section presents a detailed analysis of the research that took place in terms of the working process: the materials and the procedures. It focuses on the potential of the materials involved in the relational mesh from which ANI_MATE came to exist. Specific attention is drawn to the materials' capacity to evoke and maintain as well as to delay and resist movement. Weaving through this analysis is a tracing of how ANI_MATE developed from stage to stage via experimentation with the performativity of chosen materials and with the ways in which distinct parts, linkages and particular appearances could be collectively consolidated. It outlines the motions and rhythms that describe the evolution of this work, an enactment of relations over time.

ANI_MATE's research and development phase took place during 2005-2006 in Toronto and Amsterdam and was developed in an interdisciplinary collaboration with the artist and electronic engineer Jim Ruxton, the sound artist Leon Spek and the dramaturge Nicola Unger, all of whom joined the team during different phases of the process. Their expertise co-shaped the project under my direction. The process, as it traversed the disparate areas of the skill-sets of the collaborators, moved through diverse stages of development. These correlated with specific work procedures derived from knowledge areas such as experimental architecture, electronic engineering, digital sound design, computer programming, visual arts practices, choreography and contemporary performance/theatre practice.

As a result of this working strategy, the logic of the sequencing of the different development stages oscillated amongst the physically concrete and the informational and abstract. The process moved stepwise from the initial material experiments, to the performance of scale models, and further to computer programming, heading towards the physical construction of the object, and the rehearsal and actual performance of the stage machine. The "stepwise" method is drawn from Spuybroek's design methodology, specifically his understanding of design as an iterative process:

> I work much more with interaction between information and form, basically I'm only interested in the structuring, the patterning effect in between the two. That's why I tend toward iterative processes, stepwise methodologies, because every time the form is changed it absorbs the information differently.[127]

[127] Cho, Im Sik, "Diagramming: Lars Spuybroek interviewed by Cho Im Sik," *saraiREADER02: The Cities of Everyday Life* 3, no.2 (2002). Available at: http://www.sarai.net/publications/readers/02-the-cities-of-everyday-life/03diagramming.pdf [last accessed: July 31, 2010).

Stepwise procedures offered ANI_MATE's research and development the possibility of investigating the nature of a process that generated an outcome, rather than working towards a pre-defined result. Adeptness in handling such "open" process requires understanding and negotiating the parameters at work during the entire process so as to allow the initial research questions, or delineation statements, to materialize in successive iterations, thus maintaining the open potential of the work. By retracing the development process of ANI_MATE I distinguish between each successive stage of materialization and practical development. These can be broken down into five stages, of which the performance of the stage machine as a live event is understood as the culminating portion of an entire process. These stages are: (1) Material Experiments, (2) Machine Design, (3) Animation, (4) Construction, (5) Live Performance.

Material Experiments

The first, experimental stage of the project was the collaboration with Jim Ruxton, a Toronto-based inventor, engineer and artist who brings electronics into various fields of the arts. Ruxton is the director of Subtle Technologies, a festival situated at the intersection of art, science, new-media and technology.[128] Ruxton was invited to join the research and collaboration due to his expertise in electronic system design and multifaceted interdisciplinary experimentation.[129] This stage of the project took place during two successive work periods both in Toronto in May 2005 and January through April 2006, concurrent with my teaching appointment at Waterloo University's School of Architecture.

For the first material experiments, a range of physical prototyping such as mock-ups and partial 1:1 models were used in conjunction with the actual materials (diverse stretchable fabrics, a range of actuators) and digital imagery. The aim of these experiments was to test material and technical solutions to actuate and animate a flexible fabric screen through pulling and pushing mechanics that had the power of putting the surface under an increased tension load and thus move it out of shape. Utilizing Spuybroek's architectural design methodology mentioned earlier ("material machines.") we developed two different systems, the "Push" and the "Pull-Machine."

These machines' material potential, performative qualities, associated conceptual implications and associated meanings are discussed in the next section. With these experiments attention was drawn to the performance of materials, and the performative quality of mechanical machine articulation. Underlying and driving these experiments was a search for making tangible the residues of both the motion and pulse of a body-gesture (pull, push) in order to "inform" a material and to translate these actions as impulses of a mechanical system.

Mechanisms for pushing or pulling information are commonly linked with the push-pull paradigm as circulated in Human Computer Interface (HCI) design, which is a convention associated with fundamental machine action behavior and models of storing information and transmission and

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[128] Philip Beesley, Sachiko Hirosue, Jim Ruxton, Camille Turner and I worked as a team to realize the 2006 Subtle Technologies conference and symposium exhibition: *Responsive Architectures*, archived online at http://www.subtletechnologies.com/2006/news/index.html.
The conference proceedings were published: Philip Beesley, Sachiko Hirosue, Jim Ruxton, Marion Tränkle, Camile Turner, eds., *Responsive Architectures: Subtle Technologies* (Waterloo: Riverside Architectural Press, 2006).
[129] In 2004, Jim Ruxton and I developed the *Future House* project as part of the "International Interaction Laboratory" – an experimental Laboratory for Communications Technologies, Interactive Media & Virtual Environments at the former coal mine, Göttelborn, in Germany. The director of the annual laboratory is Johannes Birringer. Documented online at: http://interaktionslabor.de

distribution of that information to the user (or client). However, with these first material experiments we instead searched for a physical model to push or pull gestural information into the flexible material of the screen. This approach relates to Canadian Media Artist/Designer Thecla Schiphorst's proposal for a "design of expressive interaction"[130] defined by Schiphorst as a "bridging strategy between embodied practices based in the study of somatics and the design of aesthetics of the interaction as explored within HCI."[131] However, in Schiphorst's work, such as in the media art installation *soft(n)* (2007), gestural interaction is established through the fabric's networked sensor system (a matrix of pressure sensors), while in the material experiments for ANI_MATE, interaction between the expressive gestures and the active materials (the flexible fabric of the projection screen) was thought of solely as a transfer of physical pressing and pulling forces that nevertheless had the power to process information into the structure of the fabric.

The Push and the Pull-Machine

According to James Edward Gordon, British engineer and one of the founders of materials science, textiles are highly anisotropic materials, i.e. they act differently in both directions, because textiles are structures comprised of separate threads crossing each other at right angles. Therefore the effects of tensile loads on fabrics are easily detectable (e.g. the fabric deforms asymmetrically). Gordon argues that while the distinction between a material and a structure is vague, textiles are nevertheless classified as structures.[132] Structures, according to Gordon, are devices that "exist in order to delay some event which is energetically favored. Sooner or later the material will fail, but it is the structure that delays the event and it is the design that determines how long this event is delayed."[133] For ANI_MATE, even in this very first experiment with the materials and actions, it was clear that a key to the construction was and would be challenging the threshold of the textile screen's material exhaustion. The goal was to eventually cause, while indefinitely delaying, its eventual ripping and breaking. Following Gordon's definition of design, the challenge of constructing ANI_MATE involved a material understanding of the performative activity of the fabric's utmost stretch in order to design an object that could produce tension, maintain it, and negotiate how and where the tension would release and the structure collapse. The following is a note from our process of experimenting with textiles:

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[130] Thecla Schiphorst, "*soft(n):* Towards a Somaesthetics of Touch," published in CHI 2009 (Conference on Human Factors in Computing Systems) Proceedings and Extended Abstracts, p. 2427. Available at: http://sfu.academia.edu/TheclaSchiphorst/Papers/91793/soft_n_Towards_a_Somaesthetics_of_Touch [last accessed February 4, 2011].
[131] Ibid. p. 2427.
[132] James Edward Gordon, *Structures or Why Things Don't Fall Down* (Cambridge: Da Capo Press, 2003), p. 251.
[133] Ibid., p. 324.

> Carefully poke your finger into the tensile surface. Retreat. Cautiously grab the elastic fabric between thumb and index finger and pull. Release. Repeat those gestures. Sense the resistance of the fabric and the distinction between the actions. Enlarge the movement. Push slightly deeper into the screen, 10, 20, 30..50 cm = the least. Watch how the surface deforms when tension is applied. Observe the surface extruding and stretching into concave contractions. Challenge the surface even more. Push it to take on various shapes. Try alternating angles, accents and rhythms of impact. Test different fabrics; stretch and distort them. If you push as hard as you can into the fabric, how far can you stretch and extend before it begins ripping and breaking?[134]

This experiment with materials, the stretching of the screen and measuring its resistance towards material exhaustion is actually a *Zerreißprobe*: a literal testing of materials and a probing of threads of associated meaning. The German term has different actual uses. In engineering means a tensile or a tear strength test, where a tension or compression load is applied to material. The load is increased in stepwise measures, till the material splinters or breaks. This test determines the threshold of material fatigue and exhaustion (actually destruction) and defines the relationship between stress and strain for that material. The test measures, in Gordon's words, "how readily each material strains elastically under a given stress. In other words it is a measure of the elastic stiffness or floppiness of a given solid."[135] In its other metaphorical usages *Zerreißprobe* means that the tension applied to the psyche is so strong that it threatens to tear the self apart. It indicates an unsolvable problem, requiring a choice that necessarily implies destruction of one part in order to keep alive the other. Being on the verge of destruction (under stress) is the condition someone is in when in an emotional or psychological "*Zerreißprobe*." Examined during our first experiment, the notion of the *Zerreißprobe* became an integral theme of the entire process. It appeared in its vital dimension as an engineering problem: how to define the when and where of material exhaustion and system breakdown, or the "life and death" of the image. It appeared as a poetic dilemma in the question of whether or not to accept the image "play" (given what lived experiences tell us to know about "stuff" based on its material nature), or to reject what we see and therefore to reject the illusion presented.

The next phase of experimentation focused on the interaction between the fabric's deformation and the images. A set of figurative photographic stills of bodies and faces was projected onto the flexible projection screen. While punctuating and deforming the tensile membrane, we closely observed the morphing effect on the depicted bodies and faces. The precarious margin of plausibility of shapeshifting thereby provided a relatively narrow likelihood that a transformation

[134] Marion Tränkle, Notes on the working process of ANI_MATE, Amsterdam, April 23, 2006.
[135] Gordon, *Structures or Why Things Don't Fall Down*, p. 52.

would be familiar enough to be perceived as lifelike. It occurred to a greater degree when images where activated at points where kinetic movement was expected within the potential of the image, i.e. at the images' shoulders, knees, feet, hands, or, when the figures were activated in close proximity to their contour. Potential movement, abstracted into the still image of the body, was abstracted from it by "punching" at the shoulders in order to make the image tumble, and at the feet to make the figure ambulate. Relative speed and force accelerated and rhythms were established as the image gained physical flux and true instability.

Massumi has referred to this potential movement, the affordance or pre-performance of movement as already being "in intensity,"[136] without yet having extended or actually fulfilled itself. He has further suggested that this intensity is "abstract in the sense that it correspond to no actual features of the image. It is contained in the image, but it is not its content."[137] When punching at the screen, abstract movement content was abstracted from the image by activating the image's surface and gesturing at it. These experiments made tangible the "actualization of potential movement"[138] and their affiliated degree of perceptual disorientation and confusion regarding the nature of these body-image compounds.

Performing these forceful accents and intrusive pushing gestures with our own hands brought up the question mentioned earlier of how to technically translate and transfer the pulses and impacts of these gestures into the mechanics of an actuation system in order to "push" information into the fabric. The decision was made initially to use motors to mechanically articulate the gestures. Ruxton designed the electronics (Fig. 2.7) and linear solenoid motors (Fig. 2.8) as well as stepper motors (Fig. 2.9) that were strapped onto the screen's frame and set into motion. When these contraptions pushed automatically and repetitively into the screen, they indeed affected the image. (Fig. 2.11) While watching the image being "hit" over and over again, we realized that the mechanized push could not transmit anything beyond itself. It did not allow for any reading other than an act of intrusive aggression. It articulated closure, an ending of a situation, rather then a potential becoming and coming alive. Consequently the push-machine was dismissed as an inappropriate stimulus and thus a deficient "material machine" (in terms of Spuybroek's previously discussed processual design strategies). Since material machines, according to Spuybroek, have the capability to process a force or stimulus by transformation, what was the transformative potential of the push-machine? The mapping of movements and processes from one to the other, from the screen's movement to the image's deformation, mobilized both. Both

[136] Brian Massumi, "Building Experience: The Architecture of Perception," in *NOX: Machining Architecture*, p. 324.
[137] Brian Massumi, "Building Experience", p. 325.
[138] Ibid., p. 325.

moved, or both remained static. When the motor pushed into the screen, there was no further consequence to the action. There was no risk involved, no flexibility or slack taken or given. Therefore the image, although deformed by physical forces, remained flat and one-dimensional in its associative and imaginative power.

In search of a fundamentally different quality of animation, and another system of actuation, the research turned towards the opposed bodily gesture: a gentle pull and light quality of touch and a nearly invisible form of connection. The British theorist Steven Connor, in his analysis of the meanings of human skin in Western culture, has pointed out that a "light touch" [139] relates to the "pleasant urgency of caring for the skin."[140] The awareness of the skin, says Connor, "is a matter not just of forms, ideas and conceptions of skin, but also of the work of sensations in cultural forms. The sensation of delicacy is perhaps the most pervasive of the ways in which touch informs and inflects thinking, values, ideals and attitudes."[141] Connor identifies a light touch as a practice that allows for determining the exact point at which sensation interposes itself between contact and non-contact. By classifying a light touch as interstitial and the interface between the actuality of touch and its phantasm or aura as being between that what is being felt and that which is remembered, Connor describes a delicate touch as being "like a breath."[142] The correlation between a light touch and the activity of breathing is observed by Connor as a quivering of the fingers caused by the intake of breath, which needs to be controlled in order to maintain its light quality and to ensure a minimal level of tremor and a continuous friction – without which no sensation of touch and texture would be possible. Connor's arguments supported our material experiments of how to affectively "touch" an image, and how this specific quality of touch could feed into the design, mechanics and material properties of the ANI_MATE machine in two ways. First, by drawing attention to the close associative connection between the tissues of screen and skin, and secondly by negotiating delicateness and lightness as a quality that, if maintained, formed the sensate thread connecting two bodies, i.e. between the actual body and that which is remembered or imagined as a body. Furthermore, Connor's notion of rhythm as it manifests in the pulsating movement of intake and outtake of breath persuaded me once again to make the correlation between the rhythms of pulling/pushing and the pulsating breath of a living body.

Further research on how to mechanically actualize such sensate threads and subtle articulations was influenced by a number of previous art works making use of different types of mechanical

[139] Steven Connor, *The Book of Skin* (London: Reaktions Books Ltd, 2004), p. 257.
[140] Ibid., p. 259.
[141] Ibid.
[142] Connor, *The Book of Skin*, p. 261.

actuation. A project that uses pneumatic artificial muscle actuators[143] to, literally, assemble a tactile interface is *Lyt_A*, a distant-touch generator developed in 2006 by the artist-scientist collective FoAM.[144] *Lyt_A* is a display that transmits haptic information at a distance, as a way to visualize touch. When the interface-structure is touched on one site, the touch is visible as well as touchable on another. *Lyt_A* uses pneumatic actuators to transfer tactile stimuli, providing feedback via a surface actually "sculpted" through actions. The information thus stored in the slopes and shapes of the interface-structure is transferred directly to the output-structure. The relation between the input and output is that of a mirror copy between actuator and actuated; a touch of the tactile interface translates into touchable form.

A project that adopts a similar artistic strategy, i.e. the transfer of stimuli between related input and output actuators, is *Blow Up* (2005), an installation by Scott Snibbe. Snibbe describes the work as follows:

> *Blow Up* records, amplifies, and projects human breath into a room-sized field of wind. The installation comprises two devices. The first is a rectangular array of twelve small impellers, which stands on a table on one side of the gallery. This small input device is electronically linked to a large wall of twelve electric fans. *Blow Up's* simultaneous processes of recording, translation and amplification is meant to increase the breath's salience and legibility, while detaching the breath from the body that allegedly produced it.[145]

These two projects exemplify the relationship between the qualifications and specifics of an actuator and the activity exposed (contractile and extensional pneumatics: touching; fan impellers: breathing) and the transfer of stimuli (human touch: touchable form; human breath: wind machine). Through studying those projects I came to understand some peculiarities of human-machine relations, specifically through looking at strategies of mirroring (*Lyt_A)* and amplification *(Blow Up)*, both of which influenced the design of ANI_MATE later on in the process.

Experimental architect and artist Philip Beesley's geotextile installation *Implant Matrix* (2006)[146] was another work that influenced the research. *Implant Matrix* is a distributed network of sensors

[143] Air muscles are contractile or extensional devices operated by pressurized air. As actuator, air muscles produce very high forces, but pull short distances (they contract only approximately 40% of their original length). We discussed the use of artificial muscle actuators for ANI_MATE, but had to reject them, due to their relatively small extension ratio.
[144] For *Lyt_A* and FOAM's project descriptions, see their website: http://fo.am/lyt_A) [last accessed August 11, 2010].
[145] For a description of Snibbe's project *Blow Up* see: http://www.snibbe.com/index.php/projects/interactive/blowup/ [last accessed August 11, 2010].
[146] My stay in Toronto and teaching involvement during winter 2006, were attributed to Professor Philip Beesley, who invited me to join his team at Waterloo University. During our shared time, I had the opportunity to closely follow the systems research for his interactive installation *Implant Matrix.*

and muscle wire actuators[147] that, along with interlinked matrices of mechanical components, move a "cloud" of minuscule and lightweight polymer parts. The structure responded to the visiting public moving within the environment. Beesley notes: "*Implant Matrix* was a diffused cloud of interlinked elements that accumulated to make a building skin. A lightweight polymer skeleton was cloaked with a quilted mylar tilework fitted with layers of miniature valves and clamping mechanisms."[148] Witnessing and experiencing the intricacy with which *Implant Matrix* operated made me understand on a fundamental level how important subtlety and delicacy of articulation are in communicating a sense of lifelike, organic matter, and that this is true for both minuscule systems and monstrous apparatuses. I realized that whatever mechanics and actuators we used, they had to possess a capacity for delicate, fine-tuned articulation, even though such capabilities might seem counter-indicated, given the force requirements demanded for ANI_MATE.

These actual projects and theoretical kernels sharpened the conception of the relation between the qualifications and specifics of the actuator and the activity exposed, the significance of system capacity for subtle and delicate articulation expressed as a quality of light touch, and the correlation between the rhythms of pulling/pushing and the pulsating breath of a living body. However, the actuators used in the works referenced (i.e. pneumatic artificial muscle actuators or muscle wire actuators, respectively), proved unsuitable for the requirements of the ANI_MATE system. They had output loads too small to counter the screen's material resistance and could not pull over a long enough distance.[149] Therefore we turned towards pneumatic actuators, which meant utilizing pressurized and exhaust air to effect movement – and thereby creating the illusion of a breathing and living image.

The distinct sound of pneumatics, specifically when excess pressure is evacuated through the exhaust, immediately sets a tone, a rhythm and an accent. The sound expresses a powerful system in action.[150] The over-capacity and power of the pneumatics reverberate both as a contingent burst and as a potential fragility; the fabric could easily tear apart when the image is pulled to life.

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[147] Muscle wire actuators contract when power is supplied to one side of the actuator. When power is removed, the muscle wire relaxes. Those electrical actuators provide very small output loads and are therefore used for lightweight applications such as garments, textiles and wearables. The use of muscle wire actuators was not an option for ANI_MATE, since their load capacity is not sufficient to meet the screen's counterforce

[148] Phillip Beesley, *Hylozoic Soil: Geotextile Installations - 1995/2007* (Kitchener: Riverside Architectural Press, 2007), p. 139. Documentation available at: http://www.philipbeesleyarchitect.com/sculptures/0610implant_matrix/implant.html

[149] A measurement with a fish scale hooked into the fabric indicated that ANI_MATE's screen resistance load was approximately 50N at a stretch of at least 50cm. This presents a far too heavy a load for pneumatic artificial muscle actuators or muscle wire actuators.

[150] The system is as powerful as it sounds. Valves require little pressure to operate and usually multiply the input force, thus the pressure and powers created is tangibly larger than the forces required.

When first listening to the expressive tone of the air system, what resonated was that the power of its sounding force supported the visual sensation of animation: its accent and rhythm patterns felt like breathing, verifying Connor's description of rhythm as something manifested in the pulsating movement of intake and outtake of the breath in a living body. This sound could integrate with the animation, which had not been true of the motor system we had previously experimented with. The visible effects of the animation and the audible motor noises did not coincide. The uniform, even hum of the motor never modulated or changed, which rendered silent the motor's energetic struggle to force its way into the screen while encountering increasing material resistance. The noises of the motor are mechanical and lifeless. The sound of the pneumatics, on the other hand, provides a sense of immediacy and powerful action. This correlates the pneumatic-mechanical movements with the visual effect of the fluctuating images.

The following test included a linear pneumatic cylinder (Fig. 2.13), a valve (Fig. 2.14), hoses, an air compressor and custom-designed electronics (Fig. 2.16). Thin threads were sewed into the fabric and pulled the screen from a distance. Moving images in and out of depth caused a shuttling sensation. A different emotional quality was attached in pulling an image towards oneself or in releasing it. There was a sense of longing when bringing the image close, and an opposing desire to distance oneself from a distorted image. Translating this shuttling of emotions into system mechanics demanded a bi-directional flow of movement. First a pull stretching the screen into utmost extension and three-dimensional curvatures (Fig. 2.16-2.18); second a release, allowing retraction to flatness and two-dimensionality. Therefore double acting air cylinders were used, which have two ports to allow air in, one for the out-stroke and one for the in-stroke. Those cylinders have the capacity for both of the basic types of pneumatic actions: the "pressure" system and the "exhaust" system. In the pressure system, air pressure is let into the tube, inflating the pneumatic cylinder that opens the valve. This causes the plunger of the cylinder to extend and the screen to release. In the exhaust system, an input command lets the pressure out. This collapses the pneumatic, opens the valve and the cylinder's plunger pulls in and thereby stretches the screen. It is this feature of an active release that on a systemic level enables the screen to revert fully to flatness and thus conceptually allows for the image to fully fluctuate between flat representation (pictorial space) and animated three-dimensional figure. Without a bi-directional flow of air and active pressured release of the pneumatic system, the figure never gains its fluctuating momentum and transient, synthetic quality.

As a result of these material experiments, the pull-machine became the fundamental gesture of the mechanical, material and performative operations. The tension negotiated between the

material resistance of the fabric and the capacity and power of the pneumatics (a literal *Zerreißprobe)*, along with the performance of pulling the fabric of the screen and animating the image, provided the range of dynamic and material forces (understood both as a real-time mechanical event and as the live-performance of animation) that finally came to constitute ANI_MATE.

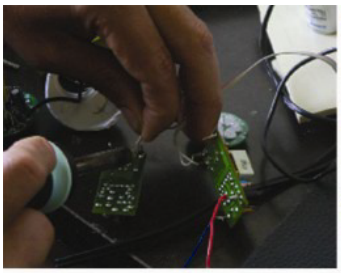

Fig. 2.7: Parts, electronics

Fig. 2.8: Parts, solenoid motor

Fig.2.9: Parts, stepper motor

Fig. 2.10: Incased motor and sound insulation

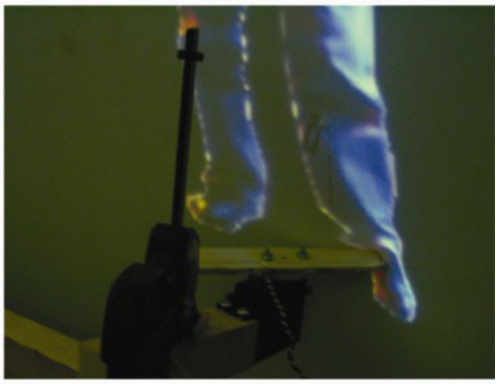

Fig. 2.11: An image is “pushed” into deformation

Fig. 2.12: In opposition to figure 2.11, here the image gradually deforms under increasing “pull forces”. When the pull is performed with maximum speed, the free leg of the image-body appears to elongate and literally shoot towards the spectator. This effect depends on the exact positioning of the image such that its outline (in this case the foot) exactly falls into the innermost cone of the fully extended screen.

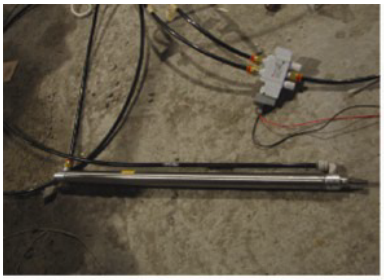

Fig. 2.13: Parts, air cylinder

Fig.2.14: Parts, valve

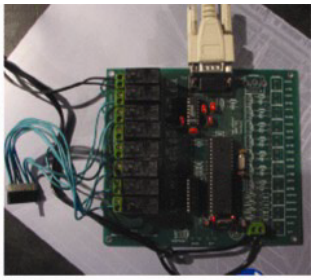

Fig. 2.15: Parts, electronics

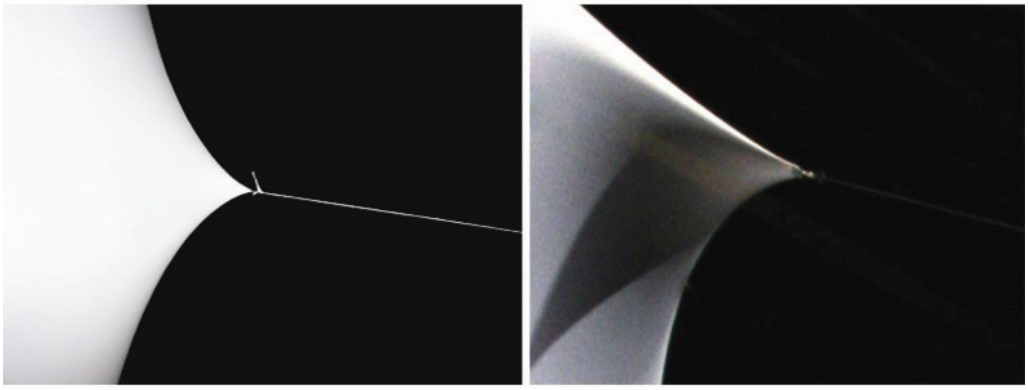

Fig. 2.16: Convex curvatures and surface envelops at maximum membrane extension.

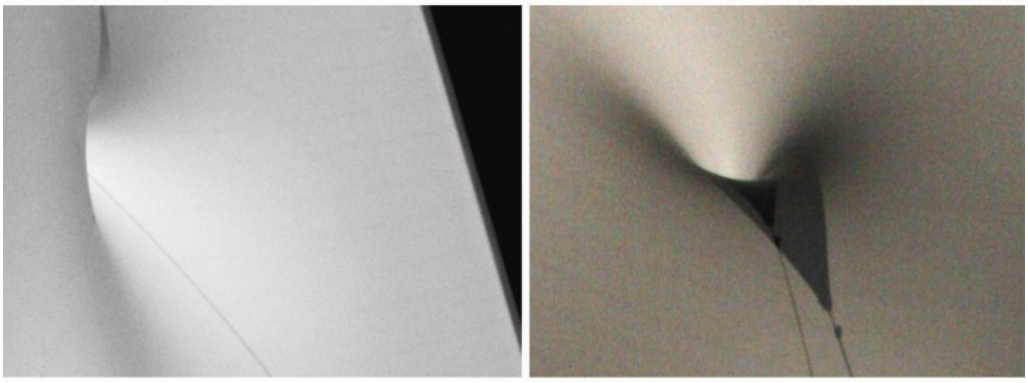

Fig. 2.17: Concave curvatures and surface envelops at maximum membrane extension.

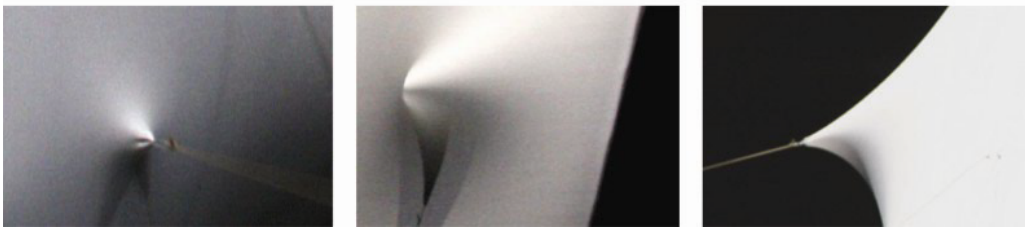

Fig. 2.18: Curvatures and surface envelops at different gradations of membrane extension.

Machine Design

After my return from Toronto to Amsterdam, I began to render the tactile gestures of our experimentation into abstraction. Moving between drawing, mapping and computer programming, I explored how, to paraphrase Connor, a "light touch" and a subtle articulation of pull could manifest within the design of the machine and be coded into its informational system. The task was a layered one: to multiply and enlarge the actuation (the organization of the pneumatic system), to structure the entire scope of relations, and to connect and "mesh" the elements, materials and processes into one networked composition. Foregrounding drawing, mapping and computer programming as the primary tools in this structuring phase of the project meant thinking through the machine and its process of concretization while engaging with drawing. Given my architectural background and practice, drawing is a familiar and a habitual procedure. For an architect drawing is a technique that is not only used to represent or document reality, but as a tool of invention, an active process of creation.

The most important outcome of this structuring phase of the research was creating distance between the actuation mechanism and the screen, allowing surface manipulation and image animation to take place remotely from a distance. Distance provided "room to breathe" and an open space within which a delicate play of weight and counterweight, power and control, could unfold.

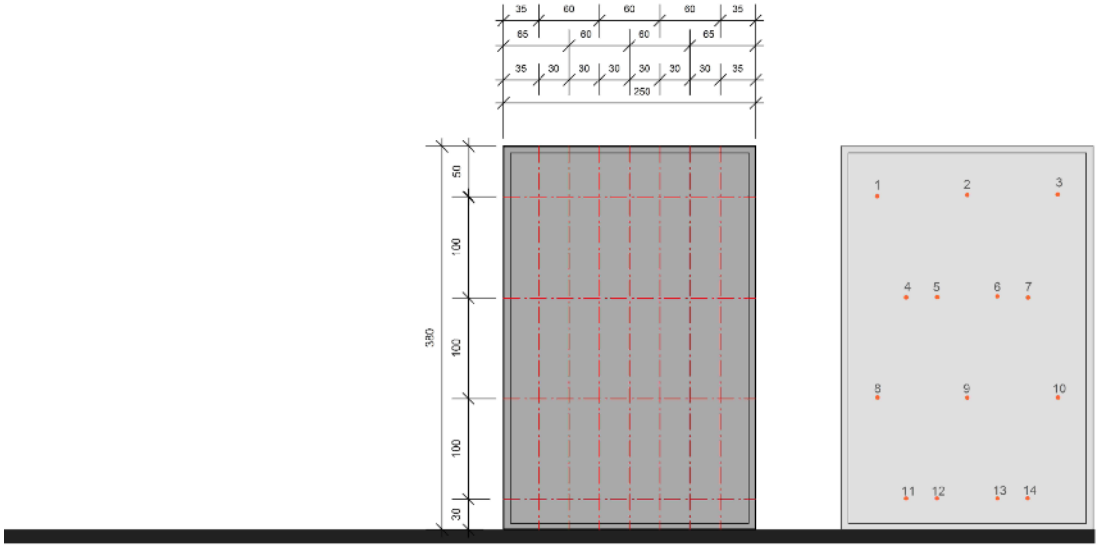

Fig. 2.19: Scale drawing, elevation. a. Screen measurements, b. Coordinates of the pull points.
Resisting accommodating common digital image formats (horizontal image aspect ratios 3:4, 16:9), the dimension of the screen suggests human proportion and measurement: twice the size of my body, standing upright and with its height taller than its width (3.80m x 2.50m). Measurements of pull actuation derive from approximate 1:1 body proportions: 30cm between the feet when firmly standing, 100cm between feet and hips; hips and raised hands or hips and arms hold aside. The emergent pattern is a grid measurement of 30cm in horizontal and of 100cm in vertical direction. When multiplied and arranged, they formed a geometrical pattern of actuation consisting of fourteen pull-points.

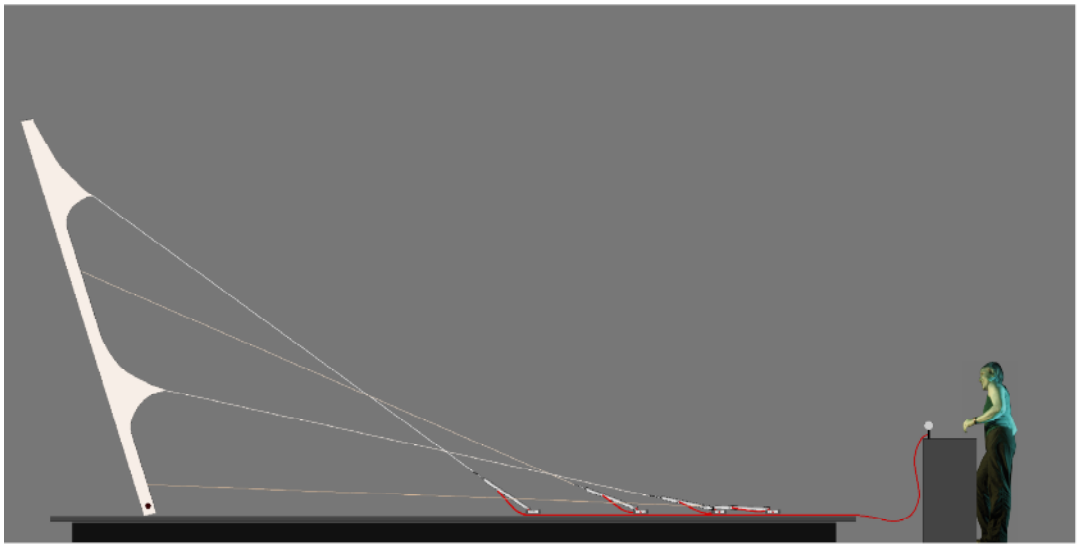

Fig. 2.20: Scale drawing, section.
The drawing shows the fragile relation between the tilted, balancing screen and the pneumatic mechanism that seems to counter-weight the tension. The screen is hooked, allowing connection with fourteen pneumatic actuators, which are staggered in four rows at the far end of the screen's podium. The linking pull threads are tied on one end to the tips of the pneumatic cylinders and attached to the screen at the other. Those thin, elongated threads measure the distance between the actuators and the screen – thus creating a distance between cause and effect.

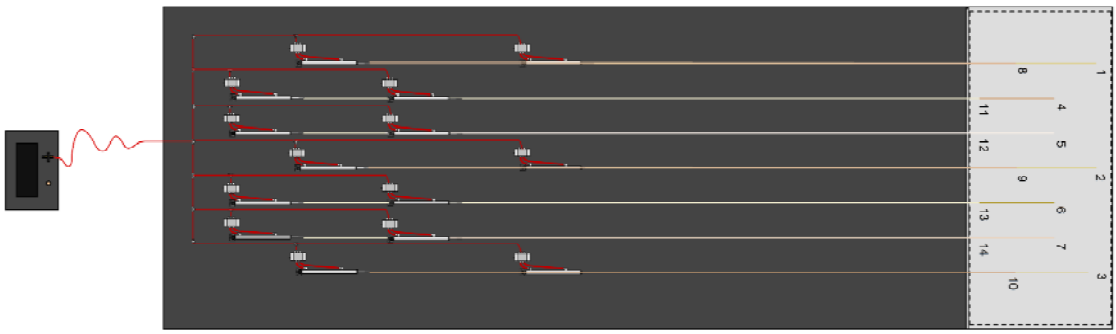

Fig. 2.21: Scale drawing, floor plan.
A study of the parts of the pull-actuation system and their arrangement to allow the most efficient flow of air from the compressor to the valves and cylinders. The main air tube, which is attached to the compressor, furcates through branching divisions and connects through to the fourteen valves, the control ports to the in-and outstroke of air into the cylinders.

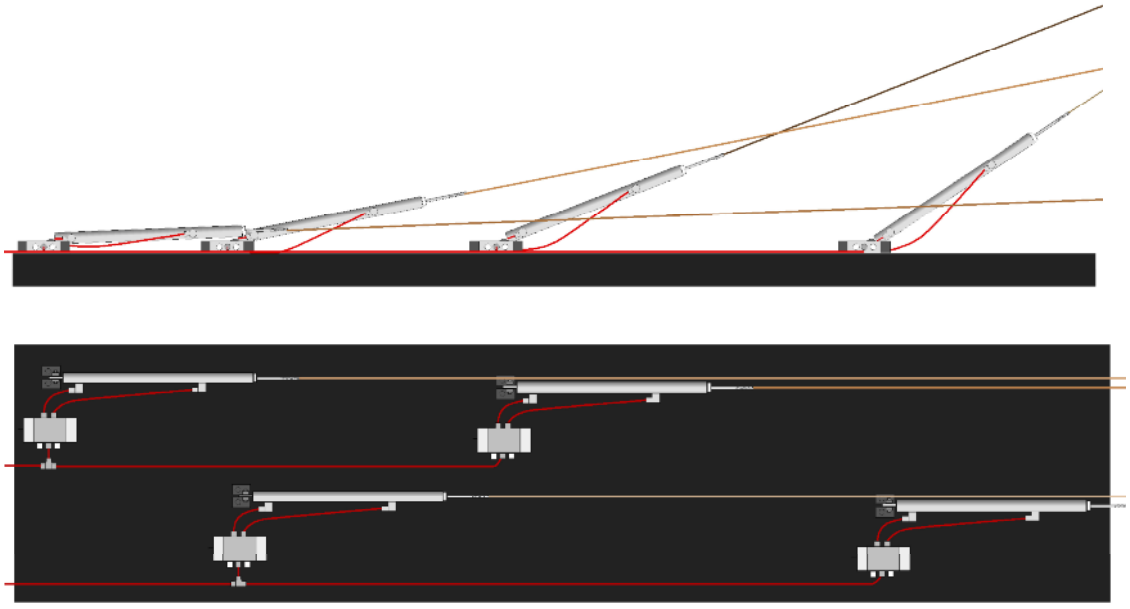

Fig. 2.22: Scale drawing, detail floor plan and section.
A detailed study of the angled air cylinders in their actual dimensions and color coding. The air-tubes connect the valve ports to the in- and outstroke ports of the cylinder, as control of airflow is required in both directions (in and out).

System Control

System design is the process of defining the components, interfaces and flow of data for a system to satisfy specific requirements. In the case of ANI_MATE the requirements derived from two primary considerations formulated through experimentation: the quality of articulation and the real-time synchronization of the moved image and movement of the machine. Both requirements were based on flow of data and information, such that all components and elements were enabled to function within a network of relations, as meshed systems. Turning towards system design meant to both conceptualize and actualize the measure of control built into a given system.

Quality of articulation: The translation of fine-tuned machine articulation (Connor's "light touch" mentioned earlier) into a system feature required extreme control over speed modulations. A dynamic control of the system's air pressure was required. High system pressure enables short, accentuated impact; low system pressure allows for slow, continuous and suspended movements. The dynamic slide between these qualities provided a range of nuances.[151] At the system level dynamic pressure control was applied in two ways. Electronically, a built-in feature of the steering system allowed for an overall control of system pressure. One proportional solenoid valve was integrated into the system, controlled from the keyboard (the main input device). Proportional valves are designed to respond to variable power inputs (1-10V) to regulate the flow of air proportionally, thus the valve acted as the main pressure slider for the system, boosting or slowing the overall speed of action. Variable control of the valves that regulated the pressure at each air cylinder individually was achieved through direct manipulation of machine parts. Speed reducers were mounted on each port of the valves. When the reducer was opened, the pressure in the individual air cylinder increased, when it was closed, the pressure decreased and slowed the speed. Being able to manually manipulate the machine was what allowed performative actions into the system. It made it possible for me, the operator and performer of the machine, to interfere and interact with the machine during performance not only through electronic communication but, directly through tinkering with its mechanical parts. Both air control mechanisms (manual and electronic) could be addressed independently, and simultaneously so that their activities could potentially overlap in parallel processes. The system could thus perform and be performed in more than one way. This allowed for a degree of improvisation with the machine, centering on an

[151] The range of pull-duration, i.e. the variable time within which one pull stroke can be accomplished, was set to between 2 minutes and 500 milliseconds. The fastest pull-stroke thus impacted the screen 240 times faster than the slowest, nearly imperceptible pull.

in-the-moment compositional method that paired manual, material performative manipulation in tandem with electronic, systemic operation.

Real-time synchronization: The second important system design requirement was the necessity of synchronization and the real-time linkages between movement, image and sound.[152] The initial material experimentations had revealed that the manipulation of images and their plausibility of deformation depended on the exact location of pull. Spatial and temporal exactitude and the synchronization of the moving image and the movement of the pneumatic machine was an indispensible and core requirement for plausibly effecting of the images' animation.

The system design thus needed to link the heterogeneous parts of ANI_MATE, while rendering it open for both automated and manipulative action. The keyboard was the main input device for one-person operation of the machine. Fourteen keys were assigned to control the fourteen pneumatic actuators. Upon pressing a key, a serial signal was transmitted to a Micro Programmable Logic controller (PLC), which translated code to voltage. This control signal triggered the valve (ON/OFF) and set the cylinder in motion. The thread connected to the cylinder was pulled, and the screen stretched. During performance, each actuation point in the screen could be pulled at any moment. The serial signals were transmitted along a line through three computers which managed within different coding environments: the image sequences (*Macromedia Director,*[153] programmed by me), the machine movements (*Pure Data*[154] and *MusE,*[155] programmed by Jim Ruxton) and the sound scape (*SuperCollider,*[156] programmed by Leon Spek), connecting visuals, mechanics and sound in real time.

[152] Sound was an integral part of the system, though it was implemented at a later stage of the project. Conceptually, the soundscape was thought of as an instant composition, a mingling of actual machine sounds (air exhaust and impact force at the end of the cylinders stroke) and their simultaneous electronic manipulation and amplification.
[153] *Macromedia Director* is a multimedia application authoring platform. Designed for creating graphic animation sequences, it also runs a scripting language called *Lingo*. Although *Director* is commonly regarded as dated in my experience it is an excellent mockup and prototyping tool. Though there are distinct disadvantages in using *Director* (commercial software, chunkiness of the scripting syntax, large files), I argue in its favor. Within the mixed, both graphic and script-based work environment that *Director* provides, simulation of interaction can be done instantly and effectively. Especially in the initial stages of a work, when fixity of (inter)action is not (yet) desirable, this software offers the possibility of working in gradual steps from mock-up to developed project.
[154] *Pd* (Pure Data) is a real-time graphical programming environment for audio, video, and graphical processing.
[155] *MusE* is a MIDI / audio sequencer.
[156] *SuperCollider* is an environment and programming language for real time audio synthesis and algorithmic composition.

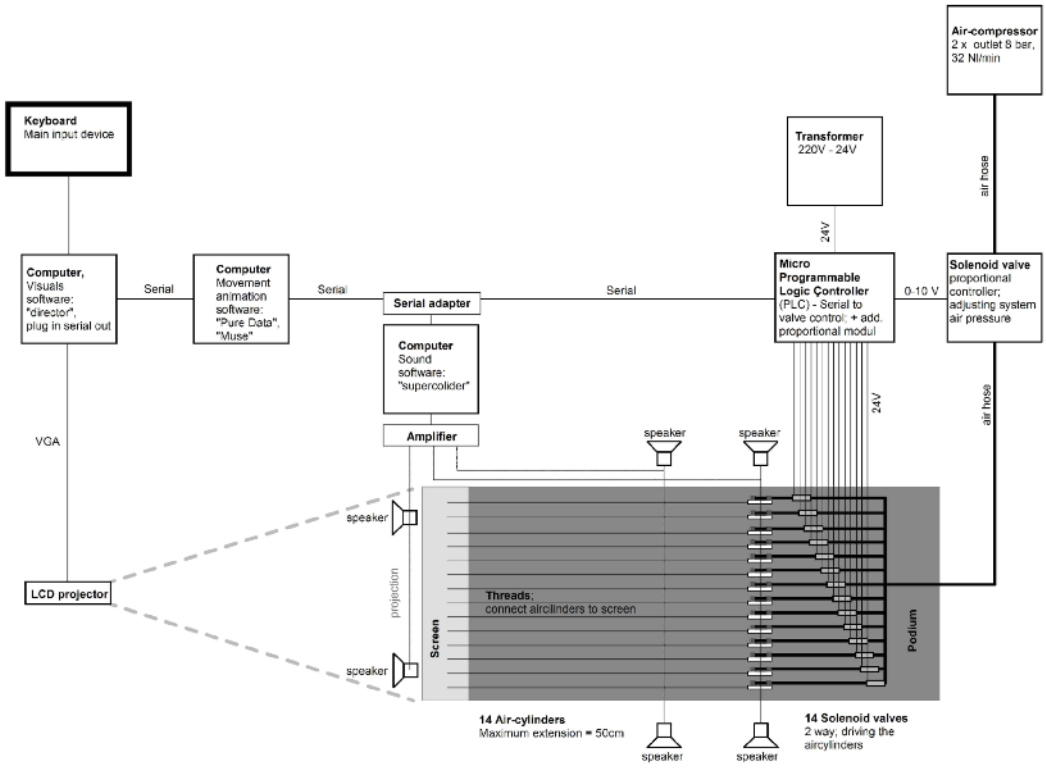

Fig. 2.24: System design and air flow diagram

List of Parts

1 Micro Programmable Logic Controller (serial signal to valve control)
2 Air compressors (silent), 8/120 bar/psi. The compressors operate in turns to avoid heat overload.
1 Transformer 220V/24V
14 Air cylinders with pivot brackets and piston rod clevis (15" stroke, direct acting)
14 Valves, 24VDC (electronically regulates the air pressure of each cylinder)
1 Solenoid proportional valve (electronically regulates the air pressure of the total system)
28 Exhaust noise reducers (manually manipulates the air pressure of each cylinder)
1 Air pressure meter (monitors air pressure during performance)
70 Tube-adapters (1/4 adapters, T-junction, straight, swivel elbow)
Air tubing (black and red)
1 Wooden platform (2,50 m x 7,00 m)
1 Metal screen frame (2,50 m x 3,80 m)
1 Flexible fabric of screen format
14 Screen patches (self-adhesive fabric)
14 Threads
6 Speakers, positioned under the wooden platform
3 Computers
3 Serial cables and adapters
1 Video projector

Animation

In the next phase of the research the work migrated from an architectural context and engineering approach into an environment for performed animation. Having conceived of and invented the apparatus, what needed to be addressed was the performance of the ANI_MATE machine as a staged play. At this point in the working process, Nicola Unger joined the team. Unger is a theatre maker and dramaturge, with a profound experience in the blended field of theatre and visual art, and with a specific interest in animation, Miniature Theatre and projection as integral elements in theatrical staging.[157]

At this point in the research a conceptual decision regarding the content, or identity of the image needed to be made. Who would actually operate the machine? And accordingly: whose body would be depicted? The operator and the performed, the living body and the digital figure; within the environmental logic of ANI_MATE, they oppose and they depend on each other. It was decided that I would perform myself, operating the machine and performing and manipulating my image and body portrait. The motivation for taking on these multiple roles was based on a concern with the continuity of process. Continuing to perform the materials and the machine, not only during the working process, but also in the actual, public performance, let the engagements and knowledge gained through the entire process (from conception to actual build) also inform and shape the actual performance of the ANI_MATE machine.

For the further experimentation, a systematic photographic map of my body provided us with an extensive collection and archive of digital images. In addition, scale models were used that resembled the environment within which the apparatus could be "played," and within which those images could be engaged and their interaction tested. This model needed to present the whole system and was built at a scale of 1:5. It included the main material components and allowed for manual manipulation of the machine's most prominent function: the pulling of the strings. Fourteen threads were attached to the model's screen and linked to miniature actuators. The threads could be pulled by hand, as a puppeteer would do. In fact, playing the model felt like performing with a miniature theatre set. This provided an ontological shift and made tangible the machine's alliance to the class of performative objects. The tactile mode of animation, the deformation of a figure through the manipulation of strings attached, and the affecting of an object from a distance is all strongly reminiscent of the referential space traditional puppet theatre

[157] In 2005, Nicola Unger, Scott Taylor and I collaborated on the Lecture Performance NEWS, which I presented at *Gasthuis* Theatre Amsterdam. This performance staged critical comments on the seemingly pioneering technological developments of the last years.

occupies. I therefore follow theorist Matthew Isaac Cohen's conceptualization of puppet theatre as a space of ambiguity that renders the object an extension of the live body and a device for communication that amplifies, distorts, projects and focuses the performer's gesture, while being at the same time an autonomous object which carries some kind of independent volition.[158]

Holding the model in our hands, we were finally able to combine the tactile gestures of articulation with the image's animation.[159] Conceptualizing animation as a performance event, as a play that is performed live in front of an audience draws attention to the live (real-time) invention or creation of movement, rather than the capturing[160] or abstracting of movement.[161] As an animation machine, ANI_MATE resists its classification as or within traditional (cel or hand-drawn) animation, cinematography[162] or computer generated 3D animation.[163] Rather, it attempts to create a dynamic milieu that animates "living images."

In the beginning of this chapter I introduced three aspects that are key to the particular animation procedure performed in ANI_MATE. To reiterate, these are the conception and design of its meshed system (the environment within which the animation is performed), the movement instructions that activate its performance and finally the interaction between movement and figure through the potential of the elastic, flexible screen to negotiate force, to establish relations and to animate those relationships into taking on shape. This notion of interaction is related to Spuybroek's definition of form-finding processes in architectural practice, foregrounding the interaction between material and physical force as constitutive to the creation of lifelike forms. As I have discussed earlier, Spuybroek argues that form generation is dependent on material processes that are linked on the level of forces. Force, or stimulus, thus is an initial condition for

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[158] Matthew Isaac Cohen, "Puppetry and the Destruction of the Object," *Performance Research* 12:4 (2007), p. 123.
[159] I remember discussing with Ruxton how to rehearse the animation and how to anticipate the effect of the image deformation. We considered visualizing the effect by digital means (scripting software that would simulate the effect). We dismissed the idea. In retrospect, I understand our hesitation as a resistance to separating the action (the performance of pulling) from the effect (the deformation and animation of the image).
[160] Built complex contraptions, designed to investigate the essential mechanism of perception in motion, have a rooted tradition, spearheaded by inventors such as Charles-Émile Reynaud, Étienne-Jules Marey, and Eadweard Muybridge. The aim of their experiments was to capture motion (stop-motion studies) and to research locomotion.
[161] In 1950 Oskar Fischinger built the *Lumigraph* an instrument that created abstract light images. The instrument could be played by protruding a stretchable screen into arrays of sidelights. When the screen reflected the light, color abstractions became visible. Although Fischinger's apparatus used a stretchable screen similar to that of ANI_MATE, Fischinger's intention was not to create movement, but to experiment with the animation of abstract patterns of colored light and synchronized music.
[162] As mentioned earlier, cinematic modes animate images across frames, whereas ANI_MATE attempts to animate a single frame.
[163] Within a digital 3D environment, character development – the construction of a digital body – relates to the creation and manipulation of surface models and the obscuring of polygonal control meshes. A character (body) thus comes to exist through extrusion and the effecting of mesh vertices. Likewise, the ANI_MATE machine controls the three-dimensional shapes of the image's surface and controls its "flesh" and 3D "mesh." However, the analog machine is not intended to realistically depict motion, but rather to create distorted configurations and a real, physical depth that is perceived as a subjective event.

both movement and the particular inflection of an animated form. Accordingly, within the forceful and tensed environment of ANI_MATE, animation is neither conceptually, nor materially initiated at the level and surface of the image, but is a linked process based on the material capacities of the conjoint elements (the elasticity of the image carrier, the screen and the strength of the pull threads) and initiated by the actual physical forces produced by the pneumatic system. It is these forces that inform as well as continuously deform the image into animation.

However, the performance of a stage machine which includes the operator of, as well as the onlooker to, the live event of animation, requires an artistic interpretation and synthesis of such informed and deformed image to become a "play." How can these expressions be performed though the operator and comprehended by an audience? I again turn to Spuybroek's machining methodology, where the material machines provide a set of rules that govern the process of in-formation and form generation. These rules, however, only provide the basis from which to depart upon the further design process. Similarly, in the case of ANI_MATE, this field of action and environment of movements, figures, and forces called for artistic interpretation and transference into a stage scenario.

The Lives of the Image

The following takes a closer look at three instances of this movement-figure-force compound, and its capacity to express agency (and to cause ambiguity) as well as to convey different interpretations. The three instantiations I propose are: (1) tensed cooperation; (2) effortful automation (the dynamics of machine autonomy); and (3) complicit action (the performative action of speaking through the image).

Tensed Cooperation: Here the machine's mechanism remains in tensed stasis, while the still image performs a continuous and slow motion slide across the screen's frame. A single pneumatic pull force stretches the screen locally and holds it there in utmost extension. The screen's deformation is imperceptible to the viewer, because it is motionless and soundless – until the image slowly slides into the hollow cone of the screen and starts to morph. This mode of animation was used in conjunction with an image depicting a seemingly endless row of connected and interlocked figures. The image appeared on the right side of the screen, moved on, was sucked into the morph, deformed and revived only to disappear at the left end of the screen. The motion path of the image carefully traced its own outline: the line of the interconnected bodies

and the seam between figure and ground. The interlocked figures in the image depicted the backs of people, mirroring the audience, who had stood in rows in front of the screen at the beginning of the performance. While the audience watched "another" row of backs, they perceived how the projected bodies were affected and "touched" at their heads, necks and shoulders by an invisible yet perceptible pressure, and stretched into deformation. Dramaturgically, this situation provided the audience with an introduction to the sensate logic of the ANI_MATE machine. It produced a tensed situation, with the audience awaiting for something to happen while already sensing the affect ahead.

Effortful Automation: In this instance the mechanism frantically pulls the screen at multiple points in quickly alternating patterns. The shape of the screen shifts continuously. Deep recessions in the screen's membrane rapidly emerge and collapse again. Concurrent with the fluctuating motions of the screen, figures appear to fill the empty depth of the membrane, apparently "falling" into and captured inside the recessions. The center of the image matches the center point of the pull. As the image (which is a series of still images, rather than a movie or video sequence) starts rotating, at first slowly, then with ever more increasing speed and whirling energy, the figures dissolve and transform into abstract geometric patterns. Pulsating and colorful patterns appear in conjunction with the distinctively harsh soundscape of the quickly firing pistons. When the piston stops moving and the pull tension releases, the screen flattens into two-dimensionality and the figure recovers and then disappears. In performance, this mode of animation utilized automated control of the machine's mechanical-pneumatic actions, partially due to the impossibility of manually synchronizing the movement of the fourteen air instruments with the image's exact timing and localization. However, the main reason to automate movement was that the machine, when left to frantically perform on its own, revealed its most intricate sense of powerful autonomy.

Automated movement set up to read as a self-motivated movement relates to a distinctive key signature of life – it moves. However, automated movement qualifies as self-movement under the specific conditions of a particular system, thus producing movements that are pre-determined within the range of options the systems allows for. This precondition distinguishes automated mechanisms from autonomous entities. However, the ANI_MATE machine, when frantically performing high impact motions, works at a high level of "effortfulness" (a term coined by Sobchack to remind us "how difficult it is to be animate, to be alive, to struggle against entropy and inertia)."[164] The intense sound of the firing pistons, the screen reverberating under constant force impacts, and the visual effect of an entire field of actuators in high gear and motion all

[164] Sobchack, "Animation and automation," p. 390.

contribute to the creation of a highly dynamic environment and a shifting field of material action. The machine in motion draws attention to concrete materiality reverberating under force impact. The machine, when starting to fire its pistons, deconstructs the illusion produced by the cinematic apparatus (the images that are nothing more than a result of light and projection). It deliberately exposes its means of making and laboriously creates, as Sobchack says, a series of "effortful animations"[165] that perform the struggle of becoming alive and even more so, staying alive. Coupling automation with effortfulness creates affordances that, I suggest, fuel the powers of a simple automated machine like ANI_MATE into something that signals agency and therefore creates a sense of powerful autonomy.

Complicit Action: In this instance of animation the mechanism keeps the image in constant flux by pulling the screen extremely slowly and delicately. The shaping of inflected screen topographies through fluctuating increase and release of tension by the antagonistic forces of pulling and pushing is negotiated as a nearly imperceptible change of the physiognomic landscape of the image. Multiple actuation points are activated simultaneously while the image remains located. Manual manipulation of the image (by use of the keyboard as input device as well as by manual adjustment of the reducers at the valve ports) follows the irregular and intuitive patterns of performative actions. To give an example: close ups of my face were activated through strings attached to the mouth of the image. In slow motion, articulations that could be interpreted as speaking words were activated by my manipulations. I "spoke" through the image. The effect was both bizarre and familiar, reminiscent of the practice of ventriloquism and the strange dynamic of a conversation which mimics the act of speaking without miming words to the mouth or producing words through the mouth. In a performance context, this bizarrely formulated play with overly enacted mouth movements and imagined speaking was reminiscent of a silent movie where the subtitles are "spoken" and performed to match plausible meanings to the gestured words.

The machine and the operator, the words and their movement, the image and its permutation become complicit and act closely together in generating an experience of quasi speaking or, as Mitchell worded it, the transfer of "ambiguous," "nonverbal information." As I mentioned earlier, in his discussion of "the lives and loves of images" Mitchell suggests understanding images not only as inert objects which become animated, but as animated beings with desires and demands of their own. Touching on image autonomy, he observes that "images are not words [...] but the

[165] Ibid.

verbal message or speech act has to be brought to them by the spectator, who projects a voice into the image, reads a story into it, or deciphers a verbal message. Images are dense, iconic (usually) visual symbols that convey nondiscursive, nonverbal information that is often quite ambiguous with regard to any statement."[166]

In reviewing the public presentation of ANI_MATE, the Belgian architect and publicist Pieter T'Jonck described his viewing experience of the performance similarly, as being captured by ambiguous responses. He felt "affected or fooled" [167] by image manipulation, and noted that "we are moved [...] by a manipulation of images, while we nonetheless precisely see how those come about. As though we too willingly – or is it unintentional? – want to be tricked."[168]

[166] Mitchell, *What do pictures want?,* p. 140.
[167] Pieter T'Jonck, "Obseniteit, Obsessie, Obstruction," *Volume* 7 (2007), p. 33.
This review by Pieter T'Jonck for the Dutch theatre magazine *Volume* reflects on the performances of theatre makers Andrea Bozic, Carolien Hermans and Marion Tränkle. Translation from Dutch by Andrea Bozic and myself. Pieter T'Jonck is an engineer-architect and a publicist for newspapers and magazines (De Morgen, ETCETERA, A+). He writes mostly about theatre, dance and architecture.
[168] Ibid., p. 33.

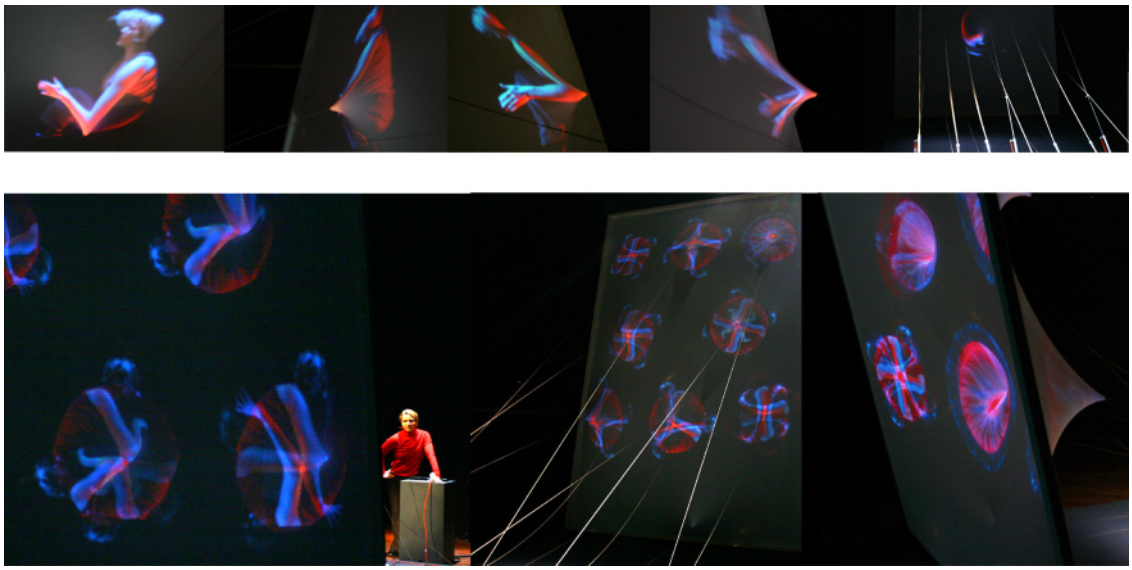

Fig.2.25: “Effortful Animation” performed by ANI_MATE. Deep recessions in the screen’s membrane emerge and recede. Figures are captured inside the fabric’s cone and left there to rotate with increasing speed,till the figures transform into abstract geometric patterns.
Photo © Annette Kamerich, Photomontage Marion Tränkle.

Fig 2.26: Close ups of my face animated in “complicit action.” The pneumatic mechanism keeps the image in constant flux. The shaping of inflected screen topographies through fluctuating increase and release of tension is negotiated as a nearly imperceptible change of the physiognomic landscape of the image.
Photo © Annette Kamerich, Photomontage Marion Tränkle.

Construction

The machine was assembled during two weeks in November 2006 at *Gasthuis*, a theatre and production house in Amsterdam. During this period, the machine was fabricated, constructed, turned into a "tuning" instrument, and rehearsed as a performing machine. Ruxton designed and implemented the electronics and programmed the sets of automated machine movements, ranging from simple repetitive routines to complex patterns of alternating movements. For the first time, the entire array of pneumatics was activated and the sound scope of the machine in movement was audible. This was when the sound artist Leon Spek joined the team. Spek is a sound designer in the broadest sense, composing and performing electronic music, as well as designing electronic sounds and building custom-designed electronic instruments. I directed him to create a sound sculpture that combined actual machine sounds with their digital manipulations, to be played and performed in real time. Spek recorded the air exhaust and impact force at the end of the cylinders' strokes and digitally manipulated their sound. He planned the distribution of speakers and the spatial layout of the sound playback. Sounds, movements and images were assembled, played and rehearsed in different combinations and sequences, till slowly a flow emerged and sequences settled into timelines and pre-sets. The final improvised public presentation of ANI_MATE made use of these pre-sets or performance modules that were developed during the rehearsal period.

Balance of Forces

The final design of the machine was inspired by lightweight tensile structures[169] and rigging systems, enabling a light and portable design solution. (Think of tents and how the pegged strings support the larger structure). The connection between podium and screen was designed as a moveable joint at the screen's pivoting axis. This allowed for a lightweight and fragile construction of both the frame and screen, which made the whole structure appear barely able to hold itself upright and in balance. The four-meter high screen was made of a thin metal frame onto which the elastic fabric was stretched, using Velcro strips. Pre-tension and some rigidity around the screen's perimeter were applied. The degree of pre-tension determines the shape of a membrane structure; it describes the exact definition of the single-pull curvature as well as the shape of doubly-curved forms (hyperbolic paraboloids) between multiple pull-points. The structure as a whole needed to be anchored, in order to compensate for the considerable pull forces that acted upon the fragile construction. Steel cables were attached to the screen's frame

[169] A tensile structure is a construction that carries only tension, but no compression.

and connected to four mounting points in the theatre grid, which stabilized the construction as a whole.[170] The pivoting joint connector and the use of a pulley made it possible to easily lift the screen and hold it in an off-balance, tilted position. The 14 pull-threads were attached to both the screen and the seven-meter long plywood podium the screen rested upon.

The appearance of ANI_MATE as a balancing, potentially unstable kinetic sculpture lies in the unbalanced relation between weight and counterforce and the machine's structural impossibility. In other words, within the logic of a sustained structure, the pull-threads are supposed to act as stabilizers to the construction, as tension cables holding the structure in place (again, think about tent constructions). But within the vital environment of ANI_MATE those threads add a dynamic instability through pulling and pushing. For the onlooker this creates a visual irritation and evokes wonder at of how things are going to hold. The sculpture in motion becomes a play about suspended forces under thread of breaking.

Material Exhaustion

The actual montage of the structure revealed a fundamental material problem: how to attach the threads to the screen's fabric? How to design the point where the considerable forces concentrate on a minuscule spot and challenge such a soft material? A test showed that when the pull strings were sewn directly to the fabric and force was applied, the screen ripped and shredded immediately without any resistance.[171] Problems and mishaps can become vital procedures that tease out the capabilities and thresholds of a situation. How can materials be connected to each other, how to materially relate them? The transmission of forces and the expressive tension negotiated within the machine hinged on this detail of material connection. That the tension needed to be acted out in the partial destruction of the system, eventually and at some indeterminable moment, was a conceptual determinate, formulated already at the very outset and with the first material experiments with textiles (*Zerreißproben*). Thus, how much strain should a connection be able to endure and when should it give in and break? This question is relevant not only to material research and design, but more so to the conceptual domain: it points at the difference between functionality in engineering terms and theatrical significance; its functioning

[170] Although there was no effort made to hide the steel cables that actually held the structure in place, they were easily overlooked. I suggest reading this as an actual construction of a willing suspension of disbelief.
[171] This problem did not occur in the scale model, since obviously materials behave differently under (proportional) different loads.

as a performative object. The critical question was how long the construction would resist its destruction and how its potential exhaustion could be negotiated.

The solution to the design problem was finally found through countless material load tests. It was a solution common to engineering practice and implied the design of a predetermined break zone, a "*Sollbruchstelle*." This German engineering term[172] literally translates as the "part that is supposed to break down." It stands for that part of a machine that is deliberately designed to be weaker, so that the breakdown can be precisely located. I thus moved the *Sollbruchstelle* away from the screen and into another layer of fabric. If a load out-ranges the system's capacity to accommodate forces the connective tissue (the weakest point) and linkage between cause and effect (between actuators and screen) will exhaust and break, but the fabric itself will stay untouched. In practice, ANI_MATE's *Sollbruchstelle* consisted of a double patch of fabric that was glued onto the screen, but the pull threads were only attached to the most superficial patch. If the stress and tension increased beyond a certain threshold, the material would exhaust and the patches would tear apart, leaving the screen intact. The machine in motion thus risks its potential destruction, the ripping and breaking of its connective tissue, while performing the actions it is designed to do.

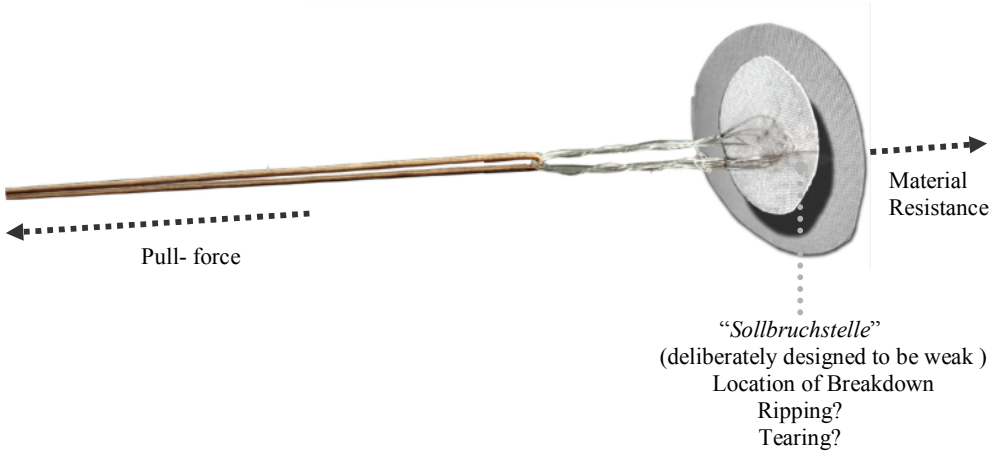

Fig. 2.27: Installation detail: Connecting tissue between screen and actuators.

When the ANI_MATE machine moves and pulls at the screen in fast and expressive gestures, the fabric stretches to utmost extension. The risk of breaking is real; the threads will rip eventually. This is an on stage experiment and the uncertainty lies not in the event itself, but in its temporal occurrence, in the "when" of the event. Each repetition of pulling and stretching brings the machine closer to the material exhaustion of its most vital part.

[172] German is my native tongue and engineering (in architecture) my primal field of knowledge. The transfer of disciplinary as well as linguistic terms into other contexts and environments proved a potent strategy to my artistic practice and conceptual approach. In the transfer of terms, metaphorical meanings can connect to actual systems. The term "*Sollbruchstelle*" links the notion of fragility and inability to endure or withstand to an understanding that weak parts are a substantial element of a system. The exact allocation of weakness allows for a specific description of the behavior (i.e. the partial self-destruction) of the system.

Machines that Exhaust Themselves

Machines that exhaust themselves, while doing what they are designed to do, tend to express either fatalism or playful nihilism. Belgian theatre maker Kris Verdonck is an artist who examines the use and role of machine exhaustion and material destruction in contemporary art and explores to what ends this can be implemented within a theatrical setting. He explores the dramaturgical function of themes such as the transformation of machines into objects and machines or objects acting "human-like". His work *Dancer* (2003) is a short, highly energetic and spectacular event, involving the performance of a ceiling-mounted machine motor and grinding disc to which a big steel L is attached. As the disc turns, the L begins "dancing" and swinging wildly. The motor quickly exhausts itself under the heavy burden of the L and burns out, filling the space with smoke and the smell of burning wires. The spectator's sympathy for the machine is called up due to the machine's "compassionate" and anthropomorphic attempt to still function within this situation, though the end (its own death) is inevitable. Verdonck describes this as the machine exhibiting the "attitude of a classic hero in trouble."[173]

Verdonck's subsequent works (*Dancer #2*, 2009 and *Dancer #3*, 2010) make use of similar aesthetic and thematic procedures by showing machines on stage in their pure and raw functionality. He designs and dramaturgically stages them so as to expose their workings and machine "life" - how they come into being, struggle to stay alive and in the end fail to do what they are designed to do. The audience becomes a witness to a process of trial and error. For example, the machine-robot in *Dancer #3* tries repeatedly to stand up straight, getting up again and again when tipping over and falling. These highly energetic actions grant these machines a sense of human-like habitus, radiating a sense of cheerful (*Dancer #3*) or fatal (*Dancer #*) optimism. Objects, according to Verdonck, can transform on stage into perfect actors. They are programmed and designed to achieve a certain aim and they will continue trying to achieve it, until it destroys them. The theatrical tension created is real: the machine burns out and dies. The audience can sense the actual energy and timely intensity of these highly dramatic moments of machinic struggle and exhaustion.

In a work by American artist Jonathan Schippers, time passes differently, but far less dramatically. In *The Slow Inevitable Death of American Muscle* (2008), a machine advances two full-sized American automobiles toward one another over a period of six days, ending in an inevitable collision. When the opposing cars crash, their fronts ends head on to each other, the

[173] A closer description of Kris Verdonck's performances and installation can be found at: http://www.margaritaproduction.be/_NL/KRIS_VERDONCK/DANCER_1/INTRO.html [last accessed June 4, 2010], my translation from Dutch.

hoods deform and their metal parts entangle. When the crumpled metal has accumulated enough material density and resistance, the advancing mechanical force finally causes the cars to rear up. At this rate of progression, movement is so slow as to be invisible, but the final destructive consequence of the action is irrevocably evident. According to Schippers, it is the condition of slowness which "isolates the moment of transformation" in the attempt to recapture it. Schippers asks: "If we slow things down can we catch the real impact?"[174]

Jonathan Schippers' sculpture *The Slow Inevitable Death of American Muscle* examines a mode of destruction and material exhaustion that focuses on details within the transformation of a vibrant power. To stay with the image evoked by the work's title, this is the shift of a potent "muscle" into its desolated remains: a wreck. A moment that might take a second in an actual collision is extended and over-exposed, revealing an unexpected sense of subtlety and quietude. The slow motion allows the viewer to experience the fragmentation and literal break-down of a spectacular and instantaneous event. The drama that lies in the violent accident and instant demolition is quieted to a slow process of consumption and self destruction that progresses with every crackle of the bent and deforming metal. The violent act of instant demolition transforms into a poetic act of slow material folding.

Jana Linke's project *Click & Glue, a system, that locks itself in* (2006) is also concerned with the exposure of a system working inevitably towards its suspended coming to its end, a final standstill. The award-winning sculptural and interactive installation is comprised of a big white latex balloon, filled with helium that is designed and automated to producing an ever-thickening web of nylon threads while floating within a small enclosed space made by four metal walls that hang from the ceiling. When the balloon drifts through the air and slowly approaches one of the surrounding walls and docks onto it through the attraction of two magnets, it mechanically glues a transparent string to the spot. Then the robotic balloon waits till the glue is hardened before it pushes back into the air, trailing the glued string behind it. Whilst the balloon moves, producing thread after thread, it gets entangled in its own sticky web, eventually coming to a complete halt. Click & glue is a fragile balloon robot and gluing mechanism that performs a singular task within an elementary architecturally designed environment. It moves through this defined space in unpredictable pathways, while it reacts to and interacts with its self-produced dense mesh of glue threads. Linke states that "*Click & Glue* was conceived not to illustrate an actual end, but rather to

[174] Jonathan Schippers' work was shown at a festival for art and media, see: http://www.artefact-festival.be/2008/programma/detail/48543 [last accessed June 4, 2010].

convey the idea of a possible end. The web grows visibly thicker each day, but the actual moment of being entirely 'locked in' is for the viewer an unreachable one."[175]

These projects are all designed towards material exhaustion, and the inevitable eventual failure of the machine over contracted, suspended, or unspecified time. They present performative systems that use themselves up or eventually are hopelessly entangled in an activity that increases the material resistance towards continuation of the intended action. To reference Gordon and the arguments he provides taken from the perspective of material sciences discussed earlier: design can extend beyond the shaping of an aesthetic object and include the design of procedures. Such procedures delay material failure (the event that is energetically favoured) and define how long that event is delayed. The artistic works described above demonstrate an interest in the act of destruction itself, rather than in the actions and events that eventually lead to material exhaustion and machine failure. These works foreground design, i.e. the procedures that are involved in its how and when of break down.

An aesthetic categorization of how things fail and collapse "correctly" and even "beautifully" is provided by the artistic duo Fischli & Weiss. This Swiss-based duo has been collaborating since the late 70s. They make use of various artistic formats: film, drawing, installation, sculptures, and multimedia installations, best known for their mixed media installation The *Way of Things* (1987) first exhibited at that year's Documenta IIX. The installation is set in a warehouse, where the artists set up and documented a half hour long spectacular kinetic chain reaction of collapsing pre-prepared and staged sequences of objects like rubber tires, plastic bags, wooden ladders, styrofoam cups and a range of liquids and chemicals. Once the self-destructive performance is initiated, the objects crash, fly, roll, and slide into one another with disastrous as well as humorous effects. The way the objects operate and are operated upon is not automated, nor is their reaction immediate. Watching the installation, it gave me the impression that each object's breakdown entails its own measure of (controlled) contingency, a momentary delay, or resistance towards destruction. I would suggest that these objects take agency - within the limits of their architecturally constructed and mechanically crafted environment - of their own how and when of breakdown. A plastic bag filled with a heavy load and hung from the ceiling needs to first accumulate enough rotational energy to effectively hit a rubber tire, causing it in turn to roll and bang into the next object in the chain. A chair seems to hesitate in its falling and the viscous liquids only slowly flow down a tilted platform to fill a plastic bottle causing it to explode. In the crafting of relationships, their causing and effecting, Fischli & Weiss pay excessive attention to

[175] For further details of Jana Linke's installation see her website: http://www.janalinke.de/media/Click&Glue_manual.pdf [last accessed June 4, 2010].

detail and to the transformation occuring in the dynamic and extended moment of system breakdown and material fatigue.

In their delightful comment on the *The Way of Things* they thereby distinguish between "right" and "wrong" system breakdown:

> An unambiguously CORRECT result of experiments exists; this is obtained when it works, when this construction collapses. Then again, there is a BEAUTIFUL which ranks above the CORRECT; this is obtained when it's a close shave or the construction collapses the way we want it to – slowly and intricately, that is, a beautiful collapse. The aesthetic layer on top of a function is like the butter on a sandwich – rather thin and smooth. The wrong result is obtained when things get going of their own accord, and the wrong result is obtained when they don't get going at all [...] On the other hand, every object in our installation is good if it functions, because it then liberates its successor, gives it the chance of development. Not destructive in that sense.[176]

The Way of Things is a delicately unstable installation that showcases everyday objects which are tied into chain reactions of controlled breakdowns, breakdowns that are based on the laws of physics and chemistry. The work describes the inevitability and chance inherent in any situation, obviously precarious or not. Each object takes part in the machinery of a chain of disasters, thus, each part of the machine assemblage carries within itself its own distinctive form of inevitable breakdown. Within the logic of the chain, the destruction of its parts is a necessity, productive rather than destructive as each "death" gives way to further development and continuation of the chain.

Death of the Image

Unlike the performative machines described above, ANI_MATE is not designed towards its own failure. However, it does not exclude failure. The system aims to hold a critical balance between the actual event of ripping and tearing and its resistance towards this happening. This balance is as fragile as is the material it is dependent on. Contingent failure as distinct feature of the material-machine's articulation introduces chance, a non-determinate process, and, for the audience, wonder at how things are going to hold that excites a desire to interfere with that fragile balance. This fantasy of and desire for destruction was expressed by one audience member who suggested to me after a performance that I "pull the strings even a little bit more."[177]

[176] For further information on *The Way of Things* and Fischli & Weiss, see: http://www.medienkunstnetz.de/works/the-way-of-things/ [last accessed June 4, 2010].
[177] Cited from the "Guestbook" of the performance at *Gasthuis* theatre, November 17, 2006.

If I did pull the strings "a little bit more" and increased the tension to the point that the material exhausted, would meand a break in the connective tissues (of the pads) and of the linkage between screen and actuators. The effect would not be of dramatic rampage and total destruction of the machine, would not provide an apocalyptic end to the situation such as in Kris Verdonck's heroic *dancer*. It would not enable chained, subsequent events as in Fischli & Weiss' the *Way of Things*. These works derive their meaning from essential destruction, while for ANI_MATE the machine would be left performing futile motions without any accompanying constitution of meaning. The gestures of the machine would be empty of power, and the image would retreat to its inanimate state for good. It would stop living and breathing: it is not primarily the machine, but the image that dies.

Thinking of an image as being a "living organism," as Mitchell has suggested, calls for a deeper investigation of this proposition. In Mitchell's words:

> I invoke the metapicture of images as living organisms, then, not to simplify or systematize the question of the value of images but to explode the question and let it proliferate a host of secondary metaphors. [...] the whole metapicture of images as life-forms, then, itself has a tendency to spawn a bewildering array of secondary images [...] can images be created or destroyed?[178]

Similarly, Australian animation theorist Alan Cholodenko in his book *The Illusion of Life* has made thematic animation a disconcerting concept, conjuring up its opposite "inanimation":

> Animation cannot be thought without thinking loss, disappearance, and death [...] one cannot think the endowing with life without thinking of the other side of the life cycle – the transformation from the animate into the inanimate – at the same time, [one] cannot think endowing with motion without thinking the other side of the cycle of movement – of metastasis, deceleration, inertia.[179]

Cholodenko's concept of the "animatic," a neologism that connects animation to mechanical (inert) entities is profound as it also addresses the "seductive life" and attraction that lies within its coupled imaginary and machinated milieu:

> And if its 'life' is singular, enchanting, seductive, theatrical, magical, it is Animatic Automaton. This is what is at stake in the "bringing to life" of what we have until now believed to be inanimate inorganic objects. It will be neither life as we know it nor

[178] Ibid., p.91.
[179] Alan Cholodenko, "Introduction," in Alan Cholodenko ed., *The Illusion of Life: Essays on Animation* (Sydney: Power Publications, 1991), p.21.

> something non-living. [...] I think the Animatic Automaton not only in terms of the *illusion of life* but in terms of the *life of illusion*.[180]

ANI_MATE, as a machine that attempts to animate and bring to life a still image, also negotiates (within the environment and milieu it inhabits), the possibility of becoming once again inanimate. The antagonistic force of life and death, found in the very real risk of the breaking down of the machine's most vital function and through its potential for material exhaustion, reinforces the deep attraction of the living image as something that will inevitably cease to be. The statements formulated at the initial phase of the working project posited "coupling of imagination with sheer force to extract a lifelike form from the image." In the end result (the actual performance of the machine) animation enabled by ANI_MATE actualized this coupling: it affirmed the illusionary by negotiating the real. ANI_MATE creates something that can be read as a "real illusionary."

[180] Alan N. Shapiro and Alan Cholodenko, "The Car of the Future" (presentation at Human-Machine Interface Dept. and the Infotainment Dept. of Volkswagen, Wolfsburg, Germany, November 2008.)
Available at: http://www.noemalab.org/sections/ideas/ideas_articles/pdf/shapiro_car_of_the_future.pd [last accessed January 4, 2011].

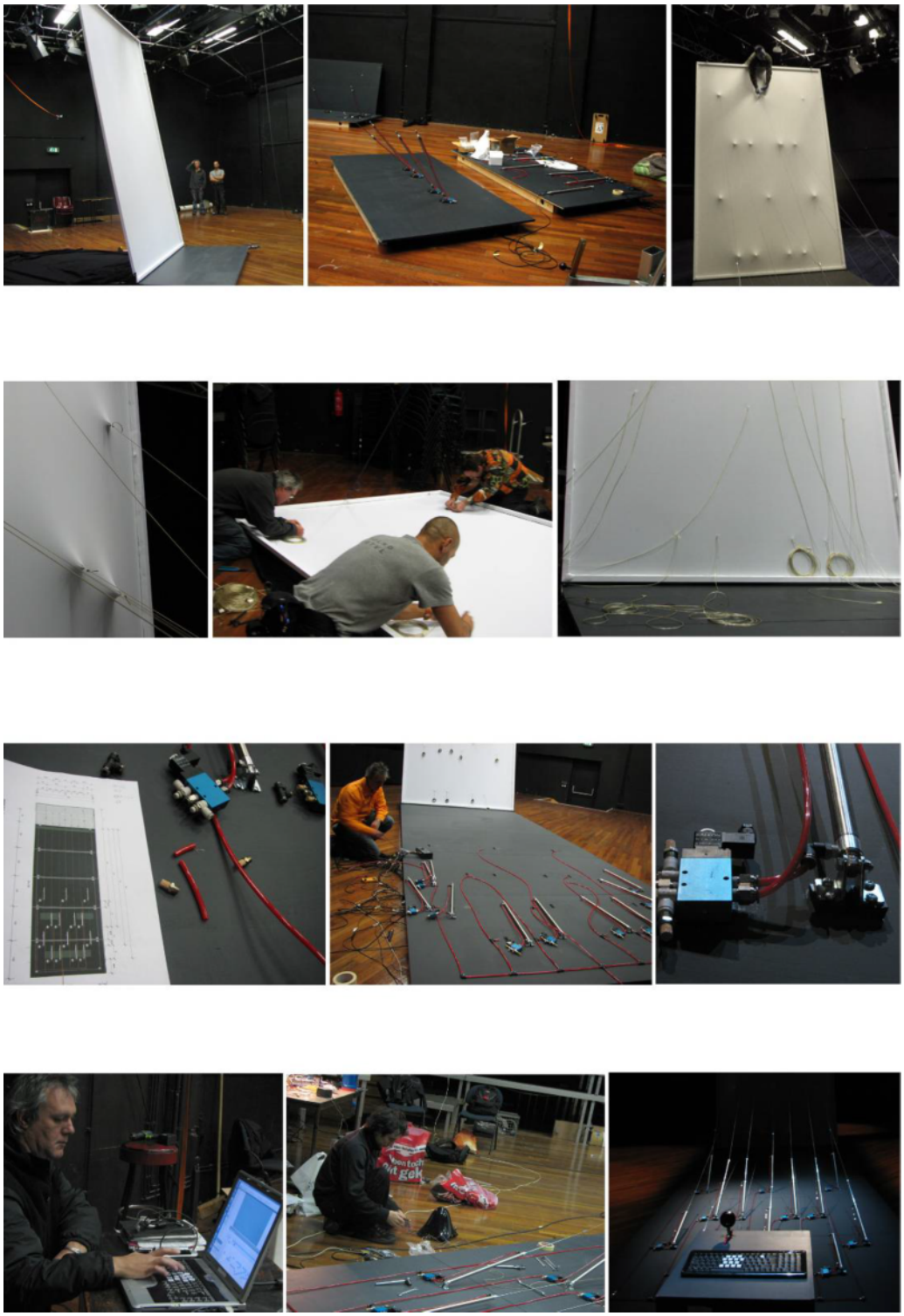

Fig. 2.28: Assembly of the machine's parts in the theatre: (a, b, c) Rigging the screen, (d, e, f) stitching threads, (g, h, i) re-assembling podium parts and layout and montage of the pneumatics, (j) Jim Ruxton testing the control system, (k) Leon Spek implementing the sound system, (l) the finished design.

Live Performance

The public presentation of ANI_MATE took place in November 2006. During the four performances, I improvised with the machine and made use of the archived collection of performance pre-sets, or "movement-figure-force compounds" (modules) and on their combinability and recombinant compositions that had been developed during the two-week rehearsal period in the theatre prior to the public performance.

The themes that were negotiated and performed in a structured improvisation between machine and operator/performer lie in the drama of the *Zerreißprobe* the real-time, real-place balancing act between life and death of the image, between destruction and desire (the ambiguous relation between the "puppet" and the "puppeteer"), and in the confusion of the liminality of what passes for a living state. Foregrounding agency and materiality, and with it the performative potential of stress and struggle, I work from a position of theatre and performance that is brought back to an event physically performed in front of the audience and that stages a concrete situation. That is different from either a digital, networked, and distributed performance occuring in virtual environments, or a dramaturgical and scenographically staged written drama. Within a theatrical context, the ANI_MATE play can be called the performance of a dilemma that "acts" in front of the spectators and toward which they are invited to take an active decision.[181] This play does not involve audience in terms of interactivity, yet situatedness, the live presence and the embodiment of agency all invite them to actively take part in the presentational situation. This positioning is influenced by the practices of "postdramatic" theatre a term introduced by German theatre theorist Hans Thies Lehman. In his writings he analyzes theatre forms developed from the 1960s onwards, including the avant-garde performances (Robert Wilson and after), and evolved "landscapes" of scenographies (Wilson), fragmented performance collages (The Wooster Group) and visual figurations (Castellucci). The theatre which Lehmann terms postdramatic is no longer primarily focused on the drama and the dramatic text, but evolves a performative language and aesthetic formation in which the drama is understood in relation to the material situation of the performance and the stage. In Lehman's words, "Postdramatic theatre is a theatre of states and of scenically dynamic formations."[182] Lehman defines "states" as "aesthetic figuration of the theatre,

[181] This position of theatre is similarly articulated in my interactive game and theatre performance NEVER STAND STILL (2003). The project made use of basic game strategies to immerse the audience in a sensitive (interactive) environment. But the game instructions carried a double signature. They were articulated as instructions to forward the game, but they were also coded to function as rule-based choreographic assignments. The same instructions thus served two purposes. It is only when the game is played and performed that the dance is generated and the inflicting and conflicting relations are performed with and by the audience.

[182] Hans-Thies Lehman, *Postdramatic Theatre* (London and New York: Routledge, 2006), p.68.

showing a formation rather than a story, even though living actors play in it."[183] States are related to the process of formation and how that process becomes visible to the viewer. The dynamics that enfold "within the 'frame' of that state – one could call it is *scenic dynamic*, as opposed to the dramatic dynamic."[184]

Drawing on Lehman's notions of "scenic dynamic formations" and "states," and thinking through the particular dynamics established between the parts and elements of the ANI_MATE machine and its play with actual material tension as well as the scenic staging of such a delicate balancing act of force and counterforce, ANI_MATE can be said to "perform" through physical tension and the meshed linkages between its materials. Together these produce a quite real situation of endangered equilibrium. Reviewing the performance of ANI_MATE, Pieter T'Jonck noted:

> Theatre is here actually brought back to its most elementary form: it is something that is physically performed, a position against theatre 'as expected or predictable'. [...]
> It is true, however, that this kind of work makes it difficult for the viewer to identify themselves in a simple and direct way with the stage actions because they themselves must give meaning to each aspect of the action. You are not offered meaning on a plate here. We are not used to this kind of active watching. In fact, the reverse is true.[185]

Lehman's "scenic dynamic formations," formulated from within the domain of theatre, actually operate similarly to Spuybroek's architectural "dynamic geometrical forms," discussed in my earlier chapter on design processes. Both enable the audience, or the viewer, to form multiple associations derived from the particular material situation, or distinct materiality. In the case of Spuybroek's *D-Tower* project, it is the "rubbery material quality" abstracted into the design that allows a reading of the tower (as looked at) to be an unstable point of orientation, which produces (as I have discussed earlier) "entangled multiple viewpoints" in an otherwise hierarchical and single-sighted situation (a tower from which one looks out).

I hoped staging and performing this animation machine would create a situation that would spark the viewers' own productivity and associations, engaging them in active watching. In conclusion, and from reviewing ANI_MATE's stages of development as traced and analyzed throughout this chapter, I find that the work did allow for multiple readings. It is a *Zerreißprobe* in terms of its materiality and the "performative activity of the fabric's utmost stretch." In terms of its mechanical actuation it has been described as an "affectively touching an image" and a "force" that animates the image through continuous movement of a "pulsating breath" (the associative

[183] Hans-Thies Lehman, *Postdramatic Theatre,* p. 68.
[184] Ibid.
[185] T'Jonck, "Obseniteit, Obsessie, Obstruction," p. 33.

powers of the pneumatic system). It operates on synchronized spatial and temporal exactitude (in terms of its control system and streamlined internal data flow) while being at the same time a "play on suspended forces" (its sculptural balancing structure) and a "real illusionary" (in terms of it animating and creating lifelike forms that inevitably will die). Together, these associations describe an environment that constantly negotiates antagonistic forces (both actual and conceptual) and that effortfully struggles to maintain a balance. As such, ANI_MATE is a meshed and multithreaded milieu open to associations with dynamic accounts of the living.

Staging a machine that performs under continuous stress and that produces, through its performance, a situation where tension threatens to tear the machine apart, thus disturbing the fragile balance that is crafted so carefully, speaks to the current instabilities regarding the boundaries between movement and non-movement, life and non-life, the human and animated entities, and with regard to Sobchack, between effortfully lived experience and effortless electronic lives. The machine in motion performs the struggle of keeping those currents and concepts in balance as it tries to sustain equilibrium of forces – while foreshadowing its material over-stretch and potential destruction. In that sense, the effort of the machine could be conceptualized through the filter of environmentalism, as defined by media theorist Matthew Fuller. He describes environmentalism as opposed to ecologist energies and as an attempt to reach "a state of equilibrium" and as "sustaining a vision of the human and want[ing] to make the world safe for it,"[186] however inert, effortlessly electronic or transitionally informational this world might be. More conceptually, considered through the structuring principle of the *Zerreißprobe*, is the flexibility of a vision of the human in a world that is constantly stretched by expansive forces. These include the forces of a global digital culture, and computing technologies that produce rhythms and movements of informational density and transfer of high speed connectivity that are perhaps less resonant to productively include and incorporate the slow, laborious and tangible threads of human living, or to give, in Munster's words, a "place for the body within computational spaces."[187] The *Zerreißprobe*, in its largest, most global sense, negotiates the process of living in an information culture. The milieu within which those addresses are played and performed is dynamic to a degree not entirely pre-determined, and needing to be enacted and actively performed. This includes the probing of its equilibrium of forces and its potential for transient transformation.

[186] Fuller, *Media Ecologies,* p. 4.
[187] Munster, *Materializing New Media,* p. 3.

Effortful Engagement

Tension and the negotiation of antagonistic forces can refer, as discussed above, to the "effort" of holding an instable environment in fragile balance, speaking about the inevitable instabilities of our lived experiences. Effort and the performative potential of stress and struggle, when staged as a live-scenario describes the expressive qualities and energies in movement as discussed earlier with regard to the "effortful automation" of ANI_MATE's mechanism. Another meaning explored previously is the effort of a machine to exhaust and exploit itself materially, which gives rise to risk and eventual failure in the artistic system and the machine's performative script. "Effort" may also refer to aesthetic aspects of performance in terms of describing the extent to which the audience is invited to inhabit the role of "active watching" – the term used by T'Jonck in reviewing ANI_MATE when describing the audiences' process of perceiving and experiencing the performance. In the next section I intend to examine the audience's role in "seeing" the performance, an activity that includes how the machine moves and exhausts itself, how the images are animated, and how these staged actions impact on the physical and bodily engagement of the spectators.

In my characterization of the relationship between the effort of the machine and the animated portraits and how the audience is addressed to see them, I refrain from the term "identification" in its common usage within performance theory as a tool to immerse the spectator into the dramatic event. I don't believe that identification captures how we experience a "material enunciation,"[188] to use Salter's term for the transient figurations ANI_MATE produces. This seems to me especially true when considering physical effort and movement. Instead, I will use the term "access" to describe the audiences' spatial relationship to the stressed and distorted images.

The type of access the audience has to the physicality and expressions of the distorted images depends on their own spatial position and the angle from which they look at the screen. The spatial layout of the performance allowed the audience to circulate freely around the machine, as there was no boundary between the stage and the audience area. Moving, they could experience the projected image of my body in its different distorted appearances. From the front (position A), the image seems to be undistorted and untouched by the threads (and threats) of the machine, whereas from the sides (Position C) the image deforms in a manner similar to that of Hans Holbein's painting of the anamorphosed skull. Visual recognition of the image is delayed and

[188] Salter, "Environments, Interactions and Beings: The Ecology of Performativity and Technics," p.30.

ambiguous. Viewing from the back (Position B), the image is perceived in its most uncanny state of deformation. Here, the pulling mechanism becomes part of the image, and the images' transformation is causally explicable (see also figure 2.6, which shows the same moment in performance from the three different viewing positions). Each moment could thus be experienced differently by each audience member. Since there was no single dominant perspective from which to "watch" the play, the relationship between the mobile spectator and the moved image is characterized potentially by a shifting relation.

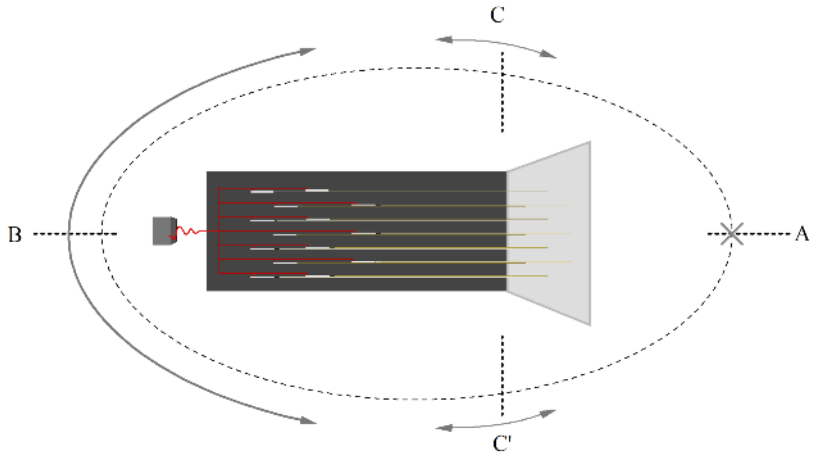

Fig.:2.29 Diagram of ANI_MATE's scenario, which includes the movement path and viewing angles of the audience members

To have "access" to these different viewing experiences requires the audience to position themselves in terms of their own desired perspective, evaluating bodily and spatially interpreting the situation. It is their own movement effort that reminds spectators that events are happening now, heightening their awareness of their own co-operation and co-initiation of the viewing experience, based on their individual choices regarding access to the performative situation within the environment provided by ANI_MATE.

The themes, syntax and vocabulary used in this chapter to consider a media art practice that seeks to create relationships between the heterogeneous parts of a composition by actualizing its linkages through the effort of performance and the effectivity and agency of its engaged materials were developed via the interpretation and analysis of ANI_MATE both as performance and as working process, and were further informed by the methodology and material design practice of Spuybroek.

In the following chapter I investigate more deeply the dynamics of a composition within which linkages between autonomous parts, materials, routines, come into process. In contrast to ANI_MATE's meshed systems which together create a precarious environment that manages to hold itself in critical balance, the mechanic-robotic installation ON TRACK investigates a system that, to quote Broekmann, aims to "remove the controls."[189]

This second practice-based research project explores an ecology wherein the processes accumulate to cause a system to go out of balance: to run off track. In this discussion the differences between environments and ecologies are explored in terms of the nature of the linkages produced, following Mathew Fuller's reading of media ecologies,

This marks an important shift in my work and the emphasis of the further research, is on an autonomous machine environment. This involves a different set of performative principles and semantic layers, and also stands "alone," without the interaction of a human operator/performer. In contrast to ANI_MATE (where human action determines the performance of the machine), the performance of ON TRACK is driven by machined routines that are exclusively self-referential, heightening the allure of machine autonomy. Both artistic works enable the performance of their engaged materials, and both came to exist within a milieu that invites artistic collaboration as a vital procedure to the compositional process. Their differing conceptual, performative, and technological principles highlight ON TRACK's engagement of organic processes as a means of utilizing "leaking" and of in-forming material formation. ON TRACK draws attention to the urgencies and responsibilities associated with irreversible processes.

[189] Andreas Broekmann, "Remove the Controls. Machine Aesthetics" (1997), available at: http://framework.v2.nl/archive/archive/node/text/.xslt/nodenr-70381 [last accessed July 21, 2009].

CHAPTER THREE

A MATERIALS ECOLOGY

ON TRACK: A Performative Mechanic-Robotic Installation

To call something ecological is to draw attention to its necessary implication in a network of relations, to mark its persistent tendency to enter into a working system. That system, however, can be more or less mobile, more or less transient, more or less conflictual.[190]

This chapter focuses on the second artistic work developed during my doctoral research. As explained in the previous chapter, after having conceived and realized ANI_MATE, where the implicated materials took on shape and fluxed transiently between states of expansion and retraction throughout an evening-length event, I next aimed to investigate active and agential materiality through more unpredictable and emergent scripts. This included investigating a performative setting that would evolve over an extended period of time, without human interference.

The performative mechanic-robotic installation ON TRACK was produced in 2009 through a collaboration between four artists known collectively as *in serial*: Linda Dement, Petra Gemeinböck, PRINZGAU/podgorschek, and myself. The work was exhibited at several venues throughout 2009-2010. The performative machine ecology named ON TRACK involves a pendulous system comprised of a mechanical mop, a pack of robotic brushes, and a collection of viscous fluids. When set into motion, the machine apparently starts to clean, but gets entangled in a series of interferences and interruptions, a scenario of spill and hindrance ending in a *mélange* of fluids. The machine, in motion, goes through a process that, over extended time, goes off track.

ON TRACK, like ANI_MATE, investigates the performative potential of materials and the dynamic forces negotiated within its operational systems. However, ON TRACK fundamentally differs from the earlier piece. In ANI_MATE, the system's coercive operational tension is played out between the screen and the animating pull-forces. The *Zerreißprobe* unfolds in the interaction between machine, operator, and spectator. In contrast within the ecology of ON TRACK, human action and interaction has been abandoned. Tension is produced through the unpredictable emergent relationalities between the heterogeneous parts, procedures, and materials the work is made of. Designed for autonomous performance, ON TRACK enacts agency and material transformation exclusively within a mechanical environment. The motifs and processes engaged within the environment initiate an entropic dynamic that performs the production of a mess.

[190] Jane Bennet, "The Force of Things: Steps toward an Ecology of Matter," *Political Theory*, vol 32, no 3 (2004), p. 365

The following chapter presents a close reading of the operational potential of ON TRACK's parts and elements. The conceptual thread weaving through the analysis positions the machine as an ecology of interlaced and individualized potentials, processes, and materials. This approach adopts media theorist Matthew Fuller's theoretical position in *Media Ecologies*,[191] comprised of an analysis of interlinked media systems, a reading of their materiality and immateriality, a tracing of their internal connections and collisions, as well as an understanding of the relative nature of their function. In the particular ecology of ON TRACK, all systems, parts, and materials work autonomously. However, their individual performances interfere with each other and create unpredictable patterns of hindrance as well as unintentional cooperation. Materials, like information processes, slip through the loopholes of the system's confines: they leak. The function of leakage and spillage is to escape and to re-connect into new meanderings and mixtures. ON TRACK is an autonomous and dynamic milieu that makes these leakages, meanderings, and mixtures tangible. I offer throughout this chapter a reading of ON TRACK as a vibrant, artistic collaboration that "exhibits the unanchored, messy production ground between different artistic disciplines"[192] and which allows for work that reflects the heterogeneous process from which it emerged.

[191] Fuller, *Media Ecologies.* Fuller employs the notion of collage as the lens through which he views media systems. He understands that the objects that make up media systems connect, interact, and collide with one another. In particular, he asks what "patterns, dangers, and potentials" result from these connections and collisions of interconnected objects and processes.

[192] Petra Gemeinboeck, Marion Traenkle, Linda Dement, PRINZGAU/podgorschek, Rob Saunders, "ON TRACK: A Slippery Mechanic-Robotic Performance," Leonardo, Volume 43, Number 5 (2010), pp. 488-89. The article was jointly written by the *in serial* members and published as part of the *e-MobiLArt* (European Mobile Lab for Interactive Media Artists) project. My analysis of ON TRACK as laid out in this chapter is necessarily informed by our shared writing and working process, public presentations, and intensive discussions, to which I here give full credit.

Fig, 3.1: ON TRACK at Thessaloniki Biennale, Thessaloniki State Museum of Contemporary Art, Greece, May 2009. Installation overview. © *in serial*.

Fig. 3.2: ON TRACK at „Biennale Cuvée 10“, OK Center for Contemporary Art, Linz, Austria, March 2010.. Installation overview. © *in serial*.

Material Wastage and the Accumulation of Loss

The initial spark for ON TRACK was the common interest of the members of *in serial* in processes. We were particularly interested in processes that, once initiated, autonomously move through cycles of events, and thereby structurally couple material and systems. Drawing on Fullers' term "complex objects,"[193] a compositional definition by which he seeks to describe media systems that are as much informational as material, we speculated on the production of a scenario of chained events that would thrive on the dilution of its own substance. In the initial phase of the collaboration, we sketched a series of apparatuses and procedures that endlessly cycled, transforming the derivates and remains of human endeavor (such as, for example waste products and abandoned body tissue). Drawing on these sketches, we conceptualized machines that executed seemingly futile activities: mixing and spilling diverse materials, wasting them for the further production process. Challenging utilitarian descriptions of qualities and functions that are typically associated with machines (such as "purpose" and "routine") we aimed to confront functionality, efficiency, and practicality with temporal and random elements.

Working through the mechanics and movements active in the creation of an entropic scenario of spillage and waste, we designed an enormous mechanical apparatus that traversed a single mop along a track system, meticulously maneuvering the cleaning instrument to dunk into buckets of fluids. In the controlled logistical effort of transporting and distributing the fluids, these nevertheless get spilled and "lost" on their pathway between the fluids in the buckets (the installation's "resources"). This inevitable yet uncontrollable wastage, despite the effort and procedures engaged to keep everything "on track," challenges notions of gain and access within systems of labor. Meant to order and distribute, our first mechanical system instead worked towards the accumulation of "lost" resources, metaphorically pointing at humanity's wasteful exploitation of materials. The quite real effect of material spillage and leakage in ON TRACK is the formation of a slowly growing and continuously changing layer of muddy fluids, distributed over the machine's playground, which, over time, coalesce and disperse to form meandering pathways, puddles, and crusts.

[193] Fuller, *Media Ecologies,* p. 1. Fuller considers complex objects "to mean processes embodied as objects, as elements in a composition." He draws on the historic accounts of Dadaist practice, specifically Kurt Schwitters' *Merzbilder*. These compositions and their "collage life" are emphasized by Fuller as fundamental to an ecology of media in two ways. First as an affordance to get busy and to carry out live interactions between media systems; and second as a "fundamentally materialist account of the world" that engages "in the conceptuality of real objects." See Fuller, *Media Ecologies*, p. 1.

At this early stage in the working process, discussions were influenced by a number of artworks that contest the "dangerous" potential of futility when charged with reality. This discussion was influenced by Belgian visual artist Kris Vleeshouwer's artwork *Glassworks II* (2005), a kinetic sculpture consisting of an enormous metal rack with shelves displaying 1000 jars and bottles. The computer system controlling the kinetics of the installation is pre-programmed to act randomly. In an act of chance operation a glass object is chosen, grabbed, pulled out of the rack and smashed to the ground. One by one, the glassworks are destroyed, an act of aggressive yet unintentional accident. The machine's appetite for futile destruction is satisfied in the occasional, random, event of noisily shattering glasswork. The real remains of this seemingly unintentional event are nevertheless of substantial consequence: broken glass. Vleeshouwer describes his system as one that lies in wait to act and to destruct:

> A wagon system, which carries a piston, moves up and down and also horizontally, selecting jars to be pushed from the shelves. This action depends on a computer programmed to select the jars at random and time at random. Therefore the event can be made to happen every 10 minutes or just two or three times a day. The act of waiting for something to happen is also part of the sculpture.[194]

Vleeshouwer's *Glassworks II* does not produce anything "useful," yet the fragile wholeness of the chosen material produces a heightened awareness of how dangerously sharp glass is when shattered. The seemingly trivial smashed glass jar engenders explosive and potentially violent consequences. The connection between cause and effect is defined by a relationship that links lack of intent and futility to the reality of the physical properties and material qualities of the engaged objects.

Glass has the curious material capacity to transmit light and to appear as barely present and even, to stretch the frame of reference, as non-material. It has a precious, fragile property associated with pureness and clarity and a potential for being destroyed.

The actual and inevitable act of falling and breaking, the transformation from jar to shattered pieces, is instantaneous and irrevocable. The act of breaking is a task-driven performative intervention that is not without danger and, within the setting Vleeshouwer has created, unpredictable in its timing and actual occurrence. It is solely in the machine's coding that the power lies to direct the timing of the event and to draw the audiences' attention to the fragility of existence and the conditionality of time. What remains from the exiting event of breaking glass is

[194] For a description of Vleeshouwer's work see: Annie Gentils Gallery, "Kris Vleeshouwer," http://www.anniegentilsgallery.com/default.asp?node=185&Kris-Vleeschouwer, [last accessed: January 11, 2011].

a reverberating sound and a shattered pile of splintered and sharp-edged pieces of glass accumulated in heaps during the installation runtime. The destruction of 1000 basically identical jars produces a multiplicity of different pieces, reflecting the light in many ways.

In reference to the working process of ON TRACK, Vleeshouwer's work illustrates the potential of materials to generate a different quality when materials are transformed from confined wholeness into shattered parts. The initial experimentation with fluids, buckets, and machines revealed that the potential of fluids is to drip and spill and to escape their confining containers (the buckets that hold the fluids). This begets a newly formed and constantly re-forming landscape of dried crusts and sticky puddles. The relative function of spillage is to disperse as well as to form freshly mixed dispersions and emulsions and to render lively such messy field. As Tim Ingold suggests: "Things are alive [...] because they leak. Life [...] inheres in the very circulations of materials that continually give raise to the forms of things even as they portend their dissolution."[195]

Another area of research, again prompted by the initial experiments with ON TRACK, was engaged with the performance and transformation of materials probed by autonomously acting machines. Examples included Roxy Paine's machine *SCUMAK* (1998). In *SCUMAK* machine, subtitled *Auto Sculpture Maker*, the raw material polyethylene is heated so as to melt together with pigments. The liquid mass is dripped and pushed onto a conveyor belt. There, the material dries to create bulbous shapes. Layers of materials accumulate, until (after about a day) the sculpture is finished. In this "Auto Sculpture Maker," the transformation of materials in various aggregate states is affected by the design of the machine itself, but cannot be entirely controlled by it. In what form the material will freeze into shape, and how the layers of dried polyethylene will lie upon each other, is indeterminate within the margins the material parameters allow for. Paine views these sculptures as portraits of the materials used. In Paine's words:

> In a way they're actually portraits of the materials that each machine works with. They get at the core essence of whatever material is. Like the polyethylene that makes the Scumaks: the viscosity, the hardness, the molecular structure [...] that is what causes them to make these forms, so they really are in some ways material portraits.[196]

Paine's notion of "material portraits" informed the further research into ON TRACK, as it draws attention to the relationship between material specificity and the transforming environmental

[195] Ingold, "Bringing Things to Life.," p. 8.
[196] Roxy Paine, Gregory Volk, Lynn M. Herbert, *Roxy Paine: Second Nature* (Houston: Contemporary Arts Museum, 2002), p.21.

processes and pressures that act upon it. Paine's series of *SCUMAKs*' proliferate as recognizably similar due to their origination from the same material, but they are also unique due to the way they are in-formed and shaped while passing through their different aggregate states. A material portrait thus bears traces of both the original source material and the environmental forces that act upon it.

It is important to note that the outcome, i.e. the sculptural appearance of the *SCUMAKs*, is not random. The result is dependent on the properties of the materials used, as well as on the environmental conditions. However, one could argue that the parameters of chance operating in Paine's installation are quite narrowly set and the resulting shapes are while not same, very similar - differing only marginally and equally consistent in their aesthetic quality. Surprises, slippages, or productive accidents are excluded from the performative script Paine's installation thrives upon. Instead, Paine succeeds in fine-tuning the narrow margin between the automation of a process and the production of sameness and chance-based operation. Chance largely lies within the unpredictable behaviour of the viscous heated polyethylene, which guarantees just enough difference for the outcome to be called unique.

The mess and dried up crusts and liquid puddles produced by ON TRACK's initial machine are, similarly, portraits of the environment that transformed the fluid source materials to become a unique mess. The mess is thus a product of, and informed by, material intensities and potentials, as well as by the forces causing the materials to mingle and mix. But the outcome of ON TRACK is indeed is messy, slippery and essentially less controllable than the production process of Paine's *SCUMAKs,* due to different performative dynamics at play and more unpredictable and emergent scripts at work.

Entropic Dynamic

In the subsequent design process, which stretched over six months and included consultations with engineer Thomas Sandri and roboticist and programmer Rob Saunders, the initial, compact mechanical machine described earlier was first torn apart and then reconfigured into a new composition and collage comprised of three distinctly different systems, including a mechanical system, a robotic system, and an organic-material system. When set in motion they move slowly through a series of actions and incidents, producing a mess in the most intricate ways. They thus create, to echo Paine, a "portrait" of the work's *own* transformative powers and potential to mix.

The parting procedure and a conceptual cut into the homogeneity of the initial machine initiated a critical examination of the nature of the linkages established among the distinctly different systems that ON TRACK finally consisted of. Questions arose: What kinds of communication and interaction are to be established? What rhythms and capacities do the seperate systems share? How are these systems oriented towards mixing and mingling and forming interrelated movement patterns, meanings and realized potentials? Do the parts and elements cooperate with each other, or do they hinder, restrict and interrupt?

Establishing an ecology of systems calls for questioning regarding their dynamics when at play. Do the systems seek to hold themselves in equilibrium, managing an energetic balance within a field of antagonistic energies (life and death, pull and push) as performed by ANI_MATE? Or, do they go off track and slip into a deteriorating performance and accumulating crisis, enacting the entropic dynamic of wastage and loss? Or do they (to consider the opposite end of the same spectrum) accumulate materials and accelerate forces in the apocalyptical dimension of Too Much?

ON TRACK's crisis and disaster-prone dynamics is reminiscent of the cultural scenario expressed in the *Sorcerer's Apprentice* (1797) by poet Johann Wolfgang von Goethe. The *Sorcerer's Apprentice* is a trans-historical narrative that is deeply embedded in German culture. It tells the story of an old sorcerer leaving his apprentice with chores to perform. Tired of fetching water, the apprentice enchants a broom to do the work for him, though he is not trained to do the proper magic. Soon disaster unfolds as the place is flooded with water, and the apprentice realizes that he does not know how to control the broom, or the process he has set in motion. He tries to split the broom in half, but instead of breaking the spell and stopping the threatening disaster, each part of the broom comes alive, and acts at accelerated speeds. Instead of solving the problem and returning to an equilibrium of forces controlled by powerful spells, new processes are called forth that instantantly deepen the crises. A situation is generated that becomes ever more uncontrollable and threatens to end in a catastrophe. The parting procedure, i.e. the spitting of the broom, is a multiplier for the dynamics at play. The parts are more potent, more "dangerously" uncontrollable than the former whole. The procedure of splitting apart acts as a process that multiplies and accumulates such that any relapse into its former, less catastrophic, state is an impossibility, given the nature of the dynamics (the wrong spells) called upon.

ON TRACK performs the tendency of a system in crisis to progress through accumulation (of a mess) and through the wasting of resources (the fluids). It is a live scenario that performs its own disaster-prone transformation and entropic ecology, while producing results that are irreversible due to the nature of the processes involved. In order to understand what happens when the implicated systems interact and interfere, the following section provides an inventory of the discrete parts and elements of the installation and examines the actual linkages established between them. I will examine the informational and material communication system and the different movement motifs and rhythms the systems produced. ON TRACK is revealed as a live scenario and a dynamic ecology of waste and hindrance, and unwilling, or at least merely incidental, cooperation. Fuller, when examining the compositional dynamic of media ecologies, points to the "ontogenetic, reality forming nature of media and [...] its capacity for connection and use"[197] which arises out of concrete conditions. Fuller lays out a conceptual argument, which I believe also describes a fertile artistic strategy from the perspective of a media art practice concerned with material processes and experimentation: "The only way to find things out about what happens when complex objects such as media systems interact is to carry out such interactions – it has to be done live, with no control sample."[198]

[197] Fuller, *Media Ecologies,* p. 2.
[198] Ibid., p. 1.

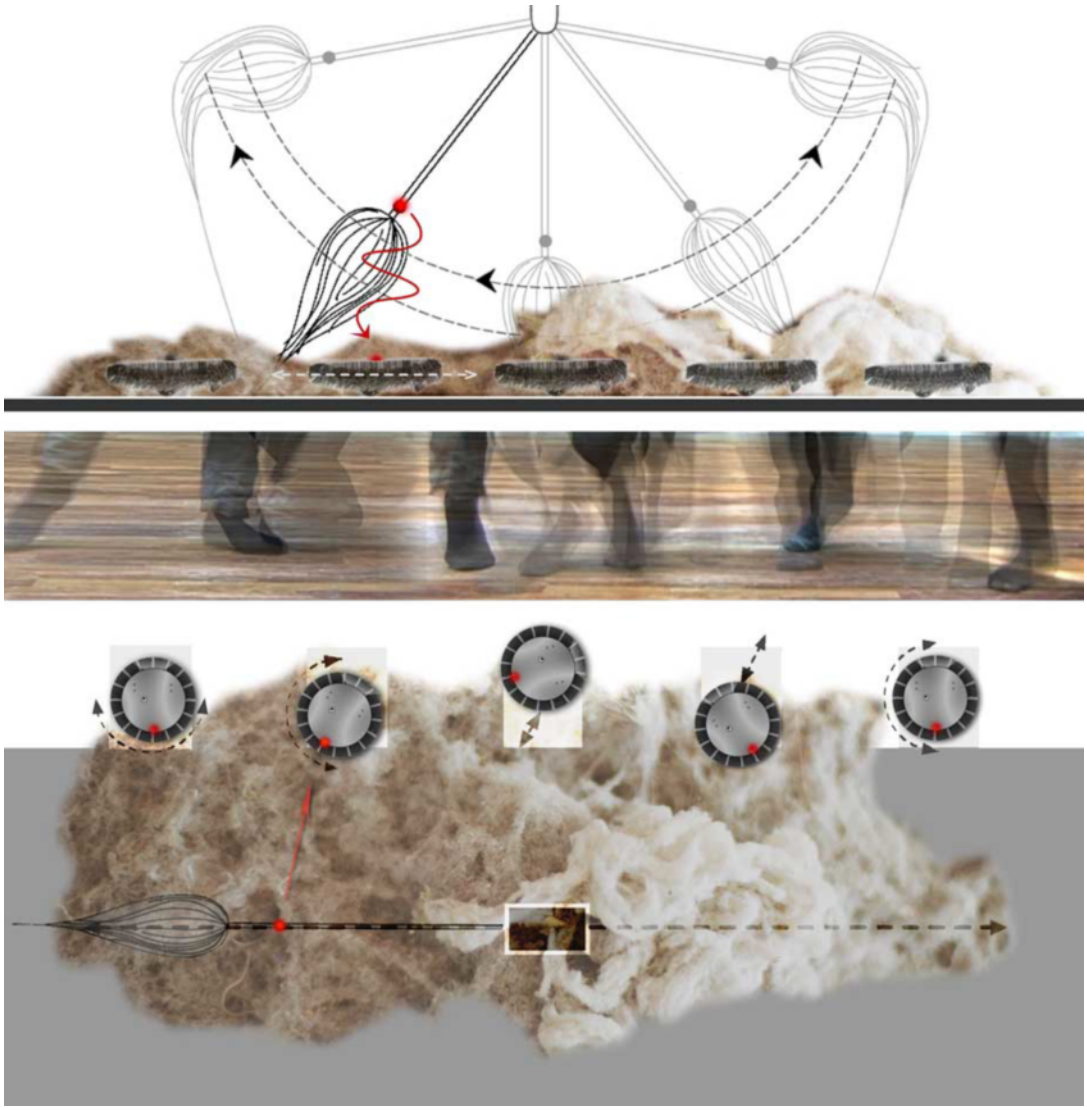

Fig. 3.3: A collage of photo, performance and technical schema, showing the elements of ON TRACK and their relations. It combines a section of the installation, a layered video extract, and the floor plan. © *in serial*.

Performing Parts

The performative mechanic-robotic installation ON TRACK involves, as already described, three parts and systems: a pendulous system comprised of a mechanical mop (a mechanical system), a pack of agitated robotic brushes (a robotic system) and a collection of vicious fluids (an organic system). Tasks and procedures are distributed between these systems and their different informational and material capacities,. However, the connections and linkages between them are neither networked, coded, hardwired or threaded mechanically, as in the case of ANI_MATE, but emerge through how the systems perform and how they establish distinct movement patterns and rhythms. The system's individual and largely autonomous performances nevertheless lead to incidental and emergent cooperation, which in turn causes them to change and transform. The *Zerreißprobe* that threatened ANI_MATE's construction and acted upon its tensile fabric as the productive force and vital procedure animating the image becomes in ON TRACK the procedure that tears the machine apart. The *Zerreißprobe* leaves the parts to perform and act independently while still belonging to one compositional embrace. ON TRACK thus is a performance of parts, which are listed below:

Pendulous System – the mechanical mop: A slowly swinging pendulum is attached to the ceiling of the installation space and moved by a powerful motor.[199] The pendulous system is a four meter long stick that ends in a voluptuous, long-stringed mop that gently sweeps over the floor, moving high into the air before swinging back. With mechanically clockwork precision, it produces an even flow of motion and provides the periodic cycle against which all other movements and parts of the installation are measured. It is a uniform, repetitious system and perfectly predictable in terms of its movement path and precision of timing. The pendulous system and mechanical mop symbolizes order, domination of control, measured time and an effective deployment of power that aids progress both metaphorically (as encapsulated in the narrative of the *Sorcerer's Apprentice*) and materially through calling upon an automated and mechanical worldview populated by its machines.

Yet, watching the performance of the system it soon becomes apparent that the mop fails to function as a cleaning instrument. It only increases the problem by sweeping into and further distributing the mess. The mop drips from its wet threads and transports its sticky load (the fluids,

[199] For ON TRACK, a motor unit (230VAC / 50Hz / 400W) was custom built. The motor's steering system allowed for an adjustable speed of broom motion (0,75 to 2,25 rpm), but did not facilitate dynamic movement modulation. Four adjustable infrared sensors determined the angle of motion, thus made the installation fit into different installation environments.

pigments, and sand) along its predetermined sweeping path. The reach of the mop is limited. Its movements are confined and delineated by the fixed position of its centre point of swing.

Robotic Brushes: Four robotic brushes are installed opposite to the mop. These disguised household cleaners[200] are enthroned on tiny unstable and elevated platforms (40cm x 60cm) that float above large industrial buckets filled with fluids. At the verge of abyss, these robotic brushes perform hectic, agitated movements that are confined as much as defined by their restricted territory. Their elevated positions prevent them from actually reaching the mess. Instead, they are banished above to execute a futile and endangered performance. Called in by the mop as an ally, the robotic (and more current, advanced technology) fails as well. Hindered by a spatial scenario of distance and elevation, the robotic brushes are prevented from doing what they are designed to do.

The movement vocabulary of the robots shows a different intention. The basic choreographic instruction for their performance was inspired by classical dance repertoire and the "*danse des petits cygnes*,"[201] a well-known and iconographic dance of Tchaikovsky's *Swan Lake.* The Dance of the Little Swans is choreography for four dancers, who perform with arms crossed and hands linked, moving across the stage in fast, repetitive, and synchronized steps. The challenge of this short dance lies in the performance of synchronicity. When one dancer errs and moves out of sync the whole row falls out of unison. Each dancer's movements are continuously measured against those of the collective. Differences between the dancers' individual movement articulation are apparent immediately. However, it is precisely these subtle imperfections and irregularities that allows recognition of each individual dancer and attracts the delight of the viewer. These irregularities distinguish human motion (and life) from mechanical machine movement (i.e. the repetitious movement of automatons and mechanical toys), or the arithmetically programmed routines that regulate the animation of software bodies (i.e. the digital characters of virtual worlds). Programming robot movement to follow the structure of the dance of the Little Swans was inspired by the steady tempo and energy of the dance, its fairly simple and recognizable movement logic and repetition of steps and, most importantly, by the dance's capacity to

[200] The installation used the *iRobot Create*, a research robot kit explicitly designed for robotics development. The model is based on the *Roomba* platform and looks like a domestic household robot. In place of the vacuum unit, it houses a cargo bay equipped with the electronic interface of the robot, the "command module." This module includes a MINI-DIN, and 25 pin connector for connecting hardware and electronics to the robot. The software interface reads the robot's sensors and allows the manipulation of its movements (behaviors) by way of a microcontroller that is onboard the command module. The robot is programmable in "C". The *iRobot Create* is an inexpensive commercial robot base and the obvious advantage of hacking such a prefabricated piece of technology is that the hardware is reliable and one does not need to build a robot from scratch. Another advantage of using an existing base is that there is a community of other artists and developers working with them and sharing code and expert knowledge.

[201] Translated from French: "Dance of the Little Swans."

incorporate imperfection and irregularity as a conceptual as well as actual element of its collective and synchronized performance. The choreography was analyzed, broken down and transferred onto the robots, and reinterpreted to suit their fairly restricted movement capacities. The timing and rhythm of the robot choreography was kept as close as possible to the original quartet. In the end, the robot's movement instructions consisted of precisely timed repetitive spins, twists, angled forward moves and pauses. When set in simultaneous motion, the pack of four robotic brushes move in perfect sync, while listening to their own, internal clock.[202] The injection of slippage, irregularities and imperfection into the robot's material mechanics was not achieved through programming and internal code, but by an external environmental pressure. The perfectly synchronized robots, placed in the installation context and within relation to the other parts and elements of the composition, started to slip and loose their synchronicity. This deliberate process of de-synchronization was made possible by two intertwined procedures: first a restriction procedure facilitated by the liminal borders of the robots' territory (their elevated platforms); and second an interrupt procedure commanded by the mechanized mop. This generated tension produced between these external structural constrains and the robots' internal instructions.

Restriction Procedure: When the robots were placed on their elevated platforms to perform, they had to instantly adapt the choreography to the limited environment. Every time a robot approaches the edge of the platform, a full stop catches it just before it crashes.[203] Every approach halts the choreographic flow. Backing away from the threat of falling, each robot was given a certain degree of freedom and individuality with which to "decide" which way to turn and where to catch up with the choreographed assignment. Through this restriction procedure, the synchronized movements of the four robots started to alter and vex, as movement orientation and direction constantly and instantly swapped and altered.

Interrupt Procedure: The mechanized mop was equipped with an infrared communication device. When swinging, the mop broadcast a narrow signal. This was incidentally received by the robots,[204] commanding them to interrupt their dance and stutter until the signal released (and the

[202] The lack of a shared network amongst the robots focused programming efforts not only on the scripting of dance movements, but also on building a system that could keep track of the time passing.
[203] The robot base is equipped with a range of onboard sensors such as: bump sensors, wheel drop sensors, cliff sensors, wall sensor, wheel turn sensors (for measuring distance travelled), and an overcurrent sensor (for measuring when wheels get stuck). In order to "catch" the robot, the cliff sensors (an infrared light-emitting diode which beams light onto the floor and measures its reflection) proved an important tool for sensing the space beneath the robot and to let them back away from the threat of falling.
[204] The robots are standardly equipped with an omnidirectional infrared receiver (IR) receiver, that allows them to be remote controlled as well as to communicate with the charging dock. For ON TRACK, the IR receiver was hacked into in order to let them respond to the IR remote signal broadcasted by the mop.

mop passed by). Over time, the synchronicity of the robots dissolved while the order of movements remained.[205]

Both the restriction and the interrupt procedure inject movement irregularities into synchronized performance as well as incidentally hinder the robots' dance and their ability to keep moving continuously. They are programmed and commanded to stop – and go. It is this energetic interrupt that activates the third system in play. The robots, by rocking their platforms, release the fluids to leak out of the buckets and thus contribute, unknowingly, to the production of mess.

Viscous Fluids: The large industrial buckets are filled with four different viscous fluids (dispersions of latex, fish glue and water). About a hundred fifty liters of liquids are part of the installation setting. Disturbed by the rocking movements of the robots, they slowly drip out of their confining containers. This allows for the distribution, drying and re-softening, and forming of dispersed emulsion. It is their viscosity, or their specific movement potential, that allows them when shaken and actively messed up, to escape their discrete existence and to re-connect into mixed formations. However, viscosity as a material quality also resists fast flow. Viscous movement describes the degree of internal resistance towards speed of transformation. In the context of ON TRACK, the viscous fluids enabled a delay, a certain lag in time – and therewith countering notions of fluidity, instantaneous transformation, and, what Sobchack identifies as figuring dominantly in our contemporary attention: "quick-change" and "effortless shape-shifting,"[206] which, says Sobchack, "allegorize the quick-changes, fluid movements, and inhuman accelerations endemic to our daily lives."[207] Instead, viscosity let the materials follow a slow trajectory and create an unpredictable process of amalgamation and transformation. Against the pendulum's even flow of motion, cyclic precision of time, and repetitious and predictable movements; against the agitated, chaotic movements of the robots, laden with human movement

[205] The procedure of de-synchronization calls for a negotiation of the robots' re-synchronization during their performance. What surfaced through experimentation was a conceptual as well as a practical paradox. In order to remove the control, to let go things out of track, an even greater control is demanded initially (in order to differentiate between a system that loses control and a situation that is not controllable at all). The robots, not sharing a network, relied on their own internal clock for keeping track of timing. Re-synchronization of the robots, once they started, was impossible. Therefore we decided in a series of residencies *in serial* was able to carry out in Australia in autumn 2010 (*Artspace,* Sydney and *Bundanon Trust,* New South Wales), to implement a sub-network between the robots that ties them together as a pack. This network allowed them to re-synchronize and perform in unison, in order to desynchronize individually. Use was made of a multipoint wireless network (*XBee*) that was mounted into the cargo bay of the robots. This implementation is, at the moment of writing, still in process.

[206] Vivian Sobchack, ed., *Meta-Morphing: Visual transformation and the Culture of Quick-Change* (Minneapolis: University of Minnesota Press, 2000), p. xi.
Sobchack, in her analysis of the computergraphic morph as a supernatural figuration of effortless shape shifting, has drawn attention to the morph as a figure of self-consumption due to its effortless and frictionless accomplishment. The "cultural ubiquity of quick-change," according to Sobchack is visible not only in the fluidity of computer bound figural transformation but also in the larger "meta-morphic technosphere we all live in." Cf. Sobchack, *Meta-Morphing*, p. xiii.

[207] Ibid., p. xiii.

intent, the viscous fluids add a sluggish, resistant quality to the polyrhythmic group dynamics of the composition. It slows things down; one needs patience to see the mess accumulating. "Waiting for growth" as Jens Hauser stated, pointing at the "artistic preoccupation with programmed and technologically induced growth,"[208] is a core experience at the heart of what Hauser terms "wetwork,"[209] which indicates a current media art practice that shifts attention from the dominant focus on code as a data-transmitting connection towards the slow connections cultivated through bio art and tissue engineering. Hauser explains:

> Media art's emphasis on the processual implies progression on the scale of time, and movement, whatever the form, set in motion by cognitively initiated, binary logical processes, hence conceived as active. By contrast, material properties are considered passive and would fall outside the realm of interfaces. But are there not, then, points of interconnection between two entities when parameters are 'programmed' not electronically but chemically, mechanically or biologically? Emulsions and dispersions can also be understood as interfaces.[210]

In the context of ON TRACK and its performance of parts, Hauser's notion of wetwork and reference to material-biological interfaces supports the potential of a connection that is based on material viscosity and slow flow. It shifts away from the purely technical modality of interconnecting systems into something that becomes interesting as a transformative instance that is not "reducing the transformative potential of interfacing to the act of translation,"[211] but allows communication beyond the pure information paradigm.

Trans-agent communication: ON TRACK is a heterogeneous object and "ecology" which has no total awareness of its parts. There is no centralized control system in place and no digital network that transmits data to inform its parts. This object is "numb,"[212] to invoke Marshall McLuhan, in terms of global connectivity and system (self)reflexivity. It instead administers a local and situated communication structure. There are various material as well as informational connections and linkages between its parts (the members of this micro-ecology). First, the infrared interrupt signal which is broadcast by the mechanical mop and incidentally communicated to the robotic brushes, commanding them to stutter and shake. Second, the fluids leaking out of their containers,

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[208] Hauser, *Sk-interfaces,* p. 18.
[209] Ibid., p. 17.
[210] Ibid., p. 13.
[211] Ibid. p. 12.
[212] In *Understanding Media*, Canadian media theorist Marshall McLuhan describes media in general as an extension of human sensory capacity. In the age of electric technology humankind has extended a live model of the nervous system itself. The global capacity for perception allowed the senses to numb each other. McLuhan points at the numbing effect of media when suggesting a desperate autoamputation, as if the central nervous system could no longer depend on the physical organs as protection against the pressuring of information, and thus needs to isolate them. Marshall McLuhan, *Understanding Media: The Extensions of Man* (London and New York: Routledge, 2007), pp. 45-52.
McLuhan's principle of numbness put into context with ON TRACK draws attention to questions regarding which interfaces and connections can become active, beyond the "numbed" digital, networked protocols.

rocked by the agitated movements of the robots on top of the buckets. Third, the fluids that slowly distribute and spread by means of their viscous, resistant flow. Fourth, the mop that distributes and mixes what crosses its pendulous path. Points of interconnection between the parts and elements thus were choreographed and programmed electronically, as well as mechanically and organic-materially. In the exchange of movements, rhythms, and materials, the systems themselves transform and change. The robots deviate and stutter and lose their initial synchronization. The fluids mix and form puddles and crusts. The mop distributes and transports and gets sticky and smelly. These transformations are nested: movement comes about through movement. The swing of the mop causes the robots to halt, which in turn activates the fluids to leak and thus be mixed up by the broom. Within these interdependent processes, the parts and elements take agency. They cooperate. They act upon each other and transform themselves – though these actions happen unintentionally and unknowingly. With ON TRACK, trans-agent communication is made tangible between the domains of action and interaction, under exclusion of a (digital) network.

Excluded Agency: Human involvement, audience participation, and user interaction was deliberately abandoned from the set of ON TRACK's relationalities and linked performing systems. Human agential power does not play a part in its compositional dynamics. The process of self-transformation that the assemblage of systems enacts through procedures of trans-agent communication and nested performative scripts instead aims to engage the viewer to consider causation in more diversified terms and allow him/her to recognize that phenomena can be described through a plentitude of intertwined processes and forces. In terms of considering anew the capacities for agency beyond the common sense that agents are exclusively humans, possessing the intentionality to make autonomous decisions and, consequently owing the right to rule and master their environments, the installation invites acknowledgment of the domain of unintentional and unwilling effects to play an active, yet indeterminate role in shaping our surroundings and environments.

The audience of ON TRACK thus does not interact with or influence the actions, but remains an outside witness to a situation where robotic machines, mechanical systems and viscous materials are (unwillingly) and autonomously effecting a mess. The parts of the installation respond exclusively to each others movements, forces, and commands and their combined performance is neither exactly predictable nor pre-programmable or cue-able by human commands or movements. In this ON TRACK appears to differ from other performance groups that put the literal machine centre stage, such as the historic accounts of stage machinery, the "machina" of

the deux ex machine, the vast experiments in contemporary hybrid human-machine performance, or the popular events and staged battles between radio-controlled robots that provide a display for hobbyists and research robots alike.

Robotic performances in particular tend to battle with the tensions emerging from human efforts to create and control machines, with the machine performance of obligatory work or servitude and their capacity to successfully interact with humans. The robotic art performance project *Grace State Machines: Flesh Bodies* (2007) by Canadian robotic artist Bill Vorn and his collaborators Emma Howes and Jonathan Villeneuve is an example of a performance-based work that juxtaposes human and robotic movement intent. It consists of two robots that respond to the movements of one live performer to whom they are connected through a high-end motion capture system. The performance evolves through different states of relationships between the interconnected "actors." At first, the live performer and dancer Emma Howes appears to command the robots. When she moves slowly, the massive robotic contraptions respond accordingly, expanding and arching its flexible structure. Vorn explains this relationship in terms of symbiosis between humans and machines:

> Through this project, we want to explore the close relationship between the real physical human body and machine body. [...] By monitoring the human body movements and internal states and transposing this information to the robot body, we aim to establish a dynamic and symbiotic relationship between the actors. Both eventually blend into a single organism, where flesh, bones, wires and tubes become a whole individual body. [213]

Over the course of the performance, faulty communication and apparently unintentional machine breakdown transforms the dynamic of guided and controlled machine performance into a fragile relationship. The robots' promise of infallible cooperation and capacity to symbiotically respond to human power seems to be disrupted, or at least questioned, through the breakdown of the command line.

ON TRACK similarly draws attention to humanity's disastrous desires (and failure) to control machines, encapsulated in the story of the *Sorcerer's Apprentice*. However, ON TRACK's machinery never promised cooperation with human interests. The machines only respond to and care about themselves. Even the robotic systems, the brushes, are solely concerned with their action to move and shake the buckets and with their solipsistic struggle of overcoming their spatial handicap of the tiny and unstable tables. They do not care about humans and they do not

[213] Bill Vorn's robotic artwork is documented at his website: http://billvorn.concordia.ca/menuall.html [last accessed October, 2, 2011].

allow the (human) audience to interfere with them. So, while the installation environment of ON TRACK disengages from human control systems and human involvement and leaves the audience of this mechanic-robotic performance to watch the course of the endeavor from the outside, the familiarity of artefacts such as the broom, coupled with recognized behaviours of cleaning, or trying to solve a problem re-introduces humanity's desire into the performance – without allowing them any tangible expression. Vital processes such as communication and transformation are handed over to machines and material systems.

The following section will discuss one of the transformative actions of ON TRACK's performance: the mixed and messed viscous fluids.

Fig, 3.4: Viscous fluid (pigmented fish glue).
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Fig. 3.5: Robotic brush with infrared sensor.
© *in serial*.

Fig.3.6: Mechanical mop with infrared sensor sweeping into the mess.
© *in serial*.

Fig. 3.7: Robotic brushes on top of elevated platform.
© *in serial*.

Irreversible Mixtures

When set in motion, ON TRACK's systems work though a series of mechanical, informational, and material rhythms, movements and contingent processes which cause the irreversible mixture and *mélange* of the four fluids. Over an installation runtime of months, these liquids disperse, coagulate, form dried crusts, dilute again and turn into a sticky brownish amalgamate. As diluted materials – a mix – they form continuously changing landscapes of crusting, sludge and smudges that are informed and animated by the systems' internal movement instructions and their informational (an infrared signal) as well as material linkages (the mixing movements of the broom, the leaking fluids, the shaking buckets). The interaction between movements, information and materials result, to paraphrase Spuybroek, in a geometry that is based on complex material behavior,[214] in this case based on the materials' viscous capacity to mix and form crusted variations. The liquids have "a certain flexibility, a certain amount of freedom to act,"[215] though their freedom is limited by the particular ecology of the machine itself, which "releases" the fluids in interaction with the robot's agitations and "mixes" them in co-operation with the mops' swing. These various mixed-material landscapes are, as noted earlier with regard to Paine, "portraits" of the work's own transformative power and mixing potential. I also suggest that they belong to the same class of topological surfaces as the continuously deformed elastic fabric of ANI_MATE. Both are surfaces that store process information within the slopes of their material, whether it is the inflected tensile membrane or the mixed-material landscape.

Greg Lynn suggests in *Animate Form* when arguing from an architectural digital design practice that topological entities are "capable of systematically incorporating time and motion into their shape as inflection"[216] and that topological surfaces "behave as landscapes in that the slopes that are generated store energy in the form of oriented rather than neutral surfaces."[217] Orientated energy is understood by Lynn as a vector force that informs the surface. This energy, mode, or motivation through which the topological surfaces are informed and animated, differ distinctively in the two projects. ANI_MATE, as discussed earlier, sets out to stress and release the screen's membrane through a palindromic process set in motion by a continuous oscillating flow of distortive physical movement. The orientating movement vector points into depth and pulls the figure into three-dimensionality. Reversibility, therefore, becomes the vital, indispensible requirement of keeping the image in movement and the illusion alive. ON TRACK instead sets

[214] Spuybroek, *NOX,* p. 352.
[215] Ibid.
[216] Lynn, *Animate Form*, p. 23.
[217] Ibid., p. 30.

out to mix its materials through a dispersive and largely indeterminable process that cannot be undone nor precisely repeated. Such a process is irreversible. Irreversibility is a signature of the organic, of natural processes and of what is intrinsically descriptive in the individual qualities of the chosen materials (fish glue, latex, water). Exposing irreversibly mixed landscapes as a consequence of the concerted efforts of the machine calls for an accounting of the actions in terms of waste and loss. It affiliates the realization that actions (our human endeavors) have consequences that cause irreversible impacts on the world we live in, effects that cannot be undone, and that may last a very long time.

ON TRACK stages a real experiment[218] and live scenario conducted to produce a unique and irreversible outcome through a series of only partially predictable interferences between movements and systems. These efforts and effects invite a comparative reading with the logic of an ecological dimension:

> Materials, whether produced naturally or artificially, distribute themselves worldwide more or less involuntarily. In our everyday life, complex logistical systems take over the distribution, unfortunately also of their permanent loss situation. Oil is in the sea, medicines in the drinking water, stones in the kidneys, nuclear residues threaten our everyday life. A process of distribution that once started has acquired its own catastrophic momentum.[219]

This brief statement, a catalogue excerpt from ON TRACK's exhibition in the Biennale Cuvée 10 at OK Center for Contemporary Art in Linz (2010), envisions the consequences of faultily mixed up materials. An ecology that is defined by the irreversibility of its own process tends, in the perspective of ON TRACK, to evolve through accumulation. Processes fold upon processes. One flawed process can only be corrected by another (potentially flawed) process. If the broom cannot clean the mess, the robots are called in to solve the problem. In their attempt to act (and clean) they only hinder and interrupt each other. Fuller, in his analysis of media ecologies has drawn attention to the "ontogenetic, reality-forming nature of media"[220] and to the potential that explodes in the collision of media systems. In this light ON TRACK can be said to accumulate an urgency that is enacted through its multiple materials, materials through which it is "continuous with those of the world"[221] – a description used by Mertins to summarize Spuybroek's engagements with form-taking processes and material agency.

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[218] I recall the curatorial note of Martin Sturm, mentioned earlier in the context of my analysis of ANI_MATE. Sturm describes ON TRACK's performance as "not just a sculptural arrangement but also a (quite) real experimental attempt".
[219] *in serial*, „On Track 2009," in *Biennale Cuvee 2010,* ed Fischer-Schreiber, I., Unterberger-Probst, C., Rückert, G. (Linz: Ok offenes Kulturhaus, 2010), p. 16.
[220] Fuller, *Media Ecologies,* p. 2.
[221] Mertins's, "Foreword," in Spuybroek, *The Architecture of Continuity,* p. 11.

Indeed, what is oil doing in the sea? A recent ecological disaster of global dimensions that went entirely out of control is the oil spill whose consequences are still unfolding in the Gulf of Mexico off Florida's coast: Deepwater Horizon's off-shore oil rig explosion in April 2010. Shortly after the explosion crude oil devastated the Gulf of Mexico and spread into the Atlantic Ocean, traveling up the coast. The oil coated the Gulf of Mexico in reddish brown streaks, threatening the whole region with an ecological and economic crisis. Weeks after the catastrophe satellite images of the spreading oil slick were broadcast daily on the news. The constantly changing formations of oil could be closely followed by everybody "live" from behind the television monitor. The aerial images of the spreading disaster, the streaks and smudges, were both bizarrely attractive and of truly gigantic dimensions.

Austrian artist duo UBERMORGEN.COM (Lizvlx and Hans Bernhard) immediately responded to the media hype and documentation of the disaster. A couple of days after the gas explosion, in May 2010, they released a fictitious press note titled: "Painting: the supreme discipline of art. The oil slick, the size of Puerto Rico, is beginning to paint coastlines."[222] In bitter provocation they state:

> Finally oil painting has evolved into generative bio-art, a dynamic process the world audience can watch live via mass media. Never before has this art form been as relevant and visible as today - only 9-11 was nearly as perfect, but in the genre of performance art. An oil painting on a 80.000 square miles ocean canvas with 32 million liters of oil – a unique piece of art.[223]

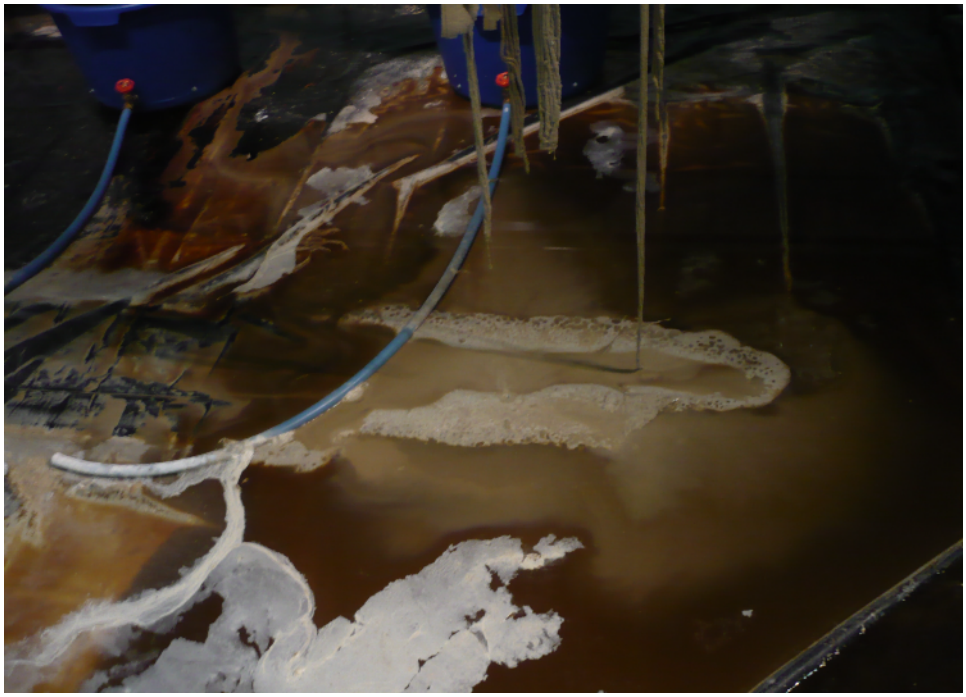
The statement was accompanied by a series of digital oil paintings called DEEPHORIZON which the duo sampled from the publicly available satellite images of the oil spill (aerial photos from NASA). They refer to these images as "ready-mades." The artists generated these paintings by use of imaging processes that cause the aerial photos to transform and liquidize.[224] UBERMORGEN.COM takes a radical standpoint on socio-political events by linking natural disaster to paintings in oil – a deliberate, artistic exploitation of human-caused disaster. It is a provocative process of appropriation which in turn shows how processes entail processes, and how one process is reflective of the other. DEEPHORIZON propose to be real-life oil paintings that are made possible through a real-life oil catastrophe.

[222] UBERMORGEN.COM, "DEEPHORIZON." Available at: http://ubermorgen.com/DEEPHORIZON/statement.html [last accessed August 25, 2010].
[223] Ibid.
[224] These digital paintings are published online at: http://ubermorgen.com/DEEPHORIZON/ [last accessed August 25, 2010].

In response to the real-life gigantic oil catastrophe efforts were made to "correct" the disaster, with the goal of making the problem disappear. British Petroleum (BP), the organization responsible for the disaster, attempted to literally "dissolve" oil. In an effort to correct a flawed system by another (potentially also flawed) system, BP sprayed oil dispersant, the chemical *Corexit*, onto the oil carpet, and has injected the dispersants directly at the underwater leak site. Chemical dispersants accelerate the dispersal process, although scientists have warned that they may have significant side effects.[225] The reason for inducing dispersants was to prevent the oil from clustering and rising to the surface, thus reducing the visible impact of the catastrophe: i.e. the all too well-known images of oil-contaminated beaches and dying birds. The disaster continued – invisibly. What remains is the fact that the unprecedented use of chemical dispersants applied underwater is a gigantic chemical experiment conducted in the largely unexplored deep-sea ecosystem.

Conceptually spoken, this gigantic chemical experiment, conducted to dissolve the fatal remains of a situation that went out of control, is just one example of our humanly conducted, overly complicated procedures, put in place to solve a problem by applying a process that only creates another problem. These potentially endlessly accumulative processes of production and control and their tendencies to deteriorate are what ON TRACK seeks to perform and for which it engages, in micro format, an ecology of parts which resist to inform each other. Instead, they thrive on a compositional dynamic of irresponsibility, hindrances, and interferences that lead to the accumulation of a mess.

[225] Scientists warn of the effects of using these dispersants. Much diverse information published on this subject. A core argument is that "dispersants have never been used in an oil leak of this size a mile under the ocean, and their effects at such depth are largely unknown." Article by Justin Gillis published in the online version of *The New York Times*, May 15, 2010. Available at: http://www.nytimes.com/2010/05/16/us/16oil.html?_r=1 [last accessed August 25, 2010]. A version of this article appeared in print on May 16, 2010, on page A1 of the New York edition.



Fig, 3.8: A sludgy mess. ON TRACK at Thessaloniki Biennale. May 2009
© *in serial*.

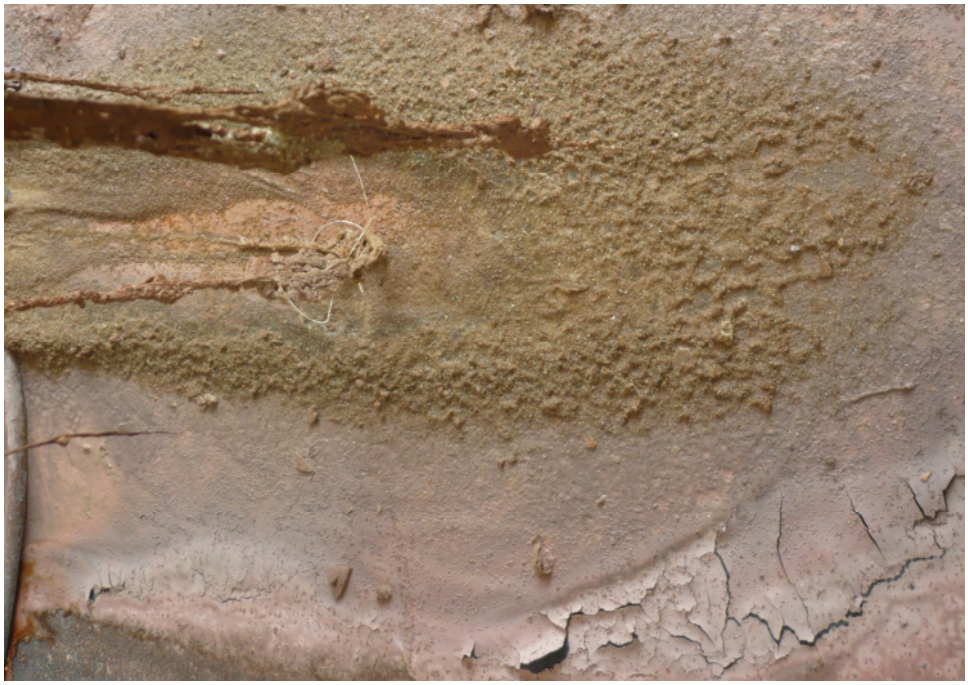


Fig.3.9: Dried crusts. ON TRACK at Rondostucki Gallery in Katowice, Poland, October 2009.
© *in serial*.

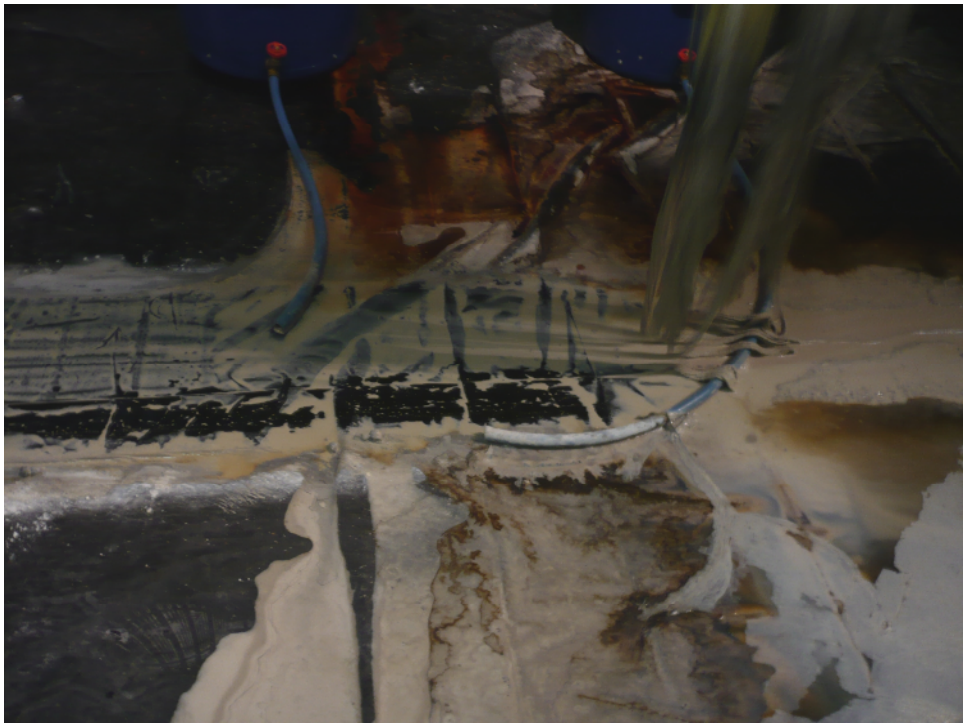


Fig.3.10: Leaking fluids. ON TRACK at Thessaloniki Biennale. May 2009.
© *in serial*.

Fig, 3.11: Material formations. ON TRACK at Biennale Cuvée 10, Linz, Austria, May 2010.
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Diversities and Tendencies of Collaboration

ON TRACK was developed and produced in 2009 through an interdisciplinary, international collaboration between four artists working respectively in the fields of architecture and design, dance and technology, film, interactive installation and arts computing, and performance. Collectively called *in serial*, the group formed in 2009 in the context of the European project *e-MobiLArt* (European Mobile Lab for Interactive Media Artists), a project tailored around the process of creating collaborative interactive installation artworks using multi-modal interfaces, ubiquitous computing, and mobile media technologies. The framework consisted of three workshops across Europe (in Greece 2008, Finland 2008 and Austria 2009), exhibitions and a symposium.[226] The three workshops and the project as a whole had at its core experimental processes of new media art and interdisciplinary collaboration. ON TRACK was presented in May 2009 at the Thessaloniki Biennale, Thessaloniki State Museum of Contemporary Art in Greece, in October 2009 at Rondostucki Gallery, Katowice in Poland and in March 2010 at „Biennale Cuvée 10," OK Center for Contemporary Art, Linz in Austria.

Within the particular context of the *e-MobiLArt* project, the conception and realization of ON TRACK moved through an alternating work pattern. Intensive shared work situations were followed by times when the team members worked separately at several locations (Sydney, Vienna and Amsterdam). During these times, the Internet served as a communication platform distances were bridged through online communication services and (Skype, Wiki). The work thus evolved through motions and rhythms that can be described as opposing energies: parted and linked. After the concept development and probing of initial ideas at the workshops in Greece and Finland, the work was broken down into the different parts and elements. Over the course of a six-month design process, know-how, ideas and actual work fragments were sent around the globe to be refined, modified and messed-up at a conceptual as well as practical level. Ideas and designs kept on circulating till they hardened into a set of physical parts, coded movement instructions, and actual materials. During the third workshop in Vienna the team brought all elements of the installation together. In February 2009, the prototype was assembled and tested at scale 1:1 and considerably modified. The working prototype was manufactured to be exhibited a couple of months later at the Thessaloniki Biennale.

[226] *E-MobiLArt* Symposium Thessaloniki, May 2009, focusing on the programmatic theme of shared production ("Collaborative art/science practice: Processes, Structures and Methodologies").

Fig.3.12: Prototyping of ON TRACK, in Vienna, February 2009. (a) First test with household robots (*iRobot Create)* (b) Rob Saunders programs the choreography of the robots (c) Four robots move and "dance" in sync (d) Petra Gemeinboek and Linda Dement manually test the swing of the mop with a rope contraption (e) Fluids are distributed by the mop (f) The robots, placed on pedestals, are cued by the infrared signal attached to the passing mop (g) Mock-up detail of the infrared signaler. © *in serial*.

The evolution of the work thus described a path – in serial – and concerned itself with process rather than finality. It exemplifies what Broekmann terms the "principle of the machinic" which is "not so much directed at particular results, but describes an attitude which is aimed of the creation of open, operative zones, at preparations towards the facilitation of a process during which temporary events and experiences can take place."[227] It refers to the machines of the Surrealists and the making of collective collages, the "cadavre exquis" (exquisite corpse) and a passing on of materials (words and images) from one player to the next, to a process that is associated with the dynamics of action and play as well as with the translations and transformations that occur.

Within in the field of media art, ON TRACK combines a rather unusual mix of concepts, practices and knowledge. It collages digital and analog media and makes use of seemingly contrasting and conflicting materials (e.g. the coalescence of fluids and electronics). I suggest to also looking at the outcome by considering the collaborative process it was produced by. Calling on this particular collaboration, as well as reflecting on my prior experience with similar working situations, I see a criteria for cross-disciplinary collaboration and process-orientated art work providing of each of the team members the ability to both enter unfamiliar terrain as well as to persist inside his or her own disciplinary knowledge, practical experience, and individual ways of engaging and doing. What at first seems a conflict is, I argue, in fact a question of how linkages are established between disciplinary knowledge, artistic domains, and individual practice. Handing over know-how, inserting individual work fragments into the fabric of the work, as well as productively interfering with and messing-up ideas (i.e. to initiate, amplify or divert them) are all strategies that create an energetic density and a result that is as much pre-programmed, and to a degree fixated as it is emergent and to a degree unpredictable. Broekmann, testifying to artistic work that engages with the "machinic," has similarly noted that results are characterized by patterns or tendencies: "The outcome of these machinic processes is characterised by a high degree of unpredictability, although they are seldom random. The heterogenic logic of the machinic creates unpredictable, yet organised results.[228]

In other words, the aim of the artist collaboration is to establish, through the particular working process engaged, a dynamic and vibrant milieu of divergent tendencies, patterns and forces that produce a "heterogenic logic." This allows a reading of the work through the diversity of its parts. Thus the notion of dynamic milieu not only alludes to the artwork – ON TRACK – but also to the collaboration *in serial*.

[227] Broekmann, "Remove the Controls."
[228] Ibid.

A consequence to this approach is that individual contributions to the artwork are difficult to distinguish or segregate: even more so in retrospect than at the time of creation. "Locating accountability in collaborative work,"[229] in the words of theorist Ann Galloway, can be challenging because of the messiness of all the connections made during the process:

> In other words, with each new creation or collaboration we arrange and re-arrange different risks and responsibilities. The resulting assemblages can be so messy that it can be difficult to figure out how one is accountable to, and for, these arrangements. These scenarios are further complicated by what gets washed off, or thrown away, in the process. This is important because whether by deletion, erasure or purification, processes of differentiation and convergence become difficult to identify.[230]

ON TRACK's materials get messed up through an irreversible process, causing results that are largely indeterminable and that cannot be made undone, as are the mix and conglomeration of different skill-sets and individual contributions set in motion through the process of making. Instead of pointing at individual contributions or at disciplinary accounts, I prefer to talk about the competencies that were individually brought to the collaboration, and the respective capacities that informed the process of the work throughout. I have given accounts throughout the chapter of my own competencies stemming from my choreographic experience, architectural design practice, and knowledge of interactive media systems. This expertise allowed me to tendentially impact and influence (though obviously never control) the development of the material, performative, and spatial scenario of ON TRACK and the movement behavior of the divergent parts the machine is composed of.

At this point of my research, I feel that these engagements have led to a more in-depth understanding regarding how relationships between systems and movement can be conceptualized and materially actualized. My long-standing expertise in experimental material practice initiated a particular curiosity regarding how, within *in serial,* "leaking" connections between fields of knowledge, individual ways of doing, and social conduct can be initiated and productively incorporated such that the work is getting done collaboratively. Leaks, in this sense, allow each approach and individual contribution to be for itself to begin with, in order to slowly transform and get "messed up" during the shared working process. This allows each person to actively

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[229] Anne Galloway, "Seams and Scars, Or How to Locate Accountability in Collaborative Work," in *Uncommon Ground*, ed. Cathy Brickwood, Bronac Ferran, David Garcia and Tim Putnam (Amsterdam: BIS Publishers, 2007), pp. 152-58.
[230] Galloway, "Seams and Scars," p. 3.

participate and be accountable, as well as witnessing and thereby take into account developments that might appear irrelevant or contrary to professional or individual interests. This approach, as the working process of ON TRACK has shown, is a serious challenge, as ideas must be materialized and interventions made before their full potential can be understood and acted upon or rejected.

Engaging in the process of making ON TRACK as well as in the collaboration within *in serial*, I began to understand, on a more fundamental level than before, how artworks themselves can reflect tangible and heterogeneous processes. Through this research I engaged with a mode of artistic inquiry that seeks to allow the continuity of its materials (in this case, the interaction between material leakage and the systems' capacity to mix) as well the nature of the process (the slow amalgamation of materials) to carry through the dynamic potential of the work. Through this thesis I inquired into a concept of artistic production that comes about in the co-evolution of these dynamic potentials as well as in their artistic interpretation. It is an approach that favors neither authorial artistic intention, nor automated or autonomously acting machinic processes, but looks for the patterns and relationships between them.

Conclusion

This thesis has discussed the experimental and conceptual procedures of creating the two media art installations completed and presented during the course of this doctoral research. It has emphasized material contextuality, aiming to formulate an approach to material agency and performative dynamics in the practices of media art. The methodology comprised of interlacing artistic and discursive aspects, and the objectives of the research posited as four components that sought to a) identify a strategy of artistic inquiry that engages materials productive contingencies throughout processes of creating installations and scenarios and to b) trace and analyse how the agential capacities of materials in turn effect change and transformation within the scenarios and environment wherein they are "staged" and situated. It also aimed to c) examine the specific relations and linkages produced between the environments, movements and materials and, finally to d) provide a reading of their collective performance in terms of their exhibiting references to culture and society.

Within the current status of post-digital paradigm in-development, this research makes a contribution, in scholarship and practice, to the media art and performance genre from a heterogeneous perspective, proposing materials to take a place in the alive world as transformative and active, engaging and being engaged within the context wherein they are situated to "perform."

a) Strategy of artistic inquiry

The approach to performativity articulated through the artistic aspects of this research (referred to as "performance of materials") was to focus on questions of performance at a material level: how material forces amplify, multiply and complicate the behaviors of phenomena, how they transform, flux and "do" things, and how they interact with their environments, the processual structures and machine actions (and including in ANI_MATE, human interferences). This artistic strategy was derived by adopting elements of Lars Spuybroek's architectural design method and theory of "machining,"[231] providing an analysis of the stepwise design procedures involved. The analysis particularly focused on his experimental method of steering the design and materialization process of physical structures by use of direct material systems ("Material Machines"). This method describes a practice of making that uses the emergent behaviour of materials in the design process, and conceptualizes them as relational and active. A relevant

[231] Spuybroek, *NOX,* p.4.

marker of transfer between this method and artistic practices concerned with emergent materialization processes is, as I argue, the importance of initial selection criteria: each "machine" embodies a different potentiality for a particular outcome. They hold the capacity for a tendential (design) development that allows one to set a goal for a yet undetermined action. However, the precondition for holding such capacity is that materials, as Spuybroek insists, "have a certain flexibility, a certain amount of freedom to act" that is nevertheless "limited to a certain degree by the structure of the machine itself."[232] Therefore, choice matters, and must be based on knowledge of materials and expertise in how to couple materials with systems in particular ways in order to control to a degree the projects proliferation in a desired direction without predetermining the result.

In other words and describing my own experience when interacting with materials in ways that allowed them, as Barad says, to perform their "agential intra-action:"[233] I observed that the materials engaged me in a process of creation which required an understanding of their physical demands and to acknowledge their capacity to "act up." That is the structural coherence of ANI_MATE's fabric and its material strength and resistance demanded different operative strategies and called upon other associations than the viscous consistency of the fluids used in ON TRACK. The fabric thus directly affected the conceptual artistic strategies of how to process gestural information into the structure of the screen, and influenced my choice regarding the operational system (the "pull-machine") and applied technology (the pneumatic system). By responding to the limited, yet specific capacities of a given material, such as the degree to which it enabled and/or resisted transformation, my own human sense of agency was put to the test. The paradox is that these inanimate materials are animate; they demand particular performative gestures, actions, and engagements and they invoke specific urgencies. I had to acknowledge and understand these responses (through expansive experimentation) when creating these works. Performing materials meant cooperating with them.

b) *Staging materials*

The outcome, both in terms of the actual projects and the realizations arrived at through conceptualizing the works, as well as through analysis of related artistic work in the field, is that the various materials, their conditions, trajectories, and tendencies, became integral to the actions staged. They become central "characters" in their plays, with specific roles and clear demands.

[232] Spuybroek, *NOX,* p. 352.
[233] Barad, Posthumanist Performativity, p. 814.

Their live performance, the things they can do and what they can affect and effect, is what makes their materiality something to be experienced and negotiated, and tangible to spectators. They invite the onlooker to be patient when watching changes and transformation happening over a period of time: the viscous but inevitable amalgamation of fluids (ON TRACK's "irreversible mixtures"), or ANI_MATE's fluctuating transformation of digital images in slow, as well as "effortful" motion ("transient transformation"), or the nearly imperceptible advancing of two cars towards collision (the slow metal folding and crumpling of Schipper's sculpture), or the time-consuming process of polyethylene hardening (Paine's "material portraits"). These materials take their required time to perform the in-between, a movement that successively comes about through movement. Their performances are those actions that move each material towards being mixed, animated, destroyed, hardened. Their performance proposes an understanding of material transformation as a relational process, and as a performative action occurring in lived time and placed in actual presence. These transformations, I suggest, are processes whereby materials are enacted into being; they come into being, as media and social theoretician Gay Hawkins suggests, as that which "is *made present* in particular relations."[234] My interest in the realities of materials, how they are enacted and made present is in *how* the modes of material correspondence and linkages, or more precisely, "transformative instances"[235] to use Hausers' term, are established within those compositions. It is important to note that these instances were quite different for ANI_MATE than for ON TRACK which are elaborated on in the following section.

c) Relations and Linkages

ANI_MATE engages pre-rehearsed performative connections between me, the human performer, and a collection of archived images, live and processed sounds, and machine parts. The linkages between images, sounds and movements are networked, coded, and mechanically threaded. The materials' behavior is not emergent, nor interactive, but structurally coupled with the machine's action – and thus with my performative, operational interventions. ANI_MATE sets out to move its most fragile and flexible part, the elastic membrane, through a palindromic, reversible process caused by a continuous oscillating flow of distortive physical movement forces. Fluctuating reversibility is the vital mode ANI_MATE's performance thrives upon.

ON TRACK is an installation that is neither interactive in the sense that it involves audiences, nor does it involve human performers. Yet situatedness, the embodiment of agency, and inter-agent

[234] Gay Hawkins, "More-than-Human Politics: The Case of Plastic Bags," *Australian Humanities Review*, Issue 46 (2009). Available at: http://www.australianhumanitiesreview.org/archive/Issue-May-2009/hawkins.htm [last accessed March 18, 2011].
[235] Hauser, ed., *Sk-interface,* p. 12.

communication are at the heart of the work. In opposition to ANI_MATE, whose performance evolves through structurally improvised, yet pre-rehearsed modules, ON TRACK explores more unpredictable and autonomous scripts. ON TRACK can be called a performance of parts within which agency emerges from an interplay between their distinct movement rhythms and material forces. Their performance leads to incidental and emergent cooperation between them, which in turn causes the individual parts to change and transform. Concrete physical realities, the mixed and spilled resources, comment on cultural and ecological notions in terms of the accumulative processes of production and control, and their tendencies to deteriorate.

d) *Material contextuality*

The extended analyses of the two installations presented in this thesis have conceptualized them in terms of "a Performance of Materials" (ANI_MATE) and "a Materials Ecology" (ON TRACK). They have contextualized materials, drawing attention to how, in both projects, materials and their potentials (e.g. their resistance, their viscosity and elasticity) are incorporated into the work in actual and metonymic ways. They specifically have drawn attention to materials as limited resources, performed at their limits: to their exhaustion (ANI_MATE's "Zerreißprobe") and consumption (ON TRACK's "lost" and diluted materials). The analysis has shown how the unintended, respectively accidental effects of such contextualized materials foster an understanding of their agential capacities and in that sense "lively" materiality. The political or ecological projection that lies behind the performative insistence on the recognition of the agential powers of materials (whether natural and artifactual), is the hope for stimulating an awareness of the connections both within and beyond their material domain, in order to foster a more careful approach to human intervention in any ecology. Such a project, expressed as artwork, brings together human performance (or human movement intent), machine action, and material activity, and stages their connections and interventions. Neither anti-human nor post-human, these performances struggle with the messy domain of material agency, challenging at times the common understanding of anthropocentric subjects and subjectivities of performance.

Through this doctoral research, I have arrived at an in-depth understanding of how to engage with a process of "performing materials," exploring their coming into action, and how to exhibiting their agential powers to effect changes and to transform. This research allowed me to emphasize the productivity and resistance of materials through the conception and realization of installations and scenarios, and through the staging of causal and effecting relationships between the materials' dynamic environment and the specific material phenomena produced.

This thesis contributes to knowledge and to the genre of media art and performance practices, by introducing the concept of *material* that acts as an agential capacity, generating performative acts. It has developed and identified a mode of artistic inquiry that addresses materials' productive contingencies and contextual capacities and argues that such practice offers a new strategy for an emergent aesthetics within contemporary physical-digital performance.

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APPENDICES

Project Record and Documentation of ANI_MATE

Credits:

Marion Tränkle: Concept, machine design and fabrication, visuals and performance

Jim Ruxton: Concept, system design and electronics

Leon Spek: Electronic Sound

Nicola Unger: Dramaturgy

Nadja Raszewski: Advice

Presentations:

16-18 November 2006 at Theatre Gasthuis in Amsterdam.

Re-staging:

RESURFACE: an_imate
28-29 September 2007 at Discovery07, Festival on Art & Science, Westergasfabriek, Amsterdam.

Paper Presentation:

13th June 2007, Moves Screen Conference, Manchester Metropolitan University, UK.

Review:

T'Jonck, Pieter. "Obsceniteit, Obsessie, Obstructie." *Volume: Tijdschrift over Gasthuis en nieuwe Theatermakers*, volume 7 (2007), pp.22-23; pp. 26-33.

Cooperation, and financial Support

The project was produced by the Dutch Theatre Gasthuis in Amsterdam, and made possible by the financial support of the Amsterdams Fonds voor de Kunst and Gasthuis.

Documentation / DVD / CD

The performance of ANI_MATE, which was originally 50:00 minutes was edited to 3:30 minutes on the documentation DVD. The documentation shows the beginning and the end of the performance.

Additionally, on the documentation CD, photographs and graphics document the working process as well as the performance of ANI_MATE.

Project Record and Documentation of ON TRACK

Credits:

Concept and Realization: *in serial*
(Linda Dement, Petra Gemeinboeck, PRINZGAU/podgorschek, Marion Tränkle)

Roboticist and programmer: Rob Saunders, Engineer: Tomas Sandri.

in serial:

The collaborative and interdisciplinary group *in serial* formed during the *European Lab for interactive Media Artists*. The group members share backgrounds in architecture, choreography, dance, theatre, arts computing, sculptural installation, film and interaction design.

Exhibitions:

Thessaloniki Biennale, 20 May - 10 June 2009, Thessaloniki State Museum of Contemporary Art.

Rondostucki Gallery, Katowice, Poland, 28 Oct - 15 Nov 2009.

Biennale Cuvée 10, OK Center for Contemporary Art, Linz, Austria, March – May 2010.

Presentations:

E-MobiLArt Symposium Thessaloniki, May 2009
Collaborative art/science practice: Processes, Structures and Methodologies.

Netherlands Media Art Institute, Round Table Discussion, March 2009, Amsterdam.

The Open Room for Discourse on Digital Culture, Quartier 21, Vienna.

Catalogue Entries:

Charitos, Dimitris ed. *e-MobiLArt: European Lab for Interactive Media Artists*
(Catalogue Thessaloniki Biennale: 2). (2008), pp. 60-63.

Fischer-Schreiber, Ingrid, Unterberger-Probst, Carola, and Rückert, Genoveva (eds.). *Biennale Cuvee 2010*. Linz: Ok offenes Kulturhaus (2010), p. 16.

Cooperation, Partners and Financial Support:

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Documentation / DVD / CD

The documentation DVD contains a video excerpt of ON TRACK's installation which was edited to 2:36 minutes. The video documentation combines recordings of the project's exhibit at the Thessaloniki Biennale in Greece and at the Rondostucki Gallery in Katowice, Poland.

On the documentation CD, photographs and graphics document the working process as well as the performance of ON TRACK.