Raphael Perret
Bodycloud

MAS Scenography 2009

"THE MOST BEAUTIFUL CONNECTION BETWEEN TWO DOTS IS A CURVE."
- BRAZILIAN SAYING

SIX FRAGMENTS OF PROJECT BODYCLOUD

ZHDK
MAS SCENOGRAPHY 2009
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DIPL. ARCH. AA STEPHAN TRÜBY

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Introduction

THE TOPIC
Project Bodycloud is concerned with the materialization of human movements into a sculpture. Human movement space is defined as the space a person appropriates by means of his or her movement, a space that is constantly expanded as the person moves. I am interested in movement spaces because it reflects the personal usage of space. Despite its habitual and daily character, this process can be cultivated and developed according to a person's talent and physical ability. Along these lines, the personal appropriation and design of space starts with one's body. In order to visualize this constitution, I choose the process of materialization into a sculpture. Thereby, I will try to the render this essentially ephemeral movement space tangible.

Due to its origin and content, the aforementioned sculpture must be perceived as a piece of art that is based on a scenographical aspect. By virtue of mapping a person's movement space, a piece of time is frozen. This moment is reanimated in a different time, in a different place, when it is transformed into a physical object. This new reality, consisting of space and time, refers to the past and tells the story of a human being in motion. This story is only tangible once the beholder and the sculpture meet physically. Thus, in a sense, the present meets the past and engage in a dialogue.

MY MOTIVATION
We are used to perceive the space a human being takes; however, we are unable to follow the movements for a longer time span. By analyzing materialized moving spaces I hope to find a certain normality – provided by unmistakably human proportions – and a convulsion of the very same through the materialized spatial expansion. Due to the forms' human origin, the process of analyzing and interpreting them can be very fascinating. I assume that this process harbors an aesthetic that is made accessible through our knowledge of our bodies. Therefore the involvement between object and recipient is meant to be a visual as well as a physical encounter.

PROCEEDING AND CURRENT STATUS
The endeavor of registering and transforming spaces into physical reality is a process that dates back several years. The present text is a status report that includes introductory experiences as well as aspects of architecture and professional dance. In six fragments, I will try to approach the actual center of this paper, that is, the sculpture itself. The six vantage points open a space that uncovers the shape and characteristics of the sculpture. At a time when the realization of the project is within reach, but has not been completed yet.

STRUCTURE
First, I will give an overview over the previous working progress, including a brief outlook. The subsequent chapter – "Inspirations and Thoughts" – is concerned with the beginnings of the project, Capoeira and early personal experiments regarding film and photography. It is followed by a reflection on motion studies as well as antropomorphism in architecture and dance.

Prior Work Progress

Empty space does not exist. On the contrary, space is a superabundance of simultaneous movements. The illusion of empty space stems from the snapshot-like perception received by the mind. What the mind perceives is, however, more than an isolated detail; it is a momentary standstill of the whole universe. Such a momentary view is always a concentration on an infinitesimal phase of the great and universal flux. [1]

[1] Rudolf von Laban, Choreutics p. 3

Development

Project Bodycloud is concerned with the materialization of body movements and the resulting spaces. Among others, this opens connections to visual arts, dance and architecture. The following text fragments serve to introduce the context of the paper and try to explain the stakes as well as the background of the material used. Furthermore, the texts provide a connection to existing findings from art, architecture and other research areas. For one parameter that has certainly changed in the meantime is technology. Therefore, the means to record and process movement have altered. Especially the computing power of modern computers allows for a mode of operation that has not been possible before. An integral part of this observation, therefore, is the knowledge about the ongoing improvements that are being made in terms of production modes. In a sense, then, the thesis reflects the feasible means regarding time, money and technology. These parameters will also change in the near future, in turn changing the aesthetics of the results. At the moment, the physical realization of the project is within grasp, but not yet completed. Therefore, coherent conclusions about the aesthetics can only be drawn at a later stage. To me, the process of the thesis and the entailing experiment is much more important than technological advances. The concept of the thesis considers itself as part of a contemporary debate about space as well as its aesthetics and perception.

Thus, the overall argument moves between the conflicting fields of physical study and technology. It is important to point to the seminal breach with traditional motion studies. While traditional motion studies used to attempt to reduce human's expressiveness due to economic motifs in order to achieve minimal wastage of space, my primal goal is to promote artistic possibilities of physical expression as well as to expand the ways to experience a space. This aim is achieved by virtue of an elegant movement that defies gravity and that is materialized into a life-sized sculpture. The movements themselves bear witness to an inspiring and unusually diverse
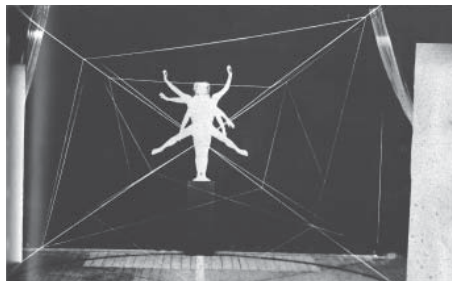
"Tanz im Raum", multiple exposure, Lux Feininger, 'Bauhausbühne' 1927. Improvised rehearsal with Christa Naef in her studio, Zurich 17.03.2009..

spectrum of physical expressiveness. When materialized to a sculpture, the beholder enters, via his body, a dialog with the spatial fossil of a movement. This encounter provides for the crucial absurdity of a movement that has materialized. It raises questions regarding perception and quality of a movement in space as well as the effect the space has on the movement.
- The sculpture itself is a piece of art and has to be analyzed as such. At the same time it has an important scenographic quality. Given that architecture is the material and scenography tells a story within three dimensional space, the sculpture holds the materialized story of a human being in motion. This narration becomes only accessible by means of a physical encounter of the viewer with the sculpture.

AIM
Generally, the aim circles around a process that has been described by Oskar Schlemmer, longstanding director of 'Bauhausbühne', in his 1926 work 'Maths of Dance': „If you imagine the room filled with a soft plastic mass in which the stages of danced sequences harden as negative forms, this example illustrates the direct relationship between the planimetry of the surface to the solid geometry of the space." However, the focus shall not be on the interaction between two- and three-dimensionality respectively – as Schlemmer suggests. Rather, I strive to capture the movements of a body in a three-dimensional space and transform the moment of movement into a life-size

sculpture. This frozen moment of time is an antagonism to the ephemeral, barely repeatable dance. It tells the viewer the story of a body in motion, and reflects its proportions and trace-forms. Besides the visualization of contoured movements, the interaction between the sculpture and the beholder is of special interest. The viewer is intended to recognize the sculpture's proportions and trace-forms by drawing on his or her own physical experiences.

Movement is, so to speak, living architecture – living in the sense of changing emplacements as well as changing cohesion. This architecture is created by human movements and is made up of pathways tracing shapes in space, and these we may call „trace-forms." A building can hold together only if its parts have definite proportions which provide certain balance in the midst of the continual vibrations and movements taking place in the material of which it is constructed. The structure of a building must endure shocks from alien sources, for instance, by the passing traffic, or by the jumping of lively inhabitants. The living architecture composed of the trace-forms of human movements has to endure other disequilibrating influences as they come from within the structure itself and not from without. The living building of trace-forms which a moving body creates is bound to certain spatial relationships. Such relationships exist between the single parts of the sequence. Without a natural order within the sequence, movement becomes unreal and dream-like. [2]

Tony Cragg, "The Fanatics" 2006
[2] Rudolf von Laban, Choreutics p.5

3D Scan of Milton.
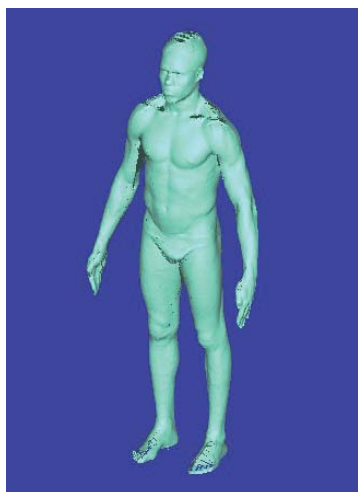
METHOD
At first, it was my task to find a suitable way to implement the project. Therefore, money was needed which was gracefully provided by a sponsorship of Netcetera Cultura. During my research I made myself familiar with different important operational steps for the project. I collected opinions from experts of different fields and was looking for project partners. Not uncommonly, there was doubt about whether the project could be realized at all; however, I tried not to be overwhelmed by setbacks. On the contrary, it became an incentive to me and my partners to master the impossible. What proved to be feasible was to record a performer's movements in a so-called Motion Capture facility. Subsequently, the movements are reenacted in a computational simulation by a human 3D-character, wherein every single position can be merged into an entire body. This body, then, can either be printed as a three-dimensional ABS or it can be milled – as an inexpensive alternative – out of Styrofoam with a CNC lathe.

PROCEDURE
As the idea for Project Bodycloud developed during a Capoeira session, I wanted to retain its original background. For this reason, I was looking for a collaboration with an experienced Capoeirista and found Milton Rodrigues from Capoeira Gerais in Zurich. In order to avoid a narrowed point of view, I also wanted to work with a female dancer. It seemed important to me to leave the outcome of the project relatively open. Thus, I rehearsed with Milton and an improvisation dancer called Christa Näf, which was a very enriching experience. In case of the Capoeira they differ by means of the use of a relatively narrowly prescribed repertoire and self contained movements. Movements, which can be varied freely and leave room for improvisation. Grace to the prescribed forms and possibilities to combine movements, they became ever more precise. Contrarily, Christa's improvisations were certainly no less important, but much more liberal and thus more difficult to grasp. Even though I would have liked to continue working with both of them, I had to restrict myself to Milton because of Christa's busy schedule.

Although Capoeira draws heavily on communication between two dancers, I decided to work with only one person. If two players were involved, the main interest would be focused on the space between the two, which would render the beholder as an external viewer of the process. However, as mentioned before, my objective is to study the direct impact of a Capoeirista's movements on the recipient.

For a better understanding of the procedure, I paid a visit to Jochen Bomm, a fellow academic researcher at 'Hochschule der Medien' in Stuttgart, and specialist for computer animation. He advised me on the necessary software, its interfaces and hinted at problems that might arise. The next step was to scan Milton's body in 3-D at the 'Schweizerische Textilfachschule'. Originally, the idea was to produce an avatar from the scan. However, as this procedure tends to be very complex and time consuming, I decided to make use of an alternative method, that is, to employ a pre-produced avatar in

place of Milton's digital reflection. This conceptual drawback can be improved at a later stage of the process. In order to have the data at hand later on, I performed the 3-D scan nevertheless. It is important to point out that the details of the body are only secondary. The flux of movement will play a much more important role.

Dr. Mathias Bankay of Prophysics, the company that resells Vicon's Motion Capture Systems, kindly offered me a day to use a Motion Capture system and to clean my data. However, the facilities of Pro-physiscs proved to be too small for Milton's extensive movements. Luckily, I was allowed to record the material with Dr. Hans Gerber in a bigger facility, at the Institute for Biomechanics at the ETH. Martin Löhrer, expert for motion photography at Prophysics consented to accompany the recordings. Additionally, Dr. Silvio Lorenzetti, Renate List and Thomas Ukelo from the Institute for Biomechanics collabo-rated and provided an ideal combination of know-how. After a provi-sional attempt, the final recordings of Milton could be conducted.

Milton with reflecting markings in the Motion Capture System at the Institute for Biomechanics, ETH Zurich.

Image sequence, combination of movements recorded with Motion Capture System. At the Institute for Bio-mechanics at ETH Zurich, recordings were made of ten different sequences, performed by Capoeirista Milton Rodrigues.
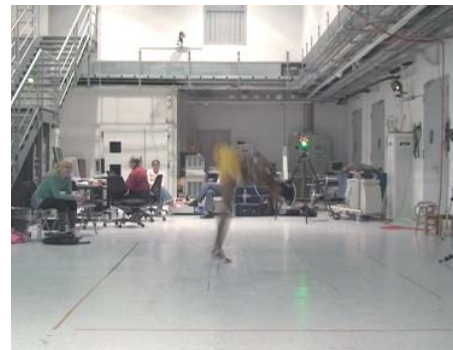
CURRENT STATUS

At the moment, I am occupied with preparing the volume of each movement stage in order to combine it into one. I am receiving support from Vladimir Jankijevic from Elefant Studios, since the task of calculating one single movement volume is very delicate because of the extensive amount of data and the limits of computing power. There are several approaches to the problem: theoretically, the innumerable stages of the movement could be added up by means of a so-called Boolean Join Operation. If, however, the volumes are not saved after each step, the computer is bound to crash after a short time. The second approach would be a virtual version of Schlemmers soft, plastic material, also called volumetric pixels, or voxels. The voxel is a three-dimensional equivalent to a pixel and is used to transform 3-D surfaces into an evenly screened bitmap. This means that out of voxels, the exterior volume of an avatar could be calculated, which would again accumulate an enormous amount of data. Much more elegant is the third approach. On each vertex of the avatar a particle is placed, which produces a point cloud while the movement is progressing. By employing this point cloud, a net of polygons can be construed. Therefore, by means of geometry, one has to surmount the critique of Henri Bergson and form a continuity of movement out of a high number of fragments. Bergson commented on the photographic motion analysis at the end of the 19th century and criticized the snap shot-like quality when aspiring to reconstruct a movement. This, however, will be discussed more thoroughly later on. When reconstructing an entire volume out of fragmented pieces, one has to raise the question whether one should work additively – as in doing pottery – or subtractively – as in sculpting. In my case, a selection of pictures will have to suffice in order to calculate the overall volume. As Rudolf von Laban commented in his book Choreutics.

This flux of time can, therefore, be understood as an infinite number of changing situations. Since it is absolutely impossible to take account of each infinitesimal part of movement we are obliged to express the multitude of situations by some selected „peaks" within the trace-form which have a special quality. [3]

[3] Rudolf von Laban, Choreutics p. 28
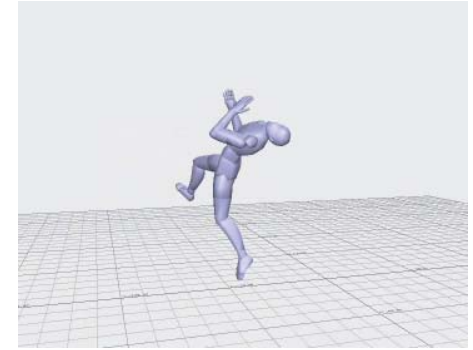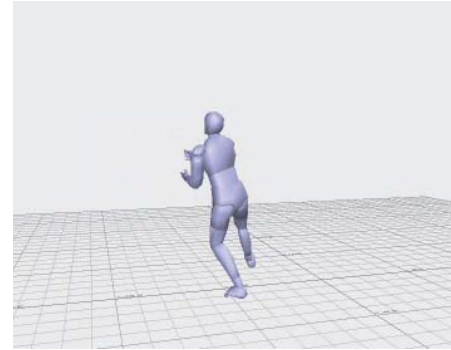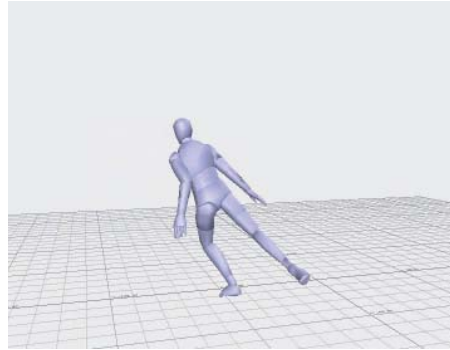
Though from a different perspective, these pictures show the same sequence as page 14, now as computer simulation. The basis of this simulation is the 3-D coordinates that are the markers on Milton's body. By means of this data from the Motion Capture System, the generic avatar of the picture is propelled.
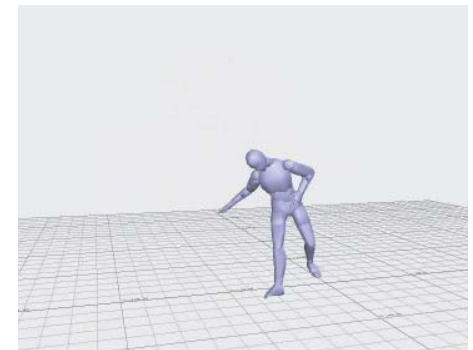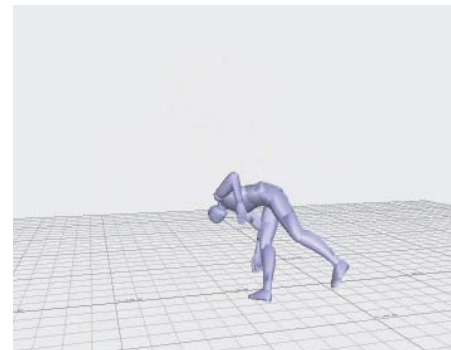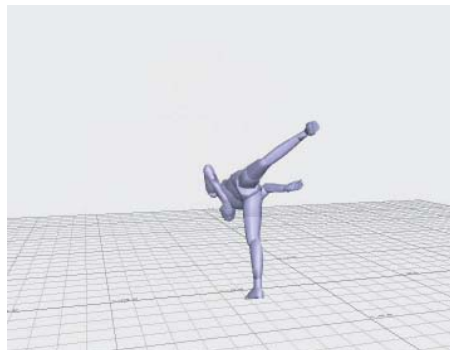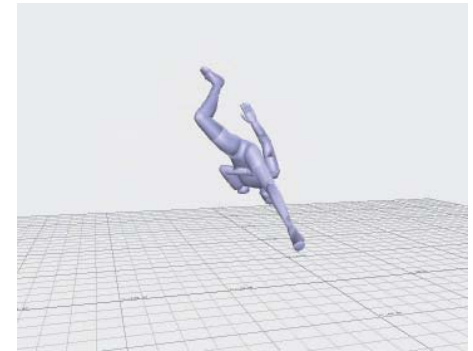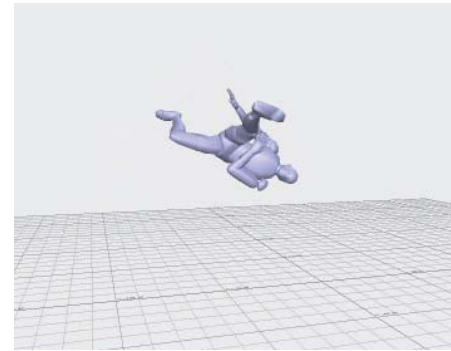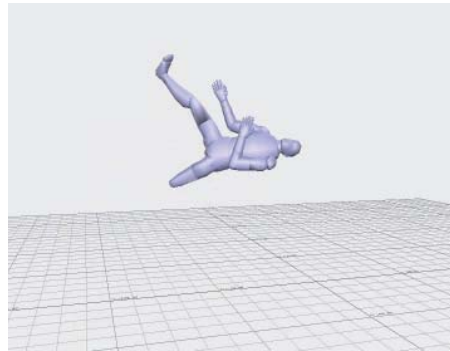
IMPLEMENTATION

A so-called Rapid Prototyping Procedure will help to print the cal-
culated volume as a three-dimensional miniature. This will deliver a
first impression of the eventual object's physics. Subsequently, the
sculpture will be milled from Styrofoam in full size. Being compara-
tively cheap and easily processable, this material is very suitable for
the task described – even though the use of other material would
have been possible as well. It is important to attain a first, tan-
gible result with the least possible delay in order to advance in the
process. Eventually, the materialization has to be seen as a project
for itself. Ingold Modellbau was kind enough to promise support of
the implementation. Both, the positive and the negative form of the
sculpture were interesting to see. It is planned to place the white
sculpture in a white room, illuminated with white lights. Therewith
the abstract piece, the amalgamation of time and movement, should
unfold its beauty. The sculpture's virtual origin will be unmistakable,
which is why it will fuse into the eventual sculpture as a stylistic
element. Reducing the visual components will help the beholder to
focus on the essential qualities of the shape and the structure. For
the necessary details will be uncovered by the lighting elements.
The aforementioned negative form has to be seen as a monolithic
bloc out of which the movement space has been removed, a space
that one can physically enter. In the inversion's midst the beholder is
intended to put himself into the position of the dancer and feel the
performer's movement space. The experience, therefore, should not
remain a merely visual encounter but turn into a physical experi-
ence where one's own movement should utterly internalize the
dancer's previous experience. The negative movement space can
thus become a perceptible playground, a cave of time and movement
in which the generic experience is explored and repeated by simple
changes in position. The story of an animated body continues to
be told and is carried over through the participation of the recipi-
ents. Changing one's position, then, also means to reenact different
phases in time. Ultimately, the beholder is not free, but incorporated
into a narrative corset.

"Body Shells". Polyester sculptures, Heidi Bucher, 1972.

Approximation to a movement volume. Different periods of the sequence introduced on page 14.
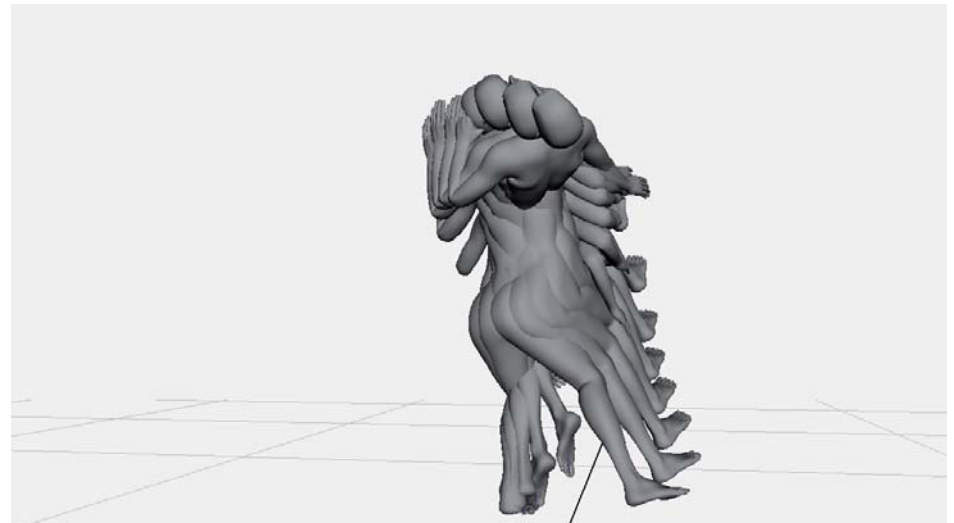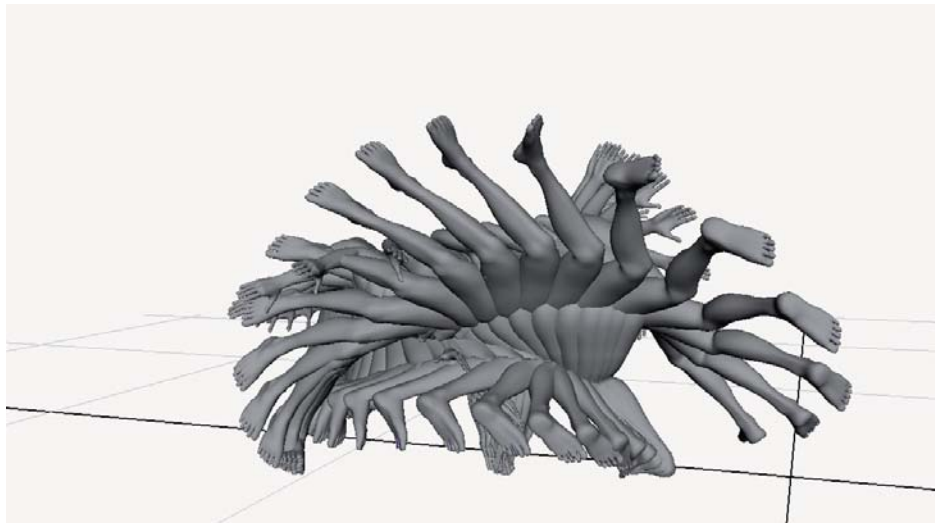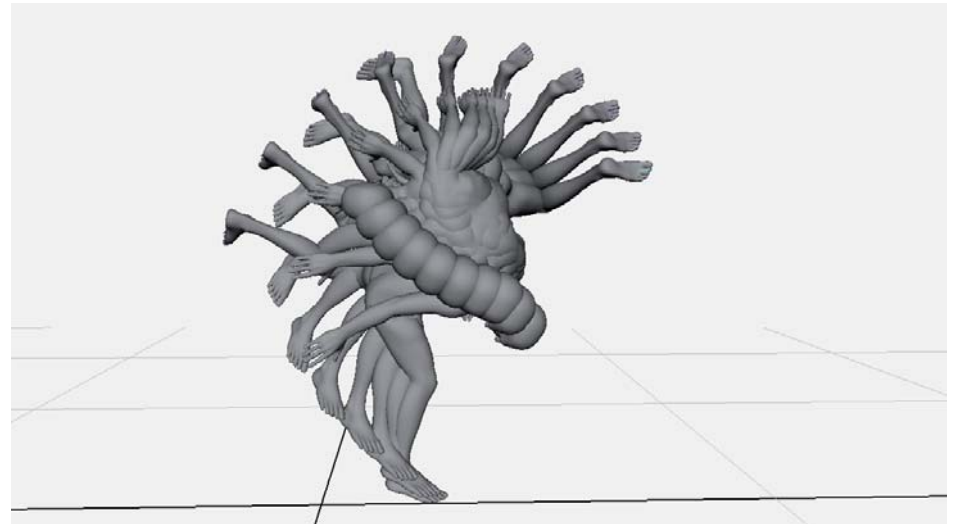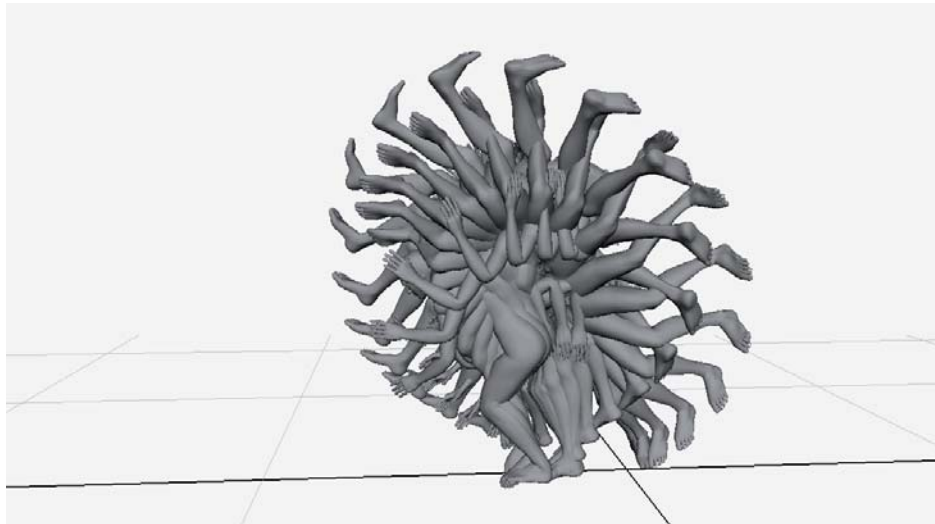
It is probable that dance and architecture are the two basic arts of man from which the others derive. ... It is evident that some of the „snail-shells of the soul," as someone jokingly called the models of dance trace-forms, have a construction very similar to modern plastic art and architecture. The first inner vision of a choreutic shape and the first inner vision of an architectural creation or an abstract drawing have a great resemblance. The invention of an architectural, plastic or pictorial form is, in reality, a choreutic phrase. This phrase is constructed out of changing spatial tendencies. [4]

MY EXPECTATIONS

etween the poles of the beholder and the 'Bodycloud Sculpture', the fixed movements of the performer as well as anthropomorphic structures, proportions and rhythmic sequences are at the center of interest. The physical delineation of a space defines a mantle, or a volume, in which I expect an aesthetic that is directly accessible for us because of our inherent body experiences. This mantle settles on the body like a second skin and reminds of proper clothes. If this space expands a little more, it becomes architecture in the broadest sense. Subsequent to the project, I will follow this trace further that leads from body to second skin and architecture.

[4] Rudolf von Laban, Choreutics p.115

"On the Road" and "Saturday Afternoon at Home in 'Neukölln'", latex balloons, Hans Hemmert, 1996. "Mummy", Full body suit from a contiguous piece of fabric and a zipper, Asfour, 2003. "Bodyshells", Foam Sculptures, Heidi Bucher, 1972.

Results

Personal Inspiration and Thoughts

Capoeira

THE IDEA
During a visit in 2000 in Brasil, I was deeply impressed by the effortlessness of Mestre Corsico, master of my Capoeira club, who seemed to jump through the room in slow motion. I was mesmerized and perceived his movements as a single entity and materialized sculpture before my eye. The vision of his leaving the ground, twisting through the air and landing on his other foot had a lasting effect on me. Ultimately, this was my motivation to implement Project Bodycloud. It was my goal to bring the elegance and beauty of human expressiveness to live in form of a physical object in space.

An early depiction of Capoeira: "Negroes Fighting", Augustus Earle, 1822.

Scene from a Capoeira game, Basel, on occasion of an international meeting in 2003. In the foreground: Mestre Corisco. It is common for a master to move in simple and sophisticated steps. He is sure of his abilities and does not have to prove himself anymore.

THE BACKGROUND

During my studies at the University of Basel, I felt the urge to exercise my body as an offset to the mental efforts. As I was not keen on doing so in a monotonous environment like a studio and since I did not want to do martial arts exclusively, I tried the Brazilian mixture of martial arts and dance, Capoeira. Its origin and history is tied to the fate of African slaves in Brazil. Being disrupted from their original surrounding, the slaves preserved their traditional dances and even developed new forms. Slaves who were able to flee entrenched themselves in primeval communities, so-called Quilombos, and cultivated tactics and techniques of self-defense. They reached from strategic planning for the settlements to efficient defense mechanisms against slave hunters. In the course of the centuries, the unarmed dance turned into a fighting technique of street gangs in the northern cities of Brazil. Ever since the French Revolution – which supposedly introduced freedom, equality and fraternity – a potential Brazilian revolution was in place, as the slaves outnumbered the regular populace. Even after the abolition of slavery, a vast majority of the people lived in poverty. Capoeira was equated with violence and was eventually forbidden by law at the end of the 19th century. Its legalization in 1937 entailed a modernization and an ongoing development. This playful martial art became popular around the globe. Furthermore, stylistic elements of Capoeira found their way into the brake dance culture of New York in the 70s.

THE CAPOEIRA GAME

Despite its expansion and modernization, the traditional framework of Capoeira remains the same. In a circle, usually two fighters play to traditional music and singing. Their dispute passes largely without physical contact and resembles an acrobatic question and answer game. An important element is the so-called Malicia, which can be translated as cleverness or cunning. This can include, for example, feigning weakness in order to trick the enemy and strike in a moment of inattention. An attack can take place at any time. Therefore, it is of utmost importance never to lose sight of the enemy.

I was mesmerized by the improvised, physical dialogue and the marking of a space by means of movement. Furthermore I was also impressed by the stable balance achieved through a continuous oscillation. In addition, a majority of the movements and strokes do not run linearly, but draw an elegantly curved line into the air, in such a way that the kinetic energy of one action is used to initiate a further elegant blow.

So far the experience of the interdependence of dynamospheric and kinespheric sequences has shown us that the conventional idea of space as a phenomenon which can be separated from time and force and from expression, is completely erroneous. [5]

PERSONAL EXPERIENCES
With continuous training, I acquired a certain level of agility and speed. This also changed the perception of my body and the surrounding space. By performing rotations around all axes, a three-dimensionality opened up to me which I perceived not only visually, but with the whole body. This experience was based on a physical and spatial continuity, as opposed to static body positions such as, for example, sitting, standing or lying. Understandably, I also built a cohesive relationship to my body. Even the apparently remote toes started to play a part in this relationship. In addition, the inventory of my movements and their combinations expanded, which incited unused areas of my spatial perception and created unknown connections. This was a very welcome addition to my usual view of the world from 1.69m eye level. I thought of it that way: in order to acquire and understand space one has to learn how to move in it.

Today's Capoeira is generally contact less and much more acrobatic than a hundred years ago. Until then, Capoeira was an efficient and brutal combat technique which also made use of razors.

[5] Rudolf von Laban, Choreutics p. 67

Capoeira group "Chapéo de Couro". Recife, Brazil, 2000. Mestre Corisco with Nego.

In a broader sense, the playfully curved conflicts became models for social communication in regular life. Of course, a straight line is the most direct route between two points in space, but only one of innumerable possibilities. And as a Brazilian proverb says, the most beautiful connection between two dots is a curve. I think one can dispense with further comment.

The high speed of the movements made it impossible to follow the game situation only with one's eyes. This led to an experience where the body simultaneously acts as a sensor and actuator. The actions, therefore, were not the product of long deliberations, but an instinctive response to the question my partner had posed in the game. The grace that emerges from the game has to be seen as an elegance of improvisational instinct, which draws on the balance, agility and strength of the body. Along the changed relation to my own body and the physically appropriated room, a modified external perception of myself, as well as the body of my Capoeira partner took place.

Early Experiments

SUPER 8 AND LOMOGRAPHY
In order to make the time at the district school more interesting, I started to work with film and photography at around 1995. In secondhand shops, there were complete Super 8 film equipments and the corresponding films could be bought for little money at Migros. Around the same time, lomographic cameras, which allowed for straightforward and simple shots, became popular. The automatic exposure meter kept the aperture open as long as it took to capture enough light on film. As the world was not standing still during the long exposure time and kept moving in front of my lens, the images were often blurred and indistinct, which made me very happy. Because this kind of photography allowed me to capture more information, more visual reality on one picture.

Particularly fascinating was the interaction between the moment experienced, the memory of it and the actual photographic reproduction. To me, the distorted and blurred images seemed much more expressive and closer to reality than a razor-sharp recording of a split second. It was as if the long exposure time was capable to reveal a much more elusive, a much deeper truth than a sober moment could ever show.

During a stay in London in 1997, I took a picture at a birthday party of Siobhan, the birthday child, while she was descending the stairs. A mischievous joy came over me, as the film, due to lack of light, was exposed for a long time. I imagined myself explaining what was in the picture and saw the smudgy photography before my eyes. It is hard to say if I knew of Marcel Duchamp's „Nu descendant un escalier no 2" at the time. I might have heard of it. However, it was not important to me back then. Much more important was my discovery of time and space via movement thanks to „Siobhan walking down a staircase". The result was, as expected, blurred lines that spread diagonally across the photograph and left room for interpretation.

The photograph „Siobhan walking down a staircase" could not be found again. Instead, a picture of Siobhan and Ruth, taken on the same evening, the same quality. Next to it, „Nu descendant un escalier no.2", Marcel Duchamp, 1912.
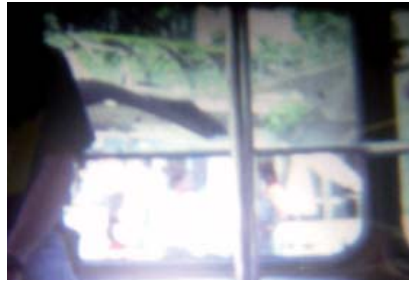
PERCEPTION OF TIME
Similarly, the Super 8 cameras made me reflect on the human per-ception of reality. Among the different modes was a slow motion that exposed the film at a horrendous speed and produced a loud hum. To shoot single frames, there was also a thread to connect a cable release. These technical possibilities allowed me to picture series in temporally distorted speed. With the intention to learn more about the nature of things, I was looking for interesting subjects for temporally distorted shots. Behind this approach was the question whether my perception of time could be the only one possible? In what extent is my perception of time equivalent with that of my fel-low human beings? What sense of time have animals? The in biology class mentioned example of the Ephemera Fly, which entire live hap-pens in one day, questions my perception.

Subsequently, I recorded several short films, such as time-lapse images out of a moving tram or filming into the hall of the main train station. In contrast, I recorded the events in a cemetery, and people in the tiled concrete desert of La Défense in Paris, in slow motion. These film experiments were very exciting and never intended for an audience. With my „cinematic look" I observed motorists in the evening traffic one day. As they passed an intersection, one car diverted after the other, all looking into the same direction; they let their sight wander and carried out the exact same movements. Each of the drivers vanished eventually, only to be replaced by the next. It was a rather frightening spectacle that presented itself to me in a somewhat tense evening atmosphere. I felt as if I were in a flip book which repeated itself continuously. The spatial conditions prompted the drivers to perform a certain sequence of action. The cars had individual external shapes; however, the movements within the cars where completely standardized and did not reveal individuality. In this situation, I observed people restricted in their self-determina-tion, subordinating themselves to external circumstances. This invoked an analogy to the wind that blows across a field, bending the blades of grass one after another.

Art and Scientific History
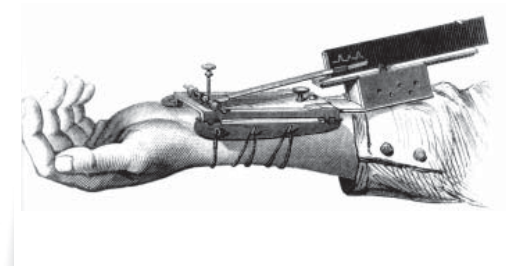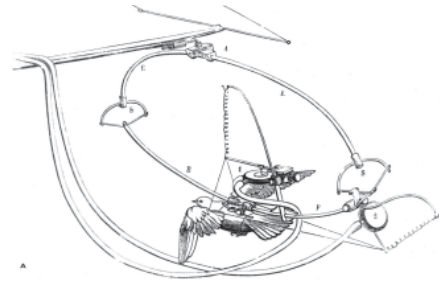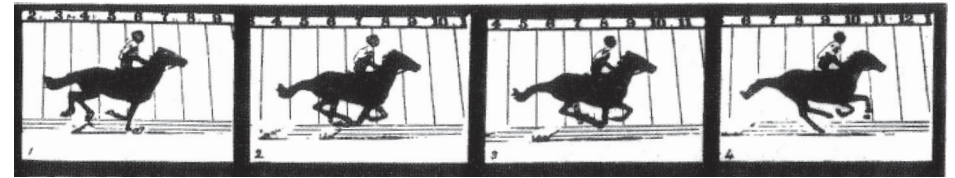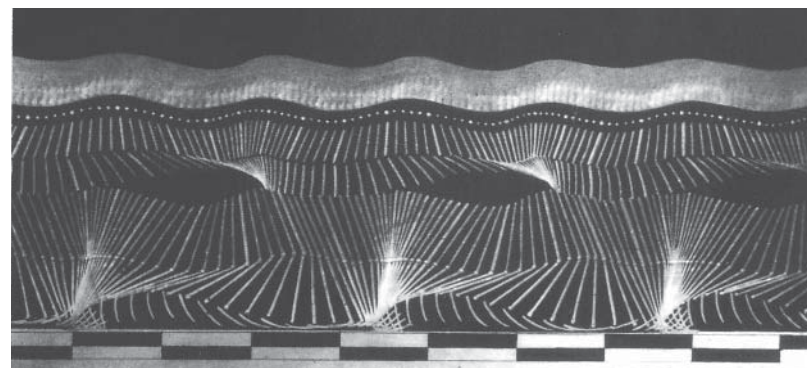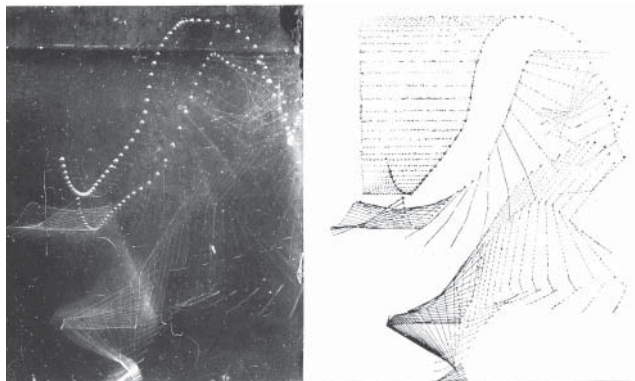

Motion studies

ETIENNE-JULES MAREY
A master of motion studies with living organisms was Etienne-Jules Marey. In the second half of the 19th century, he developed a number of procedures and machines that chronicled life processes by means of pneumatics, mechanics and electricity. He performed his studies largely without effect on the internal functionality of the organisms. Especially vivisection, that is, performing a surgery on the living body was not in his interest, since he considered it too invasive for the organism. Therefore, he built devices that could be applied on to the body. Among his early developments is equipment to chart the heart and lung activity, or to record the wings of a bird graphically. Based on the data collected, he established mechanical models that simulated the phenomena he had investigated. These re-engineering processes led, among others to the creation of an artificial heart, an insect, a bird and a lung.

EADWEARD MUYBRIDGE
The graphic recordings were suitable to abstract internal processes, but did not allow to identify external changes of the body. In 1878, Marey discovered the horse photographs of the artist Edward Muybridge, who specialized in recording image sequences by virtue of a battery of cameras. He did this in a linear time sequence; for example, he demonstrated that during a horse gallop there is a moment in which all four hooves are in the air. Alternatively, he set up the cameras in a semicircle around a subject, recording from different perspectives at the same time. Also in the latter case, there was an impression of movement, however, caused by the displacement of the shooting angles.

Eadweard Muybride, engraving of a photo sequence, 1878. Etienne-Jules Marey, sphygmograph, 1860. Apparatus that records the movements of a pigeon wing graphically, 1870.

[6] Rudolf von Laban, Choreutics, p.45

[Image] Etienne-Jules Marey, photography and analysis chart of a jump, 1884. Marey's assistant, George Demeny, in a black suit with white marking lines and dots, 1884. Running soldier in a suit with markers, 1883.

DEVELOPMENTS

Physiologist Marey was not interested in photographic single frames or multi-perspective views, but in a possibility of collecting a progressive sequence of movements as a continuum as his graphical tools had produced. So he invented recording devices, which allowed the inclusion of multiple sequential images by using a single camera only. The results were filmed sequences of single images and multiple exposures on a single picture. The latter recording technique let room for further developments, which are similar in approach to today's motion capture systems. Marey's subjects wore black suits on which light reflecting lines and markers were placed. The fact that the jumping and walking subjects were taken against a black background reduced the content of the photography to a sequential series of dots and lines. These reference points could be traced and connected in order to record the motion vectors in both a simple and ingenious way.

It is natural for all living organisms to use the simplest and easiest paths in space when fighting, not only when the fight is a matter of life and death, but also in other activities, since all working is a kind of fighting and struggling with objects and materials. Everywhere economy of effort is in evidence, including all kinds of bodily locomotion. [6]

Marey considered the mutability of an instrument as its strength and also developed the method described. In place of the reflective markers he used light bulbs that were recorded, as before, in the dark. As an additional improvement he took long-term stereoscopic images of moving light bulbs, which produced a three-dimensional arabesque of light. Frank Bunker Gilbreth made use of this technique to analyze labor movements. At the end of the 19th century, Frederick Winslow Taylor's efforts to enhance efficiency of industrial work came to brutal fruition. He fragmented operations and declared the implementation practice of the fastest worker to standard. With a more humane approach, which declared the movement, not the

time consumed, to standard, Gilbreth studied the movements of workers at the beginning of the 20th century. Interesting about Gilbreth's work in particular is the use of three-dimensional wire sculptures, which captured standardized movements. This was also prefigured by Marey. He was a true virtuoso with regards to experimenting with various two- and three-dimensional formats of a motif. Among others, these include multiple-exposure photographs, film sequences, as well as sculptures in wire and bronze. By means of the motif of a flying pigeon, one can demonstrate this diversity well: there is a multiple-exposure photograph, miniature sculptures of the flying pigeon intended to be viewed in a Zoetrope, and a bronze sculpture that represents individual stages of flight movements.

IMPACT ON ART

As regards content, Marey's work led to insights about the exposure of body parts in motion. This in turn led to insights in dealing with physical disabilities, and to a renewal of gymnastics for the military and the civil society. The scientifically accurate representations of Muybridge and Marey had a profound impact, especially on the field of art. The depiction of horses has been revised due to the clarity about the progress of the legs' positions. The spread of photography in general assumed the role of naturalist painting. The photographic potential of the display of speed and several simultaneous perspectives produced a major boost for the arts. The rejection of the traditional perspective and the aesthetic of simultaneity, as well as the fragmentation of space opened the field for styles such as Cubism, Dynamism, Futurism, etc. The aesthetic influence of Marey's chrono-photography can be found in Marcel Duchamp's „Nude Descending a Staircase no.2", as the picture reminds of Marey's scientific photographs. Eadweard Muybridge also left an influential photographic oeuvre, which extends to the painter Francis Bacon.
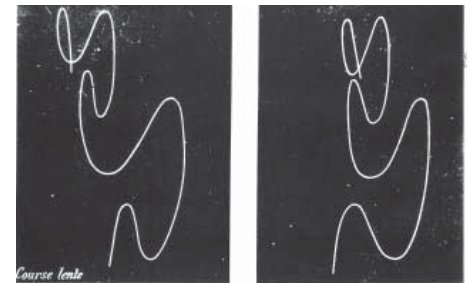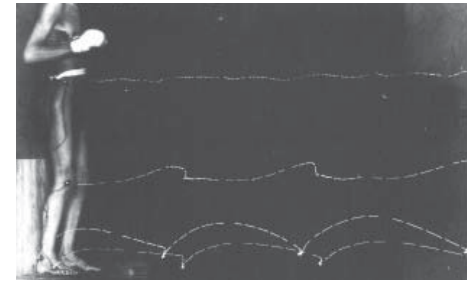
A dove's flight, photography, 1888.
Zoetrope with a mini sculpture of a flying dove, 1887. Flying dove in bronze, 1887. Motion analysis with bulb, 1887. „Course lente / Slow Race" Stereoscopic recording of a light bulb located on a subject's coccyx, 1885.

HENRI BERGSON
Marey was convinced that human perception was insufficient for generating scientific knowledge, a deficit which could be resolved with devices such as the photo camera. Philosopher Henri Bergson, who wrote at the same time, commented on Marey's deliberations. Bergson, however, had a completely different understanding of movement. His view laid the focus on an impressionistic intuition, which is found as well in the Futurists' approach.

Movement, according to Bergson is reality itself. It is continuous change, an undivided fact, a passage from rest to rest, and it is absolutely indivisible. Pure time has no separate or distinct moments; its parts do not begin and end, strictly speaking, but each of them prolongs and continues itself in all the others. Matter, for Bergson is best conceived as energy, and energy is the ultimate form of motion; thus the shapes of material objects are not properties of those objects but are "snapshots taken by the mind of the continuity of becoming" – the misleading data provided by ordinary and inadequate perception. "All division of matter into independent bodies with absolutely determined outlines is an artificial division." Like our ordinary perception of space and time and motion, form is a principle of division and of solidification introduced into the real (which is neither solid nor divisible), with a view to action and not with a view to knowledge, which attributes to things a real duration and a real extensivity. Objects, then, or matter in general, cannot be known through analysis, which is the way positivist science approaches them: analysis gives form to objects by fragmenting them, and thus through analysis we can know only parts. What is real is a unity, and this can be known only through intuition: a disinterested, self-conscious instinct, a form of empathy by which we place ourselves within the object and break down the barrier that our spatialization of time puts up. Analysis is the very negation of intuition. [7]

FUTURISM
As mentioned before, the Futurists drew from an intense experience of energy and movement dynamics. What follows are three passages from futurist manifestoes as an illustration of this approach.

"Our growing need of truth is no longer satisfied with Form and Colour as they have been understood hitherto. The gesture which we would reproduce on canvas shall no longer be a fixed moment in universal dynamism. It shall simply be the dynamic sensation itself. Indeed, all things move, all things run, all things are rapidly changing. A profile is never motionless before our eyes, but it constantly appears and disappears. On account of the persistency of an image upon the retina, moving objects constantly multiply themselves; their form changes like rapid vibrations, in their mad career. Thus a running horse has not four legs, but twenty, and their movements are triangular." [8]

"Sculpture must, therefore, make objects live by showing their extensions in space as sensitive, systematic and plastic; no one still believes that an object finishes off where another begins or that there is anything around us – a bottle, a car, a house, a hotel, a street – which cannot be cut up and sectionalized by an arabesque of straight curves. … In sculpture as in painting, renewal is impossible without looking for the STYLE OF MOVEMENT, that is, making a systematic and definitive synthesis of the fragmentary, accidental and hence analytical approach of the Impressionists. And this systematization of the vibrations of lights and the interpretations of planes will produce a Futurist sculpture …" [9]

[7] Marta Braun, Picturing Time, S. 278
[8] From: Futurist Painting: Technical Manifesto 1910, Umberto Boccioni, Carlo Carrà, Luigi Russolo, Giacomo Balla, Gino Severini; Umbro Apollonio, Futurist manifestos. p. 27
[9] From: Technical Manifesto of Futurist Sculpture 1912, Umberto Boccioni; Umbro Apollonio, Futurist manifestos. p. 52, p. 62

"In sculpture, therefore, we are not necessarily looking for pure form, but for pure plastic rhythm, not the construction of an object, but the construction of an objects's action. We have abolished pyramidal architecture to arrive at spiral architecture. A body in movement, therefore, is not simply an immobile body subsequently set in motion, but a truly mobile object, which is a reality quite new and original." [10]

Tony Cragg's recent sculptures provide evidence of an intense dealing with bodies in motion and astonish in their compelling aesthetics, starting with vessels, such as vases, whose tortuous movement space was materialized. From this process emerged an independent three-dimensional body, in which the original form of the vessel manifests. Reaching to complex organic compositions, which can display faces and anthropomorphic features. The three-dimensional curves lead the viewer into a field of associations while also leaving room for interpretation. At this point the project „Sculptures", released in 1996 by Tamás Waliczky, should be mentioned. He has calculated three-dimensional sculptures by virtue of adding human silhouettes continuously into a Z-axis. To my knowledge, these computer models have not become physical reality.
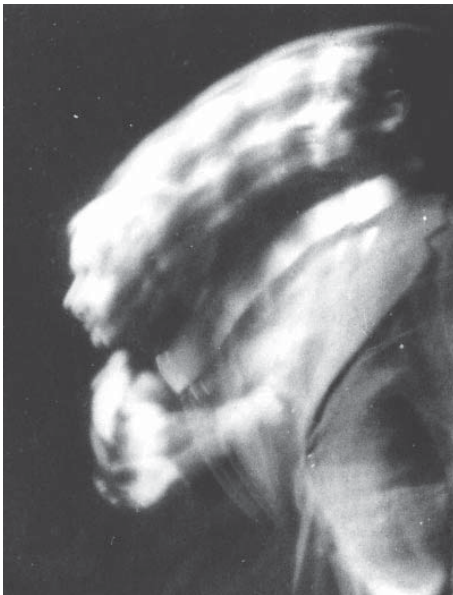
Tamás Waliczky, "Sculptures," 1996.
Tony Cragg, "Early Forms," 1993.

[10] From: Plastic Dynamism 1913, Umberto Boccioni; Umbro Apollonio, Futurist manifestos, p. 93

Examples of Futurist art:
Anton Giulio Bragaglia,
Fotodynamic "Portrait
of Arturo Bragaglia,"
1911. Umberto Boccioni,
"Unique Forms of Con-
tinuity in Space," 1913.
Giacomo Balla, "Dog on a
Leash," 1912.

Anthropomorphism in Architecture

VITRUVIUS POLLIO
In the third of his „Ten Books on Architecture" (De architectura libri decem) Vitruvius Pollio – an architect at the time of Roman Emperor Augustus – describes the ideal formula to build a temple. He compares the proportions of the human body directly to those of a well-designed temple. He explicitly points out the proportions of various human body parts such as foot, ulna, hand, etc. Similar to the human body, proportionality and symmetry should be achieved in a temple by using a standard measure and its multiplications. This will harmonize the size of each part, its structure as well as the entire building.

1. ... No temple can have any compositional system without symmetry and proportion, unless, as it were, it has an exact system of correspondence to the likeness of a well-formed human being.

3. Similarly, indeed, the elements of holy temples should have dimensions for each individual part that agree with the full magnitude of the work. So, too, for example, the center and midpoint of the human body is, naturally, the navel. For if a person is imagined lying back with outstretched arms and feet within a circle whose center is at the navel, the fingers and toes will trace the circumference of this circle as they move about. But to whatever extent a circular scheme may be present in the body, a square design may also be discerned there. For if we measure from the soles of the feet to the crown of the head, and this measurement is compared with that of the outstretched hands, one discovers that this breadth equals the height, just as in areas which have been squared off by use of the set square. [11]
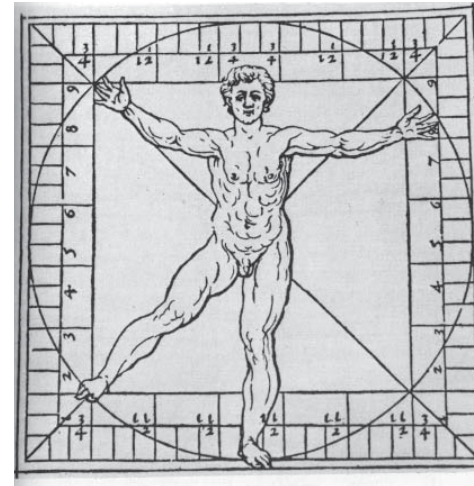
Drawing of the Vetruvian Man by Sebastian Serlio.

Thus, Vitruvius' accounts relate to human proportions and lead to the basic shapes of circle and square, which are derived from the human body. An example of the consistent implementation of these two basic forms is the Pantheon in Rome, Richard Sennett notes. The floor, as well as the ground plan is a game of circles and squares. This extrapolation of human dimensions, as Sennett describes in „Flesh and Stone", also reached out into urban planning. A ritualized planning that was equally implemented all over the Roman Empire.

[11]Vitruvius,TenBooksonArchitecture,p.47
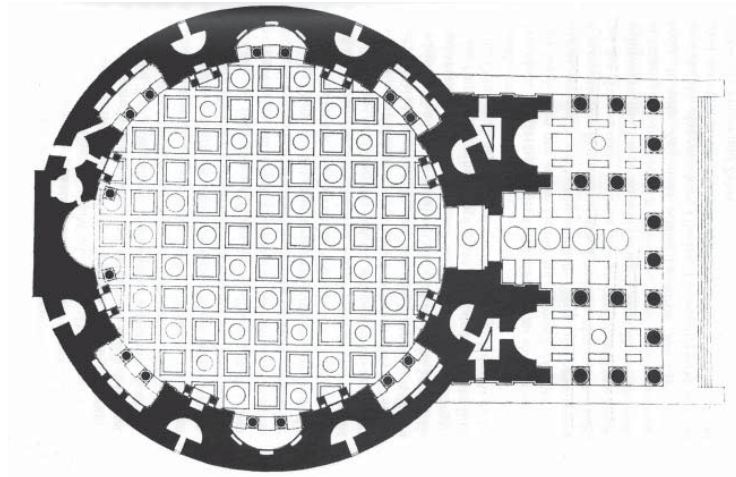
Contemporary Drawings of the Pantheon
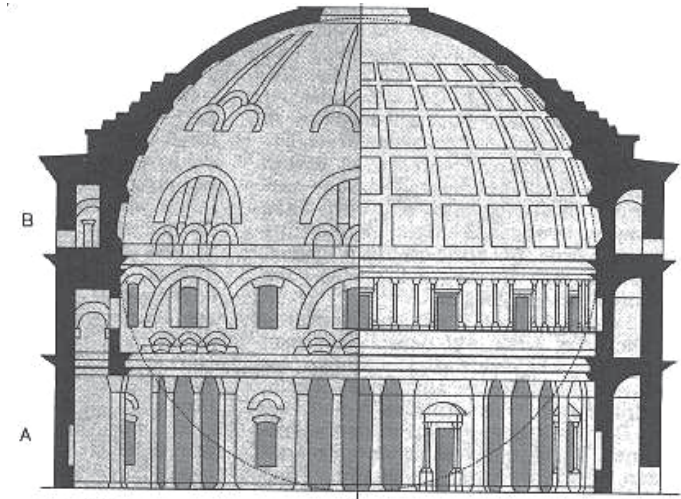
[12] Richard Sennett, Flesh and Stone, p.102
[13] Richard Sennett, Flesh and Stone, p.107

Vast as the Pantheon is, the building seems uncannily to be an extension of the human body. In particular the Pantheon's symmetrical play of curves and squares recalls famous drawings made by Leonardo and Serlio during Renaissance. [12]

To start a city, or refound an existing city wrecked in the process of conquest, the Romans tried to establish the point they called the umbilicus, a center of the city approximating the navel of the body; from this urban belly button the planners drew all measurements for spaces in the city. ... To found a town, one sought on the ground a spot that reflected directly below the point where the four parts of the sky met, as if the map of the sky were mirrored on the earth. Knowing its center, the planners could define the town's edge; here they tilled a furrow in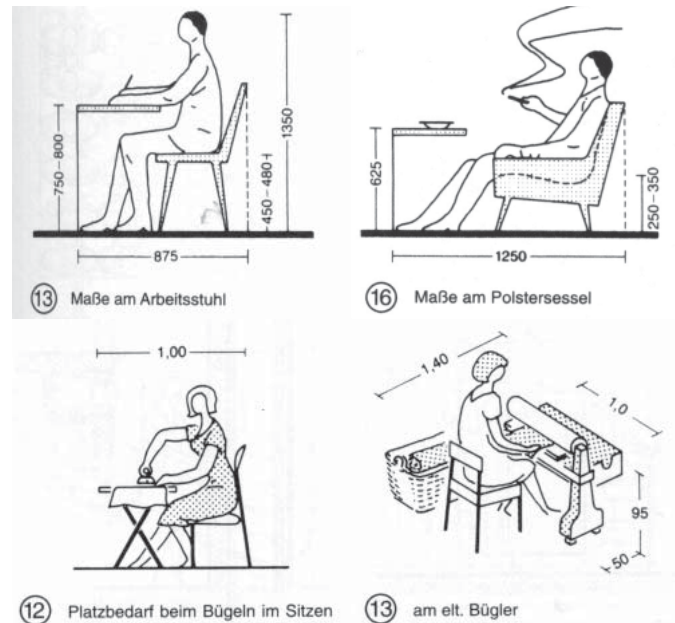 the earth called the pomerium, which was a sacred boundary. To violate the pomerium, Livy said, was like deforming the human body by stretching it too far. Having now a center and an edge, the set-

tlers drew the principal right-angle streets which would intersect at the umbilicus; ... These street lines created a space of four symmetrical quadrants; surveyors next divided each quadrant in four. Now the city had sixteen sections. It would be divided again and again until it looked like the floor of the Pantheon. [13]

PROPORTIONS
In the Renaissance, musical harmonies superseded anthropomorphism in terms of architecture. And by the introduction of the meter, man was no longer the measure of all things (even though the Anglo-Saxon measure ‚foot' retained this notion). In the course of the industrialization, which saw a standardization of production means, the architectural proportions were increasingly determined by pure mathematics. These contained considerations on the resilience of the material, the serial production and its use. The project that defied measures and that relaunched the debate on anthropomor-

Zwei Darstellungen der Modulor Zahlen-
reihe.

thism was Le Corbusier's Modulor. The Modulor as a „representa-
tion of a generally applicable measure in the human scale," is based
on the Golden Section and is basically a freely scalable series of
numbers. By assuming a hight of 183 cm, the Modulor is adaptable
to human proportions. Due to its reference to the Golden Section,
the Modulor cannot be considered new, but follows various works
that go back to Renaissance mathematician Luca Pacioli. After the
Second World War, Le Corbusier managed to establish the Modulor
in architecture. Following the Vitruvian tradition, he aimed to provide
a universal tool, a „scale of proportions" to engineers, planners, ar-
chitects and designers. As Einstein wrote: "It is a scale of proportions
which makes the bad difficult and the good easy." [14]

In terms of reconstruction after the war, the focus was on establish-
ing standards and norms. Le Corbusier had already fought for such
standards in previous years.

*We must strive towards the establishment of a standard in order
to face the problem of perfection. The Parthenon is the product of
selection applied to a standard. Architecture is a process based on
standards. Standards are the products of logic, of analysis and pains-
taking study; they are evolved on the basis of a problem well stated. In
the final analysis, however, a standard is established by experimenta-
tion. [15]*

*Building should be the concern of heavy industry, and the component
parts of houses should be mass-produced.*
*A mass-production mentality must be created: a frame of mind for
building mass-produced houses, a frame of mind for living in mass-
produced houses, a frame of mind for imagining mass-produced
houses. [16]*

[14] Le Corbusier, Der Modulor S. 58
[15] Le Corbusier, Vers une architec-
ture nouvelle, 1923, in The Modulor p. 33
[16] Le Corbusier, Maison en série, L'Esprit
Nouveau, 1921, in The Modulor p. 34

(13) Maße am Arbeitsstuhl (16) Maße am Polstersessel

(12) Platzbedarf beim Bügeln im Sitzen (13) am elt. Bügler

Ernst Neuert, Bauentwurfslehre

[17] Hugo Häring, Wege zur Form, 1925

To put geometric figures over things means to uniform them, to mechanize them. However, we do not want to mechanize things, but only their production. To mechanize things means: Their life - and with it our lives – is mechanized, and thus, killed. The mechanized production, however, is tantamount to producing life. The shape of a thing may be identical to geometrical figures – take a crystal, for example - but in nature, the geometrical figure is never content and origin of this shape. We are against Corbusier's principles - (not against Corbusier himself). It is not our individuality we have to create, but the individuality of things. Their expression is identical with their very being. [17]

STANDARDIZATION

Le Corbusier was not the only one who held the opinion of standardization and rationalization. In the 1930's, Ernst Neufert published the first edition of his „Bauentwurfslehre" (there is no English equivalent, however it means how to do a construction plan). This has become a standard work compendium, in which the entire architectural world is reproduced. It has become a huge success and influenced the industrialized architecture fundamentally. In the following decades, the compendium has been revised and expanded continually. In the last edition of 2005, it reports any possible detail regarding usage of space, ranging from required space when ironing to connecting nodes of space trusses. For every task and living situation, then, there is a standardized measure for which the industry produces matching parts. Today, this has less to do with utopia than with economic organization. Confronted with the avant-garde of contemporary Swiss architecture and its reduced-to-a-minimum, crystalline rooms, I wonder how this is a reference to the people liv-

As an example of Le Corbusier's insistence on the implementation of his ideas, the „Unité d'Habitation" (French for housing unit), can be listed. This project, situated on the Boulevard Michelet in Marseille, started in 1947 in the context of the rebuilding after the 2nd World War. The „Unité d'Habitation" is designed for 1600 people and uses only 15 measures, obviously borrowed from the Modulor. This machine is the living symbol of an architectural utopia, in which, on a macro level, society forms an organic body. At the same time, for each citizen, that is, the minimal cell of this body, individuality is denied. This society's cosmos is built on harmonic measures, and measures that are in harmony with human proportions. However, this world only contains standardized needs that are satisfied with standardized products. However, Hugo Häring represented another opinion. Contrary to the planning approach of Le Corbusier, he presented organic buildings, determining the shape from within, based on usage.

ing in them? The answer cannot easily be deduced from the concrete walls or glass windows, because it is hidden as a mathematical formula in the proportions and measures of the rooms. Due to the functionalist reduction in material and shape, proportions play the crucial role.

BLOBS

A completely different design language is used by the so-called blob architecture. In the 90s, the possibilities of CAD software were so far advanced that buildings composed of organic forms could be calculated, and in some cases even built. Remarkably, this complex architecture is in a contradictory relationship to Le Corbusier's rigid geometric structures which form an entire organic body. Although the blob structures are borrowed from nature, they lack a direct reference to man either by means of proportion, or by shape. How Christin Kempf in „The principle of innocence - computer gener-ated design and the new organics in architecture" argues, either the purely aesthetic form without human reference is foregrounded or the parameterized, individual needs of the future user. In the first case, the aesthetic considerations can be based on algorith-mic natural phenomena, where a direct authorship is lost, or stem from an interplay between analog and digital modeling. The design process in this respect draws on technical and aesthetic decisions without a direct, functional relationship to man. In the latter case, it

AFGH Architects, architects' and artists' house, below the Uetliberg, Zurich 2003.

Lotus," Zaha Hadid and Patrik Schumacher, Multifunctional furniture installation, 2008. Pavilion, calculated on the basis of the ideal sunlight, Jelle Feringa, Paris 2007. „My House," indvidualized apartments NOX, Lars Spuybroek, 1999.

is possible for the user to implement individual adjustments in a marked space. This approach brings back the individual and his needs into the planning procedure, which is a promotionally effective sales argument, as the individual has largely been hidden since the adoption of standard sizes. Thus, in order to integrate individuality in mass production at all, there had to be a significant development of materials and processing techniques. Though how Blob architecture mingles with adjacent buildings remains an open question.

Dance

... Movement is the life of space. Dead space does not exist, for there is neither space without movement nor movement without space. ... [18]

LOÏE FULLER

In the following fragment, I will investigate selectively into personalities of dance that stand in connection with my project. One of the main dancers in the late 19th century is, in addition to the somewhat better known Isadora Duncan and Ruth St. Denis, the „Goddess of Light," Loïe Fuller. She became famous with performances in which she twirled long fabric around her body and thus magically produced an arabesque that was detached from her body. There was a series of dances that made use of this technique, which were accompanied by sophisticated lighting and audio support in order to create sensual orgies. Her interest in the experimental use of new scientific knowledge and technology for various productions made her an avant-garde artist of movement, color and lighting, who was copied many times. The ongoing transformation of the abstract forms refer-ring to nature, in combination with a sophisticated light show, also met with the approval of the audiences, especially with regards to the increasing spread of film. Especially interest-ing is the insignificance of Loïe's body. Although her body is the origin of the movements, the entwining fabric structures are in the foreground as abstract sculptures made of light, fabric and motion, but without physical reference.

"Loïe Fuller dans sa dance du Lys", 1900, Harry C. Ellis. Poster 1898, Portrait of Loïe Fuller, 1902, Frederick Glasier.

'Space: as the unifying element in architecture' was what Schlemmer considered to be the common denominator of the mixed interests of the Bauhaus staff. What characterized the 1920s' discussion on space was the notion of Raumempfindung or 'felt volume', and it was to this 'sensation of space' that Schlemmer attributed the origins of each of his dance productions. He explained that 'out of the plane geometry, out of the pursuit of the straight line, the diagonal, the circle and the curve, a stereometry of space evolves, by the moving vertical line of the dancing figure'. The relationship of the 'geometry of the plane' to the 'stereometry of the space' could be felt if one were to imagine 'a space filled with a soft pliable substance in which the figures of the sequence of the dancer's movements were to harden as negative form.' [19]

[18] Rudolf von Laban, Choreutics p. 94
[19] RoseLee Goldberg, Performance Art S. 104. See also Oskar Schlemmer, Mensch und Kunstfigur as well as Dirk Scheper, Oskar Schlemmer Das Triadische Ballett und die Bauhausbühne, p. 274

Man as a machine. Repetitive movements on the assembly line up to a nervous breakdown staged as a danced revolt. „Modern Times, Charlie Chaplin, 1936. Figure and Space-Delineation, 1924, Oskar Schlemmer. Egocentric Space-Delineation, 1924
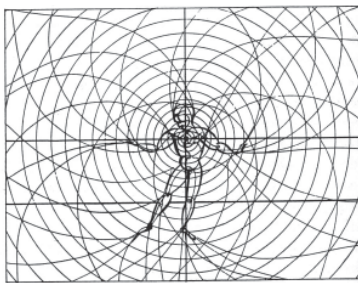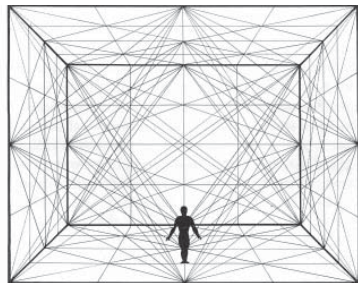
OSKAR SCHLEMMER

The head of the ‚Bauhausbühne', Oskar Schlemmer, refers to the term space perception on a volume felt by dancers, which is defined by the space they occupy. This feeling effectuates a close connection to the surrounding space. He distinguished two fundamentally different views of this relationship. In one he considers the dancers involved in a strictly mathematical and geometrical space, in which mechanical movements are performed. In the other, the dancer stands in the center of attention producing a net of radial motion by means of organic movements. These two approaches reflect Oskar Schlemmer's view of man being a combination of organic and mechanic components. By using alienating costumes, he named a further possibility to change the relationship to the exterior space. He assumed a real body and continued on its borders to wrap it and to put it into an enlarged context.

MERCE CUNNINGHAM

A conceptually liberating approach in the 50s was pursued by Merce Cunningham. Influenced by John Cage, his partner and musician interested in Zen, he began to write choreographies with the help of random components. His interest was to dance combinations of movements that could not have been found with a traditional approach to choreography. Cunningham's subsequent participation in a computer program for the development of choreography appears as a logical consequence of this way of working that is detached from all human intention. What remains is the mechanical expression of the human body. A user of the aforementioned software Dance Forms, is Pablo Ventura, who uses it for random operations which give the choreography a mechanical aesthetic. One step further than Ventura's man-turned-robot goes Louis-Philippe Demers, who lets robots dance choreographies alongside human dancers who perform the same choreography.

WILLIAM FORSYTHE

Not afraid of technology either is the innovator of ballet, William Forsythe. With the background of classical ballet training, he expanded Laban's idea of kinesphere by shifting and multiplying the movement centers. Also, he developed technologies for improvisation that are tied to a complex set of rules. His work is based on a specific technique of movement and improvisation. A comprehensive, continuous process of change, which, is not only inherent in the dance moments, but in the work as a whole. The dancers are again and again challenged to push their physical boundaries. Especially noteworthy is the resulting communicative moment, and the knowledge that is transmitted to the body, as Gerald Siegmund writes.

Forsythe rejects the idea of ballet as a mere technique one must learn in order to bring it to perfection. More important for him is the mental agility and alertness of the dancers who must be capable to take independent decisions quickly, to communicate with their colleagues on the stage they are on: the beauty that manifests when observing intelligent bodies at work. [20]
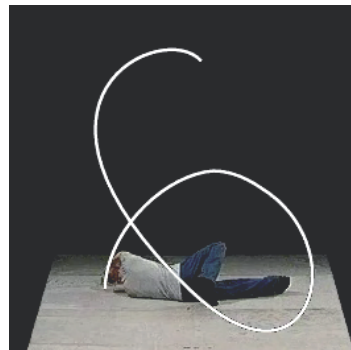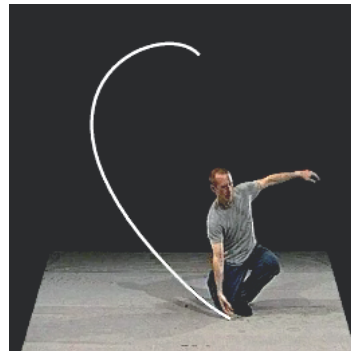

William Forsythe explains 'dropping curves', CD-rom "Improvisation Technologies," 1999. "aura-S," Zaha Hadid and Patrik Schumacher, 2008. Sculptures marking the 500th anniversary of Andrea Palladio's birth, an artist who used musically harmonious proportions in his architecture. The „aura" sculptures try to translate the hormonies applied in the Villa Foscari in a contemporary form.

[20] Gerald Siegmund, William Forsythe - Denken in Bewegung, P. 58

Three excerpts from William Forsythe's latest project: „Synchronous Objects for One Flat Thing reproduced - visualizing choreographic structure from dance to data to objects". In collaboration with the Ohio State University's Advanced Comptuer Center for the Arts and Design. http://synchronousobjects.osu.edu/

„Furniture System," individually milled Styrofoam blocks based on choreographic structures. "Motion Volumes", dynamic visualizations of the recorded spaces of dancers. "3-D Alignment Forms", Visualization of the movements performed.

[21] Gerald Siegmund, William Forsythe - Denken in Bewegung p. 66
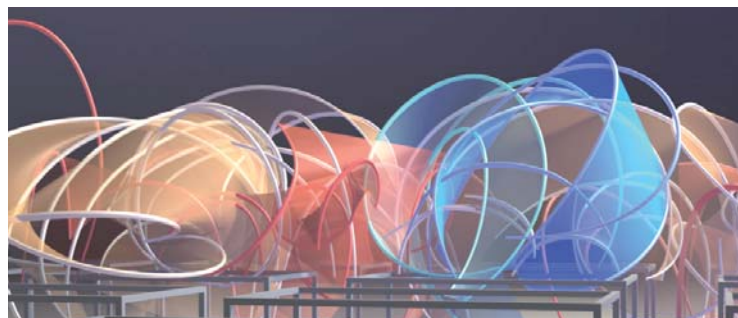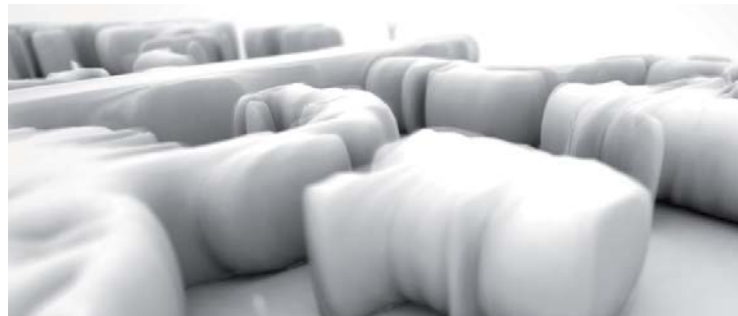
Additionally, Forsythe poses an interesting question on the relationship of the body to the room that is taken; a question in which the physical capacity of recollection plays a crucial role:

"I use the space occupied by the body as a kind of brain, as a way to remind the body", Forsythe explains in an interview. "The entire theory developed after my wife's death, because I started to feel her arms around my neck. The sensation was so real that I could really feel them. Of course I was aware that this was only a wish of mine, but it was a sensation I really felt. This led me to the question of what would happen if we could intensify our body's memory of itself, if we were to put the body on itself, so to speak." [21]

The positions described harbor an intensive technological exchange with a dance background. With my work, I do not seek to find a mechanical logic or aesthetic that is applied on human beings. On the contrary, I am interested in the precision and diversity of human expression. For a mechanical analogy in human movements does not seem very original to me, given that our society is permeated by mechanics and electronics. Precisely because of this limited body awareness, it appeals to me to tap the rich potential of a body's articulation. I think therein lies a treasure of shapes, expression and stories, which in turn have an important impact on our world.

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