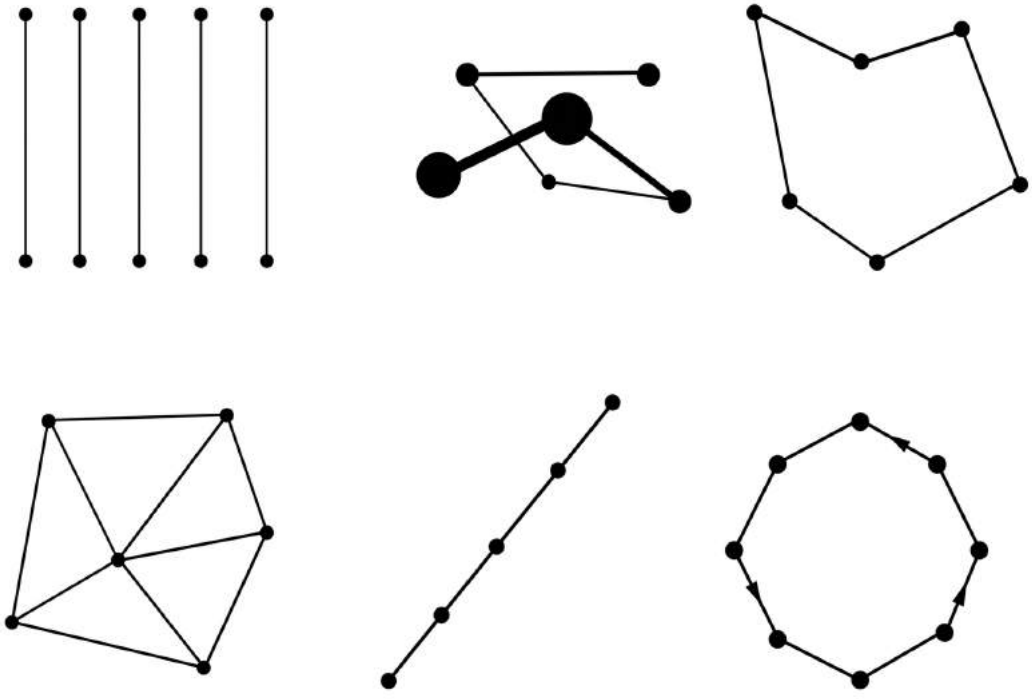
Jens Vetter

Performative Topologies for Musical Expression



To my parents

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FOREWORD

The interplay between performance, technology and sounds is a wide field full of fascinating sub-areas and latest exciting developments, which has a long tradition. Artists, scientists and philosophers have been working for centuries on the various aspects that are merging into it today. The performances of ancient Greece, the developments of European theatre over the last 2000 years, the great technological achievements of the 19th and 20th centuries are incorporated into it. The history of musical instruments encounters the revolutionary upheavals in art and society. The radical reinterpretation of artistic expression, for example among Futurists and Dadaists, meets the achievements of technologisation and networking in today's world. Self-empowerment and the development of new artistic possibilities is supported by new approaches to microelectronics, electronics, computer science and the latest findings on acoustic and digital sound generation. Fascination and curiosity is stimulated by a broad documentation and availability of scientific research and artistic tradition. This can lead to enthusiasm for the large number of musical compositions, philosophical research, virtuosity in art, literature and music, which leads to ever new artistic confrontations.

To benefit from this knowledge and to participate creatively in it is what this book is about. I will relate the wide spectrum of cultural achievements of past centuries to a contemporary artistic performance project, in which aspects of cultural, technological and artistic history are reflected in different ways.

At the heart of the book is *Homo Restis*, a performance project that was created over a period of more than two years as a collaboration between me, Jens Vetter, the musician, artist and technology-oriented instrument developer and the visual artist Sarah Leimcke. *Homo Restis* originated in the context of my studies at the University of Art and Design in Linz and represents, on the one hand, on the technological level the course contents and

artistic insights that I acquired during my time at *Interface Culture*. On the other hand, as the most recent project of my collaboration with Sarah Leimcke, it is the continuation and culmination of more than 10 years of joint work, building on numerous previous performances and technical-artistic realizations in the intersection of sound, sculpture, performance, technology, installation and staging.

In order to present and contextualize the project *Homo Restis* appropriately, I will make excursions into relevant and adjacent areas of performance art and the development of tools for musical expression. Thereupon I will briefly present relevant previous works from the collaboration between Sarah and me and finally discuss the project *Homo Restis* in its artistic form as well as in its conceptual and technological evolution.

The main aim is to sensitize the reader to the various implications and artistic-technical traditions in order to sketch out the context into which I believe the performance can be placed. I would like to introduce the impressions and visions that have guided and accompanied me during the work on *Homo Restis*. I will try to find a balance between the reference to a broad spectrum of cultural-technical precursors and developments and the reduction and condensation to a manageable and easily accessible collection of cross-references and explanations according to the limited space.

The book is roughly divided into three parts. After an introduction to my personal motivation and artistic background, I will first give an introduction to the topic of performance art and public spaces. In it, I will discuss areas that I think have to do with the project *Homo Restis* and its performative nature. An excursion to mask dances, excerpted theatre history and marionettes is included, as well as a discussion of performance art and performative-fictional spaces, heterotopias and heterotopic interfaces.

Secondly, I will focus on the theme of musical expression and the impact of recent developments on it. I will advance from the first instruments of mankind to the young genre of electrophones. I will talk about interaction modes, instrument topologies, tangible interaction and portable music technology.

Thirdly, I will come back to the project *Homo Restis*, the main subject of the book. The centre of my work on the project is the conception, development and realization of a new interface for musical expression, which is closely interwoven with the costumes and performance as a whole. First with a description of some relevant predecessor projects, then with a description of the evolutionary history and finally with a sketch of the technical implementation, I will introduce the reader to the project. Therefore I will go into detail and give insights into the technological aspects and results of my artistic research. I will write about the performance experiences, processes, highlights and feedback from the audience.

I hope that reading the book is just as much fun as I felt when I was writing it.

Jens Vetter, Linz 2018.

ACKNOWLEDGMENTS

I would like to express my sincere thanks to the people who made this work possible. First and foremost, I would like to thank the course of studies *Interface Culture* of the University of Art and Design Linz, especially Prof. Dr. Martin Kaltenbrunner, Prof. Christa Sommerer and Prof. Laurent Mignonneau for the enormous support and the inspiring, instructive and very special study time. I would like to thank Sarah Leimcke for her many years of cooperation, on the basis of which the project *Homo Restis* presented here became possible in the first place! I would also like to thank all those who helped me in writing this book through advice and support, especially Enrique Tomás, Andre Zogholy, Manuela Naveau and Sibylle Ettengruber. I would also like to thank Barbara Seyerl for advising and correcting the English version of this book.

I would like to thank Elisa Unger for her huge patience, her feedback on this book and for her documentary about *Homo Restis*. And above all, I would like to thank my family for their continuous support, participation and encouragement, which made the studies possible in the first place.

PART 1

INTO INTERFACES

Today, science, technology and art are increasingly blending. As a musician it is nowadays possible to design, construct and use one's own instruments and interfaces on stage. As an artist, the activity in this area is a new genre of artistic expression and creative participation. However, despite many new opportunities and easier access to knowledge and technology, dealing with these topics remains a major and time-consuming challenge. The question of whether and why one should use one's time, money and energy for this can not only be answered with rational arguments, but, like artistic work in general, stands in the context of an artistic existence itself, a creative confrontation with one's environment and art as an end in itself and an existential task.

On the following pages I would like to talk about my own motivation and artistic background in order to explain why I am so enthusiastic about creating and using new musical interfaces.

I would also like to point out that the development of these interfaces has attributes of research, as we know it e.g. from science. Therefore, I will briefly address the topic of artistic research and present my personal methodology.


TINYSIZER
MPC800
K88

1.2 ***opposite:*** Home studio Jens Vetter (2014)

1.1 Motivation

For many years I have been looking for new ways to express myself musically and artistically. A recurring motive, as far as I can remember, was the desire for new possibilities. Curiosity about those things that were unknown to me has always kept me going.

This curiosity was stimulated by topics that I encountered in books, excursions and conversations that drew my attention. In my youth, these included books on science fiction, magic and shamanism, authors such as Aldous Huxley, Friedrich Nietzsche, Franz Kafka and Stefan Zweig. Later I was impressed by writers like Egon Friedell and his *Kulturgeschichte der Neuzeit*. In a conversation I noticed how much confidence and motivation I drew from his praise of dilettantism in the introduction to the book. Books such as Peter Sloterdijk's *You must change your life*, in which he reports among other things on the armless violin virtuoso Carl Unthan, who made his lack his trademark. Experiences such as a visit to the willow rod palace in Auerstedt, an architecture made entirely of naturally grown willows, impressed me. The book *Wasser-Klang-Bilder* by Alexander Lauterwasser [48] brought me into contact with *Chladni figures* for the first time, as well as the book *Nada Brahma - the world is sound* contributed to my interest in undiscovered aspects of music and in more comprehensive contexts with regard to places, instruments, performances, sounds and concerts. I was equally impressed by concerts with unusual instruments such as the *steel cello* by Bob Rutman or Jan Heinke. Theatre productions such as *WindRose* by Derevo, in which they transformed the entire outdoor area of Dresden's Festspielhaus Hellerau into a utopian *other-space*, left their mark on me.

As far as music is concerned, I started to work with other musicians and non-musicians at an early stage - motivated and supported by my own self-taught learning of different instruments. I have given workshops in which I conducted musical experiments with children, pupils or adults. The workshop for the symposium *MUSIKMASCHINENMUSIK* at the Institute for Cultural Infrastructure in Görlitz was especially beautiful. Mainly with synthesizers, organ pipes, *Theremin* and percussive objects I was allowed to teach children to make music in an open format for several days. We didn't document the musical results - a pity, because the quality of these experimental mini-concerts was considerable.

With the musician Maciej Kazinski I got to know the Gregorian chorale as an amateur in singing and I was part of a choral concert in the synagogue in Görlitz, which was performed at its opening. This experience has also long contributed to the search for new possibilities of musical expression, among other things because Kazinski has inspired me with his enthusiasm for music and instruments in addition to the training of the Gregorian chorale.

In my own musical development, some of the most important discoveries were the *Theremin* and electronic instruments such as samplers, synthesizers or loop stations (Fig. 1.1). I encountered them only in 2007, after already playing traditional instruments in different bands for many years. One evening in Dresden I accidentally attended a concert of several electronic solo projects in the club *Scheune*. Among them were Tonia Reh as *Monotekktoni* and Dorit Chrysler, a world-famous thereminist. I quickly realized that I wanted to use these electronic instruments they used as a medium for my own artistic expression.

I started to play with these new instruments and tried out new forms of sound. And since I have always been someone who likes to be on stage and make music for other

people, I quickly tried to involve the new instruments into my shows. It was exciting and full of surprises. I have to say that it was not in my interest to become famous or to achieve commercial success. During all my later stage shows and concerts the main motive was always the desire to surprise the audience and myself. I was interested in leaving conventional paths in my music. I wanted to think outside the box of clubs, festivals and concerts.

That was when I met the Dresden artist Sarah Leimcke. Sarah, as a visual artist, was also looking for new ways to produce her art. We started to work together on shows that were performances rather than concerts or exhibitions.

This new collaborative work was great, and it often began with problem solving. Problems that arose when we were talking about room installations, about the combination of performance, costumes and sound. This in turn led me to realize that the musical instruments I had used so far were not sufficient to express our new intentions. I began to think about whether I might be able to develop instruments and concepts myself that would fit in our performances and make them even more succinct, personal and exciting.

I began to search the Internet for ideas, approaches or inspirations. I found the Arduino platform, which I used to create my first own instrument. A battery-powered device attached to the back of our costumes, consisting of sensors, solenoids and sound objects. It was about hitting and vibrating acoustic materials, triggered by moving the hands and arms in the air. The device represents my first self-developed portable and battery-operated instrument (see section 4.3).

But I figured out, that the development of new musical instruments and performance concepts is a very long and time-consuming process. Which raises the question, why one should face such a demanding challenge when ready-made solutions are commercially available? Why should you go through trial and error and try to develop custom technologies? Why should you invest so much time and money in the realization of an artistic idea without knowing whether anyone will ever be interested in it?

Probably that's what is called intrinsic motivation, what drives me to expand boundaries and build things, even if I don't know if they will be useful at some point. Although often used as a justification for the exploitation of artists in most creative areas, it is curiosity and the urge to experience technology, the dream of self-empowerment and the constant willingness to make a fresh start that leads me to question the existing and to constantly look for ways to solve things differently or in my own way.

1.2 Artistic Background

My artistic background consists on the one hand of the performances of instrumental and electronic music on different stages for many years. I have given solo shows and collaborated with artists, dancers and theatre-makers such as Leanne Rivers, Anna Anderegg, Alexandra Börner and others. I composed music for movies (*Cheese Dreams* 2012, *Mind the Map* 2015, etc.) and worked on new sounds and instruments in my own studio.

On the other hand, I have also started to create installative artistic works, mostly with a reference to sound and rhythm. I started experimenting with platforms like the Arduino, taught myself how to solder small electronic circuits and developed my first own instruments. In the last years during my studies at *Interface Culture* in Linz, the programming language *SuperCollider*[1] also became a musical tool for me.

[1] http://supercollider.github.io/

1.3 *Bureaumaschine*, live in Helsinki (2015)

Concerning musical projects I mainly performed on stage with my solo project *Bureaumaschine*[2] (Fig. 1.3), which is an electronic live loop project, that has existed on stage for 10 years. It is based on the use of analogue synthesizers, samplers, loop station and the *Theremin*. With this project I have played in many European countries and at many

[2]http://www.bureaumaschine.de/

1.4 *Bureaumaschine & the German Voize* Album cover (2009)

festivals, clubs and events such as art exhibitions or street theaters. I also collaborated with other artists, such as the opera singer Vilbjørk Broch (Fig. 1.4).

I want to add that the *Bureaumaschine* project was created in 2008 during a festival in Istanbul, which had a great influence on my further development. This festival was my initial contact with street theatre. The festival was called *Trans Yapit* and took place for the first time that year. A community of altogether 23 groups of artists from 8 countries came together for four weeks in an old industrial complex, the former gas factory *Gazhane* in the Kadikoy district on the Asian side of Istanbul, to present performances, interventions and music. The program included acrobatics, music, theater, dance, performance, figure theater, machine object theater and fire art as well as new and experimental stage formats (Fig. 1.5/ 1.6).

It was impressive to see how many different genres came together and how they could still interact with each other. Later I learned that most of the participants had been professional artists or artist groups for a long time. The intention to enrich the residents and vis-

1.5 *Antagon Theater* Performance at Trans Yapit (2008)

1.6 Freak-show with *Rock-It* at Trans Yapit (2008)

itors of the festival with unusual experiences has been realized despite the understandable language barriers and considerable organizational problems. But all those performances, concerts, workshops, theater shows and parades together were a huge success. Even live on Turkish television some selected excerpts from the program were shown, including myself performing on the *Theremin*.

Back in Germany I got involved in various music projects. I founded the Dresden new wave band *Uebercreutz* (2010), which brought minimal electronic dance music to the stage with a line-up of electric drum, bass, guitar and synths. This was the first time I was active as a singer. I perceived this band not only as a music project, but also as an artistic performance that plays with the stereotypes of the 80s and exaggerates them. Out of *Uebercreutz* the project *Spitze* (2012) emerged, which was a smaller ensemble of e-drum, synthesizer and vocals. In this project, Marten Schech on drums and myself on vocals and synths have tried to translate older electronic music á la *DAF* or *Grauzone* from the sequencer-based tradition of techno into the sphere of live music.

During this time in Dresden, the already mentioned artistic collaboration with the visual artist Sarah Leimcke began. What started out as a simple film adaptation of her art film *Fliegenmetamorphose* (2007) quickly took on larger dimensions and forms the basis for the performance project *Homo Restis* presented in this book. In the intervening years we have conceived and realized various performance projects, art films and exhibitions (see section 4).

I also realized sound installations for various exhibitions, such as *Rhabarbar* (2012). This shows a gold-painted stove in a desolate kitchen (Fig. 1.8). A play of light can be seen in the oven, which evokes reminiscences of a mouth, repeating the words *rhabarbar* over and over again. Those words are then played back from inside the oven through a loudspeaker system. I associate the oven in the abandoned kitchen as the voice of an indeterminate past that celebrates these words. Words I mumbled as a child with my classmates in school to confuse the teachers and disturb the lessons.

1.7 *Eins nach dem Anderen* (2015), Memphis, Linz

Another installative sound work is *Eins nach dem Anderen* (2015), in which I illustrate the different cities I have been living in through an algorithmic program. The program assigns *emotion-temperatures* to the cities and generates random *sound chapters*, which are presented as metaphorical personal stories (Fig. 1.7).

1.3 Artistic Research

While starting a new artistic idea, one will be first confronted with a series of different aspects: a new idea, a new artistic work is usually based on own experiences and expectations. It may start with a question, an artistic detail or an experiment. It is the anticipation and enthusiasm that opens the first doors. But then, slowly, when the first idea takes on concrete forms, one may be open to a more structured procedure. Maybe new solutions have to be found, based on old solutions. Maybe you are looking for similar approaches or predecessors. Maybe the entire development process is part of the artistic exploration of the new topic.

What many intuitively do, can be a starting point towards a relatively new scientific-artistic approach called *Artistic Research Practice*. A structured exploration of a self-chosen topic with and through one's own artistic work. It is the attempt, as an artist, to develop one's own artistic craft and to conceptualize one's own art, as well as to contribute to the academia.

> Instead of a mechanical and closed relationship, artistic research is a good example of an activity which by its nature is relative, uncertain and changing, but at the same time (in the best case scenario) experimental, an intellectual pleasure creating new knowledge.

1.8 *Rhabarbar*, sound installation by Jens Vetter (2012)

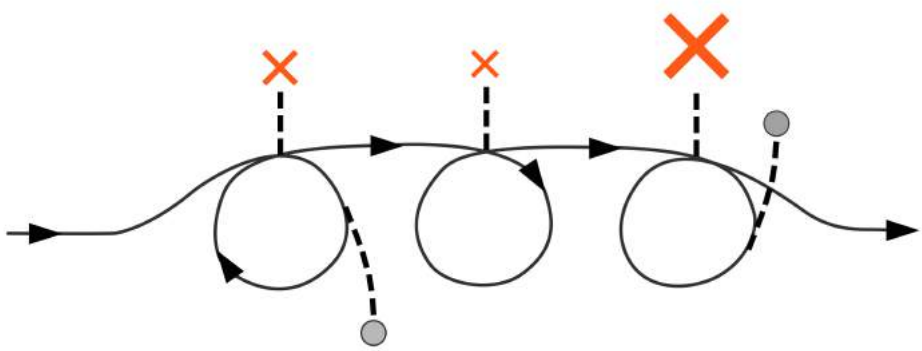
> In other words, it is an activity which challenges and exposes, opens up and activates in order to consider who we are, where we are, and how we are.
>
> From the book *Artistic Research Methodology.* [38]

Here, in the relationship between theory and practice the focus is not only on the production of knowledge through the production of an artwork, but moreover, as addressed in the book *Artistic Research Methodology* [38], it is part of artistic research practice to share insights found with other artists, the academic community and the interested audience. In relation to the project *Homo Restis*, this book is a summary and publication of the results. There were also further publications, as described in the section 5.6.

Question Even if artistic research practice - at least for me - still seems to be a rather theoretical approach and perhaps plays a subordinate role for concrete projects, I consider the development of *Homo Restis*, the result the collaboration between Sarah Leimcke and me, as an example of artistic research practice. The research question, in which the coming investigations, discussions, experiments and works of art will be retrospectively measured, emerged in this case quickly, and at that time even light-hearted: **Is it possible to develop a technology in conjunction with artist's costume that is capable of using ropes to convert body strength produced by the movements of the limbs into sound, independent of power supplies or external sound systems?**

At the beginning of our work, I was not yet aware of the future dimensions of this first question. But in the cooperation with Sarah Leimcke projects often grew bigger than expected and I was used to work hard when it came to conceptual shifts.

It turned out that this question led to an implementation of an interface in which we focused on transforming the connections between performer and their environment into sounds. To what extent the results of this research can also be of interest as universal knowledge for other application fields is a question that will be partially touched in the coming chapters. However, the detailed elaboration of this *technology of interconnectedness* for applications in other areas is a task that exceeds the format of this master thesis and for which there is not enough space in this book. Nevertheless, I hope that in the descriptions of our process in the coming chapters sufficient material will be presented so that interested readers can form their own opinion and their own thoughts on how this technology can be transferred to other domains and whether the principles presented can be a starting point for further research.



1.9 Iterating artistic research methodology

Methodology In scientific research projects, particular importance is attached to methodology as the basis for the research process and for generating knowledge. This also applies to the artistic research practice. But while in sociology questionnaires and natural science experiments are recognized as methods and widely used, the question arises which method we can use in our case.

As Paul Feyerabend described in his book *Wider den Methodenzwang* [26], there should be no binding rule for the operation of science, by which the research process could possibly be restricted. The researcher should follow the procedure that he considers appropriate, according to the motto *anything goes* [26].

Applied to our intention to develop a new performance with the associated technology, Feyerabend's statements means that we should find our own appropriate method. The intuitive way in which Sarah Leimcke and I worked together previously already shows the methodology applied at the development of *Homo Restis*: a continuous development of prototypes, update and feedback processes and iterations of the discovered findings.

In Fig. 1.9 this circulating principle is shown. The continuous line represents the process of exploring different approaches in order to answer our questions. First results are temporary prototypes and other outcomes (shown as crosses in the figure). In addition, as part of the process, also secondary results arise, that may lead to independent work and further independent development processes (shown as circles).

PART 2

PERFORMANCE ART AND PUBLIC SPACES

> "In the museum you can decide how close to be to the art. But in life you can't control the art."
> Guillaume Désanges [23]

Sometimes your own artistic work absorbs you through deadlines, time pressure, inappropriate materials and time-consuming communication. The own basic idea becomes a continuous line, which remains an orientation only with difficulty. Your initial concept is the thread you stick to in difficult times. It can happen that one loses sight of the actual dimensions of the work in the face of everyday challenges. Few people allow themselves to take the time to consciously and actively search for cross-connections, sources and references in art and history that concern their own work. It can be a source of inspiration and self-knowledge, a way of exposing oneself to one's own themes in a broader context.

Thanks to the need to write this book as a conclusion of my studies, I started looking for implications and historical ancestors related to the project *Homo Restis* and its intention to be a performance for the public space. On the following pages I will contextualize this intention and discuss predecessors and cross-references. I will go a little further than just discussing performance art, because the roots and underlying motivations of *Homo Restis* go back in time.

At the end of this chapter I will summarize the topics discussed and explain the relation to *Homo Restis*.

2.1 Ancestors and References

Although it would presumably suffice to consider the way of working and presenting *Homo Restis* as a continuation of an artistic style of expression that has been treated as performance art since the 1970s, I would nevertheless like to take a few steps back into the past to broaden the space of interpretation.

As I will describe below, *Homo Restis* is a performance consisting of a mixture of costumes and masks, instruments and sounds. This and its semi-mechanical nature of movement point to motifs that are much older than performance art. They are elements that have been used in this way or similarly in earlier advanced cultures and religions.

Therefore I will first make an excursion into a historical and neighboring area and try to get closer to the meaning and manifestation of rituals and masks. Afterwards, I would like to briefly step into the history of the theatre as a development that emerged from the greek Dionysos masks dances. I will sketch the development of theatre up to its modern versions, e.g. the *theatre of the absurd* or the *post-dramatic theatre*.

Rituals and Masks

Rituals Rituals are a formal and festive act with a high symbolic value, which can be secular or religious in nature. A fixed ceremonial of rituals or ritual actions can also be called rite. Rituals are a phenomenon of interactions with the environment and can be described as regulated communication processes [11]. They intend to make the meaning of an action visible or comprehensible, or to symbolize or contextualize actions beyond their everyday meaning.

Religious rituals and practices that served religious life are also called cults. The task of cults was and still is to increase the power of both the cult object and its worshippers. The cult is a means of influencing the divine will in order to ward off the threat of disaster, to put an end to misdemeanours, to turn towards blessings and, in addition, to cultivate an inner connection with a deity.

And while cults can consist of rituals, sacrifices, prayers, meals, recitation or the staging of myths, I am particularly interested in cults of sacred music and cult dance. They can be seen, perhaps more strongly than the other forms of cult, directly as precursors of today's theatre.

Cultic dance The oldest surviving documentation of cultic dance can be considered to be cave paintings, such as the paintings in the caves of Bhimbetka (Fig. 2.10), which were created between 5000 and 2000 B. C. and which show a series of dance formations [54]. Other representations show the god Shiva as Natraj, the *king of dance* in Hinduism. Pictures from French and Spanish caves show dressed up magicians, who are supposed to attract animals by rhythmic movements. They hoped that this would lead to hunting success, which was vital for their survival at the time.

The earliest transcriptions occurred in India, a collection of Sanskrit Hindu texts called *Natya Shastra*. The texts consist of 36 chapters and contain 6000 descriptions of dance performances [6]. In ancient Egypt there were ritual dances which represented the death and rebirth of Osiris, the goddess Hathor was goddess of dance as well as goddess of death and love [8].

Also ancient Greece knew religious dances - the dance as a powerful means to arouse religious feelings, the dance of the individual as well as that of a group, which is welded together to form a unit that feels the same and wants the same. As Nilsson describes [63]

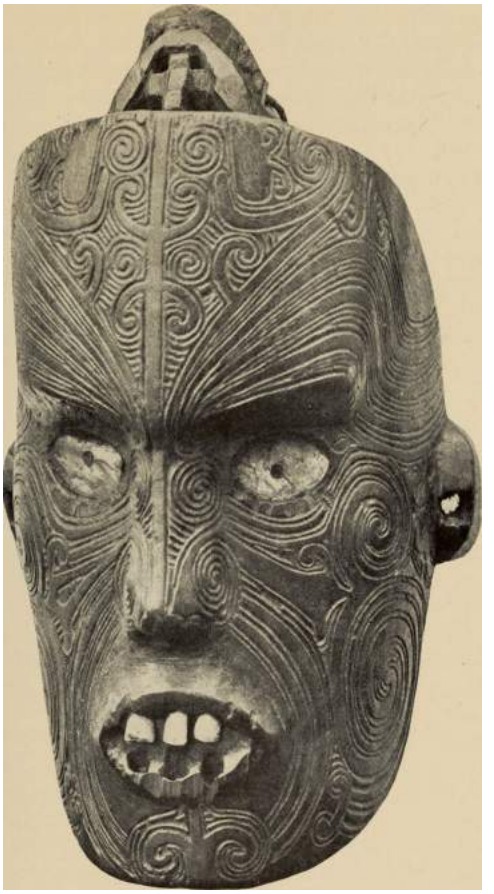
2.10 dance-formation in the caves of Bhimbetka 5000 BC.

there are two types of dance in ancient Greece: the first - familiar to us - consists only of body movement, the second is mimetic and consists of the rhythmic imitation of sexual or erotic acts, as an accompanying expression of the Dionysos cult. The dance was usually accompanied and stimulated by music performed by a simple percussion instrument. The dancers put themselves into ecstasy through dance, which appears to be one of the most important means of awakening external excitement. The mimetic utterances can be interpreted as a precursor of the later *Greek tragedy* (see 2.1).

Masks An interesting observation is that man in all cultures - accompanied by the development of an idea for supernatural beings and gods - just as early on began making masks for these cults and rituals. Masks that either only covered the face or the whole body. They were used at turning points in life: birth, marriage, initiation, illness and death, but also events such as sowing, harvesting or the start of hunting were accompanied by rituals. The magic often lay in the mask itself. Already the production was subject to magical ceremonies. The mask builders were often subject to special requirements and taboos. When the mask was put on, the wearer changed into another form of existence: Here no god or demon was only to be represented, the wearer himself transformed to it. Some rituals ended with the destruction of the mask, whose power had depleted. Other masks kept their power or became even more powerful.

Masks have been used by many tribes, including Native Americans in North America and Africa. Likewise of natives on the Polynesian islands, like New Zealand, Tahiti or the Easter Islands (Fig. 2.11/ 2.12).

2.11 *Crooked Beak of Heaven*, mask by Kwakwaka'wakw tribe, Pacific Northwest coast, British Museum



2.12 War mask (1921), New Zealand, British Museum

The religious dance rituals in ancient Greece in honor of the god Dionysus also included facial masks that represent the particular deity during the dance, like Dionysus or his followers, the Satyrs [46]. Consequential, the *persona* mask is a typed mask used by actors in ancient Greek theatre to better express the feelings of their roles. Since then, a laughing and weeping mask (comedy and tragedy) have become a symbol of dramatic theatre and are still used today in Western culture as a pictogram for the performing arts (see fig. 2.13).

The Theater

The term *theater* is derived from the greek *theatron* (greek *theatron* = scene). The history of the Greek Theater originated from early mask dances, performed to honor the god Dionysus, or as Nietzsche puts it: *It is an indisputable tradition that the Greek tragedy in its oldest form was only about the sufferings of Dionysus, and that for a long time the only existing stage hero was Dionysus... All the famous figures of the Greek stage - Prometheus, Oedipus etc. - are only masks of that original hero Dionysus.* [62]. While the cultic purpose increasingly took a back seat, the theater played an important role in the development

2.13 Mosaik with scenic masks 200 BC.

of Attic democracy: it stood for self-assurance, representation, and demonstration of power of the polis society, nonetheless initially, the performances were exclusively on religious holidays. Structurally and content-wise from simple choral precursors developed the three dramatic genres: tragedy, comedy and satire play. Political issues were addressed, mass entertainment was as much a task of the theater as were lessons for people to recognize what was morally right and wrong. Nevertheless Egon Friedell sees in the Greek theater first and foremost an *expression of a certain world view*, which shows the *reality of divine laws and human passions, it is therefore completely submerged in a pessimistic-fatalistic mood.* [32].

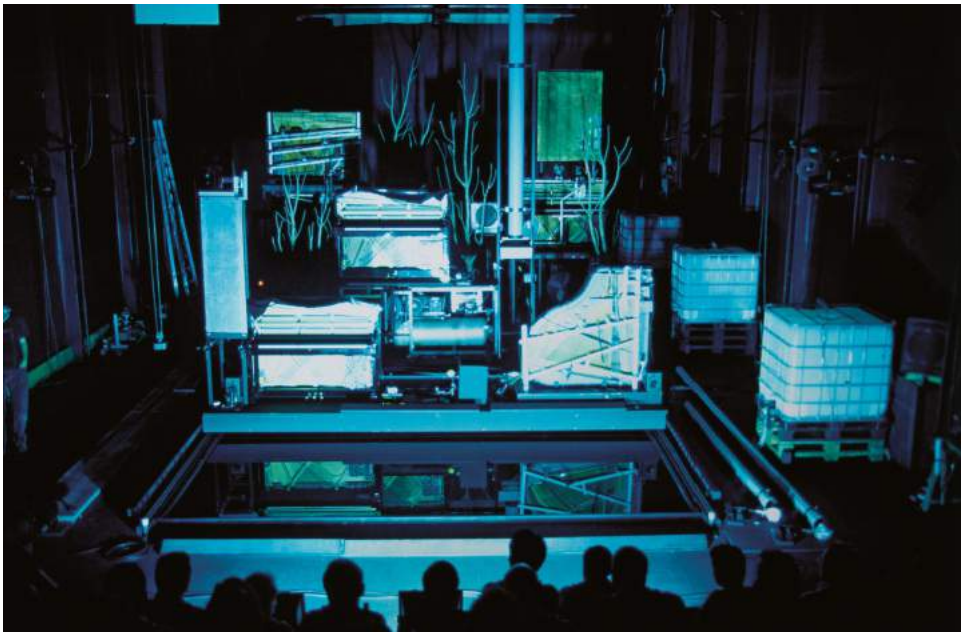
Historical Avant-Garde Aristotle's theory of drama is the point of reference right down to modern times, even though the perception of theater has fundamentally changed in the last hundred years. From the middle of the eighteenth century, bourgeois theater, in the wake of emancipation from feudal-absolutist rule, strove to replace the hollow refinement and declamation with a lifelike style of play. Against this background, Konstantin Stanislawaski developed a new acting method in which the *art of experiencing* [27] was the focus. At the beginning of the 20th century, however, there was another change in attitude: the illustrative stage style was to be replaced by an emancipation of stage art. The historical avant-garde declared the theater to be an art form independent of literature and its performance as an autonomous work of art: *The art of the theater is neither the acting, nor the play, neither the scene design, nor the dance. It is the totality of the elements that make up these individual areas.* [16]

Epic Theater Brecht went a step further - he and Piscator radically developed the concept of an *epic theater* in order to emerge from the static presentation of individual fates

and address the audience more directly - they wanted the depiction of major social conflicts such as war, revolution, economics and social injustice, in order to set social and political changes in motion. To achieve that, the *epic theater* connects two literary genres, the drama and the epic, that is, theatrical and narrative forms of literature, including the Brechtian alienation effect: an action is interrupted by comments or songs so that any illusions are destroyed in the audience. The essence of the alienation effect is to make things familiar to the viewer appear in a new light, thus making visible contradictions in reality and enabling a more critical and conscious perception of what is shown. This metaphorical demonstration of social contradictions on stage should activate viewers. By these means, theater should intervene directly in the social reality outside: *The new art should not be a mirror, but an elementary component of social reality, not to depict reality, but to contribute to its change, thus showing it that they can intervene.* [70].

Theater of the Absurd As well in the dissolution of classical forms of theater, but perhaps even more radically than the *epic theater* in Brecht, the total alienation took place in the *Theater of the Absurd*. Primarily produced by European playwrights in the late 1950s, with influential precursors such as the theater of Antonin Artaud and the philosophy of existentialism, it relies on the display of an absurd world: *It was no longer about the destruction of bourgeois reason, ethics and conception of art, and about a naively vitalistic freedom of the artist, but about the elimination of all attempts at explanation and rescue: the illogical, moral-free, confused, isolated and speechless as a seal of total absurdity. Not looking for the 'new', but the presentation that met expectations, which were now reduced to a 'nothing'.* [21]. In the *Theater of the Absurd*, the events appear to be incoherent, the language is questionable, parable and abstracted, the space and time of the action become indeterminable. The thread of action is often dissolved beyond recognition. It shows the situation in which the human being is located, namely the enigmatic, the incomprehensible, the transcendent, the chaos and the nothingness. Sabine Schlüter speaks cautiously of an *extremely pessimistic view of the basic human situation* [69]. The *theater of the Absurd* is known for works such as *Waiting for Godot* by Samuel Becket, *King Ubu* by Alfred Jarry or *The Bald Singer* by Eugène Ionesco.

Post-Dramatic Theater In the second half of the 20th century, the theater's ties to an underlying text dissolves. Shaped by post-structuralist discourses and philosophers, the theater begins to reflect on itself and its representation. There are no more roles in the sense of the dramatic theater, the actors' work moves in a performative direction. The theater critic Andrzej Wirth coined the term *post-dramatic theater* [50] to name these current forms of theater, sound collage, speech opera or dance theater. The prefix 'post' is intended to indicate that it is no longer the text fixed in writing that is at the centre of the staging and performance practice, but other scenic elements and theatrical means of design such as actors and their facial expressions, gestures and proxemics, mask, costume, stage, props, sound, light and space that are generally regarded as equally important elements. It involves questioning and critically reflecting authorship, turning away from speaking and acting characters, placing non-professional actors as so-called *theatrical ready-mades* on stage [34], focusing on more performative acting and incorporating different media, even pop culture (Fig. 2.14). Crossing borders into other genres like the opera or the dance and music theater. With the attestation of the *aversion to organic unity, the tendency to extreme, distortion, uncertainty and paradox* [50] Lehmann outlines the charisma of the works of Pina Bausch, Frank Castorf, Heiner Mueller, Christoph Schlingensief, Heiner Goebbels or Robert Wilson.



2.14 Assemblage of pictures and sound in *Stifter's Dinge* (2007) Heiner Goebbels, Documenta14

The Spectacle

As a term of art, already in the theatre of the 17th century, I would like to briefly discuss the concept of spectacle. In general, the term *spectacle* describes an event that is memorable and sensational because of the appearance it creates. This term was used to describe extraordinary productions that were known since the Baroque era, initially for an exclusive audience. Since the end of the 18th century they became increasingly popular among the people and which then primarily served the spectator's curiosity. As folk theatre, fairground theaters offered not only spectacles, but also living images or performances of horse theaters and wandering menageries to satisfy the curiosity of the public for the unusual. Over time, however, the term *spectacle* took on an increasingly negative denotation, describing events of a shallow or strange nature.

It was not until the book by the French artist and philosopher Guy Debord *The Society of the Spectacle* [22] that it regained a new meaning. At the heart of Debord's book is the spectacle, organization, totality and connection of all economic and most cultural or political processes in the modern industrial state of the late 20th century, and the social relationship between people that arises. In the spectacle everyone, whether boss or worker, man or woman, careerist or rebel, plays their assigned role. His concept is an incisive social critique that equates society with a soulless and perfectly organized machine in which the actual reality becomes invisible behind a facade of advertising, clichés and propaganda. He writes about the corrosive effect of representations as a *surrogate*, in which the real experienced or longed-for is increasingly replaced. Above all, this threatens the individual and his freedom.

In his opinion, society seems to be hypnotized by the sight of real life as an image and a cliché, while in everyday life and on the street human emotions take hold:*Their vulgarized pseudo-fests, parodies of dialogue and gift, stimulate an economic overspending, but only*

2.15 *Venus von Willendorf*

2.16 *Cha-hakobi ningyo* (Tea-serving Boy)

bring back the disappointment that is always compensated for by the promise of a new disappointment [22]. The role models of society are now more likely to be the film, pop or political stars. The star represents the *spectacular performance of a living human being*. He describes the paralyzing influences of the spectacle on politics, economy, people and their ideology. He criticizes a world which is now only made up of goods and dominated by consumerism, in which freedom of choice is limited to the choice between products and offers on the market.

Debord provides a radical reinterpretation of modern achievements and regards his theses as an invitation to action. It is above all through re-appropriation and awareness of these conditions that he promises himself and society a change for the future.

Debord has thus turned the surface, the spectacle, into a projection screen for social and cultural criticism. Not as a cultural pessimist, however, but as an artist who wishes to explore new territory, convinced that art can find a way to deal with these existing conditions, and that art can perhaps find a new language. And perhaps a part of this language lies in performance art, in self-empowerment, in masks that simultaneously represent the surface, but also hide it.

Puppets & Marionettes

Here I would also like to make a short excursion to dolls and puppets. Marionettes are string puppets that can be moved by one player with the help of several strings. *Homo Restis* (lat.) means *man on strings* in English. The concept behind this name is the idea of performing as a marionette.

Hand puppets, which used to be made of wood, were seldom larger than a toddler, and their movements were tied to pendulum movements and gravity. Their range of motion was therefore limited. Human movements such as grabbing or embracing could only be implemented as an indication.

The history of the marionette can be traced back to the past in all parts of the world. It goes back in Europe to ancient Greece, where puppets such as the *neurospasmata* made a livelihood possible for professional puppeteers [90]. In the China of the *Tang Dynasty* around 700 AD., puppets and stick dolls can also be found. Puppet shows can be considered as an ancestor of the Chinese shadow theatre [82].

Likewise in India, the use of marionettes as part of a dramatic form was mentioned in the old national epic *Mahabharata* from 400 BC. and is still shown today as a folk theatre. The Czech father-son couple *Speijbl and Hurvinek* is another internationally known puppet couple.

The ancestors of marionettes are simple dolls, figurative replicas of humans or human-like beings. Dolls are among the oldest toys. They are probably based on the need of children to imitate their mothering with the help of objects (sticks, stones, roots, etc.), which could be observed even with young chimpanzees. Figures and materials found in Neolithic children's graves were interpreted as dolls.

In many cultures dolls have magical or religious meaning, like the approximately 30000 years old *Venus of Willendorf* (Fig. 2.15), which, probably as an object of magical-spiritual practices, symbolizes the desire for fertility. The same applies to the West African Voodoo, where dolls are used as a tool for analogy magic, often to heal sick people, and more rarely as damage magic. Also Ovid in ancient Greece speaks about practices at which a wool doll is punctured [84]. Dolls, in which one believed to achieve magical effects by piercing and physical transformations, were called *Atzmann* by the later Germans [39]. Known dolls today are for example the nested Russian *Matryoshka* or the children's doll *Monchhichi*.

Dolls also provided models for the production of automata, mechanical devices that imitated natural movements, such as Japanese *Zashiki Karakuri*, which were used and presented as attractions in private spaces. The best-known example is the Karakuri tea vending machine (1800), a figure in whose hands one could place a cup of tea, on which the doll moved its feet and nodded its head to offer the guest the tea bowl (Fig. 2.16). The Swiss watchmaker Pierre Jaquet-Droz also created three androids in the 18th century, which triggered a wave of euphoria in Europe: the *Writer*, the *Draughtsman* and the *Musician*. These androids have been able to imitate the movements typical of their name [74].

Certainly a special attraction was the *Chess Turk* (1769), developed by Wolfgang von Kempelen, an automata with the puppet of a chess player, who pretended to be an intelligent chess robot. At first, the *Chess Turk* caused quite a stir, until it could be proven that inside the chess table a human being was hiding.

Modern versions of the puppet theme can be found in works such as Hans Bellmer's *Die Puppe* (1936), which combines in numerous variations the principles of the figurative representation of humans with aspects of fetish and prosthetics (Fig. 2.17). His dolls were quickly presented in the context of surrealistic objects in the magazine *Cahiers d'Art* and classified as *fantastic realism*. Thus, later artistic variations such as the *Third Hand* (1981)

2.17 Hans Bellmer, *Die Puppe* (1936)

2.18 Stelarc, *Third Hand* (1981)

by Stelarc (Fig. 2.18), the implants of the main characters in the science fiction anime film *Ghost in the Shell* (1989) or the artificial figures in Matthew Barney's film series *Cremasters* (1994) can also be considered within this surreal context.

2.2 Performance Art

After the excursions to antique masquerade dances, the development of the theatre, the excursion into Debord's *spectacle* and the sketching of puppets and dolls, I will now speak about the relatively young genre of performance art.

Since the 1970s at the latest, with ancestors in Futurism, Dada, Surrealism, a new form of expression manifests itself known as performance art. This form of representation, provocation and intensity came about on the basis of the abandonment of the static display of images and sculptures, mixed with a strong anti-establishment attitude and the rebellion against predictable and trained behaviours.

In the artist's direct and mostly wordless communication with the audience involved, pictures, moments, situations and manifestations are created that can only be experienced in this way and only as such. It is a radical kind of art in which it is not important to create a product, painting, or any other manifestation of artistic intent, other than the current moment and the actual experience - an ephemeral moment in which the body and the artist's intentions coincide with space, time, and in which communication is made possible by the presence of the audience. Live Art [33], in which the degree of authenticity, artistic intensification and intention of the pieces differentiates them from show and entertainment. Theatre and fashion are familiar with similar moments of condensed experience, but in themselves they are not as radical, uncompromising and ultimately not free enough - in an artistic and non-commercial sense.

The term performance art encompasses such a multitude of different forms of expression that today it is difficult to unite them all. Happenings, live events, fluxus concerts, actions on the street and even demonstrations can be subsumed under it, as well as body maltreatment, the artificial creation of boredom, destruction, or even shamanistic rituals. As an impressively extensive archive printed on a poster, Gerhard Dirmoser tried in 2001 to depict a compilation of all core and peripheral areas of performance art [61].

What is Performance

Performance art is based on the concept and meaning of the word *performance*. The word performance has undergone a far-reaching change of meaning over the last 60 years, which I will recapitulate in the coming chapters. But what does the word actually stand for in its original meaning: *the Latin word "forma" roughly means form, figure, figure or texture, character or image, appearance, Model and beauty. The verb "formare" means to shape, to form, to represent, to make. Accordingly, "formatio" is the design. The prefix "per" means "through and through" and intensifies the meanings mentioned.* [89].

In 2006 Richard Schechner describes performance as a *relationship between performer and audience* [68]. Behind him lies a decade of research and approach to the term. That is why I would like to look back on performance studies in which the word *performance* appears for the first time in its current meaning.

Performance Studies Although there are competing views, many see the origin of the concept of the performative as originally derived from linguistics. In 1962 John L. Austin established the expression of *performative speech acts* to describe a kind of embodied language: *In contrast to the 'constative description' of states that are either true or false, 'performative utterances' by the fact that they are uttered change states in the social world.* [88]. As an example of such a performative utterance, the yes-word can be quoted at the marriage. It changes the social reality of those involved in the act of speech. The act of

speech thus has the function of carrying out a symbolic action, a sentence constituting a new reality. Yet, these statements can not be classified as false or true. They are self-referential. They mean what they do. Language is thus credited with a world-changing power that can bring about transformation, which summarizes the meaning of the concept of *performativity* according to Austin [4]. The performative utterance in this sense is the performance of a social act, and at the same time subject to the rules of the participating community. The community is in agreement as to who the authorized person is allowed to make this statement. The success of a performative speech act is linked to these external social conditions [28]. The linguistic reference is important insofar as it was possible through this realization to apply the concept of the performative to bodily actions.

Scientific analysis of the concepts of performance has since taken place in the *Performance Studies*. Besides Austin or Judith Butler, many also see Wallace Bacon as the father of Performance Studies. In his confrontation with literature he finds the following words for the performance: *Our center is in the interaction between readers and texts which enriches, extends, clarifies, and (yes) alters the interior and even the exterior lives of students [and performers and audiences] through the power of texts.* [20].

Building on this, Richard Schechner also provides theoretical foundations by differentiating between two categories in his book *Performance Studies: An Introduction* [68]: artistic and cultural performances. While artistic performance is marked as art (solo-performance, performance art, performance of literature, theatrical storytelling, plays, performance poetry), cultural performances are actions and events that can appear and repeat themselves in everyday life (rituals, religious ceremonies , community festivals, controversial storytelling, performances of social and professional roles, individual performance of race, gender, sexuality and class).

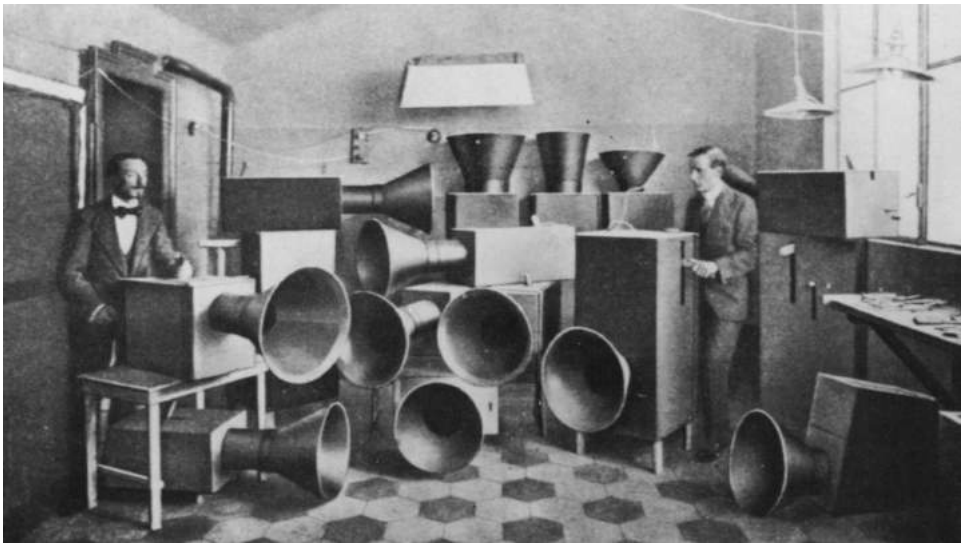
Anyway, this new emerging interdisciplinary - or post-disciplinary - research is difficult to pin down, as the concept of performance, as we can see, is so complex and ambiguous.

Performative Turn In the exploration of performance by artists and cultural and social scientists, the term has expanded considerably. Today it refers to much more than in the 1960s. Speech-act theory, the use of the performative in the context of theatre events or the limitation to the analysis of the link between literature and society are far too brief today. The sheer mass of parallel and crossover uses of the concept of performance, the separation into several layers of meaning and sciences and also the radical development of performative expressions in art have led to a *performative turn*.

The nature of the relationship between subject and object, observer and observed and artist and audience has been refigured to create a dynamic and transformative event. There is no separation between the production and work, and the audience becomes part of the work. The performative turn has transformed the work of art into an event. [29].

While it is in the sphere of theatre and performance studies that the concept of performativity has most decisively been embraced, in the visual arts it was ushered through happening, body art, action painting, and was continued with performance art, light sculpture, installation, immersive environments and art events. In music, John Cage's works, influenced by FLUXUS, led to pieces and performances that transformed themselves instrumentally into a performative musical practice. In literature, however, the reader becomes an active shaper of the text. Hybrid text and interactive novels, even hypertext could be attributed to the performance of literature as a literal realization of Roland Barthes *writerly texts* [5].

Even the occupation of the *Volksbühne* in Berlin in 2017 as a protest against the change of the artistic director to Chris Dercon is pervaded by the motif of performance. On the



2.19 Intonarumori (1910), Luigi Russolo

one hand, activist groups from the collective *Glitzer zu Staub* have resisted performatively against the takeover of the *Volksbühne* [59][35]. On the other hand, in its opening program the new director Dercon demonstratively used works of performance to stage a reconsideration and institutional critique of the theatre itself [10].

Between Futurism and Bauhaus

But let's go back to the beginning of the 20th century to get an insight into the forerunners and pioneers of modern performance art.

The Futurists, a new Italian avant-garde movement, at the beginning of the 20th Century, were the first to proclaim a radikal separation from traditional notions of art and theater and the break with established art. Through manifestos, provokative stagings, literature that disdained all rules of writing, they pushed themselves into the middle of society which had only recently been shocked by technological developments and the dawn of modernity, claiming to create a new culture.

And although art studies rightly ascribes the work of futurists mainly to the fields of literary, painting, theatre and music, RosaLee Goldberg explains in her book *Performance Art* that the first eruptions of futuristic expression, just as those of Dada and Surrealism, were rather of performative nature. The play *Ubu Roi* by Alfred Jarry [44], a wild and bizarre exaggeration of traditional theatre practices, can be understood as a symbol of this newly acquired will to overcome cultural rules, norms and conventions by provocation. The Italian poet Filippo Tommaso Marinetti, who with his *Futuristic manifesto* [52] introduced this new era, and who in this manifesto celebrated unconditional taboo-breaking, glorification of violence, aggression, speed and war, is also likely to have been deeply influenced by his visit to the premiere of the Jarry piece in Paris in 1896.

The performances, including various futuristic readings, plays and discussions of the manifestos throughout Italy gained fame beyond the borders of the country thanks to their radical and provocative gestures.

Russolo This radical reinterpretation and reassignment of the social environment to art led, among other things, to a new understanding of music. Influenced by Marinetti's public performances of texts from his book *Zang tumb tumb tumb* and his emphasis on the *orchestra of the great battle* accompanied by simple noises, the painter Luigi Russolo began to research the art of noises.

In the context of industrialization and mechanization, new sounds aroused his interest: the rattling of trams, explosions of engines, trains and the shouting of crowds. In 1913 he published the manifesto *L' arte dei rumori* [67] and began to develop his own instruments that could reproduce these sounds as much as possible. The first performances with those *Intonarumori* (Fig. 2.19), among others at the Coliseum in London, unsettled and provoked the visitors no less than Marinetti's *onomatopoetic artillery*. In a review of the London concert in June, 1913 London *Times* calls the instrumentalists of his orchestra *noisicians* and reports about how the audience from all corners of the auditorium pathetically shouted in order to stop them.

Mechanization of Movement Later on, noise music was often involved in performances, at least as a background. The Futurists also played with concepts such as the *mechanization of movement*, for instance to be found in the notebooks of the English director and actor Edward Gordon Craig, who, thinking even further than just the mechanization of movement, suggests the idea of an *Übermarionette*: replacing the actor by a puppet [42], as an expression of the actor's full subordination to the artist's will. Later Futurists included the concept in their work, such as Gilbert Clavel and Fortunato Depero in their successful *Plastic Dances* with several less than life-size marionettes.

Based on those ideas Futuristic Ballets evolved. Ivo Pannaggi designed mechanical costumes in 1919 for the piece *Balli Meccanichi*, where the figures were placed in a painted stage setting. Later the setting itself and the auditorium, with the help of moving elements, light and sound, became the subject of the performance. The experiments later condensed to *Synthetic theatre*, in which everything was possible, among other things also the reduction of comprehensive content to only one gesture, or the declaration of objects as main actors.

One section of synthetic theatre was the concept of *Simultaneity*. Performance as result of immediate improvisation or intuition, and not as result of years or even centuries of studying, was perceived as the only way to reflect and expose reality with its *fragments of interconnected events* [33], encountered in everyday life.

Dada and Surrealism Analogous and inspired by the public presentation of convictions and provocative manifestos of the Futurists in Italy, Hugo Ball staged evenings in Zurich, Switzerland, soon afterwards, in the small club *Cabaret Voltaire*. The first events were celebrated in 1916. Surrounded by futuristic posters, Russian chansons were sung - and simple poems were recited. Under the claim that *Cabaret Voltaire* was an open space to which all young artists were welcome, regardless of their orientation, to make suggestions and contributions. So artists and poets joined the circle and a group formed around Tristan Tzara, Hans Arp, Richard Huelsenbeck and Marcel Janco. On the evening of March 30th they performed a poem together for the first time - the audience was enthusiastic about what was later called *simultaneous poem*. Perhaps this evening symbolizes the beginning of *Dada*, first in the form of a newspaper and later as an international movement.

A central form of expression by the Dadaists was the *Lautgedicht*. Hugo Ball performed it for the first time on a Dada evening in a bulky costume and later called it *verses without words*, such as *Gadji beri bimba* (1916) or the *KARAWANE* (1917) (Fig: 2.20, 2.21). The sound poems are a confrontation with language itself, criticism of journalism and the

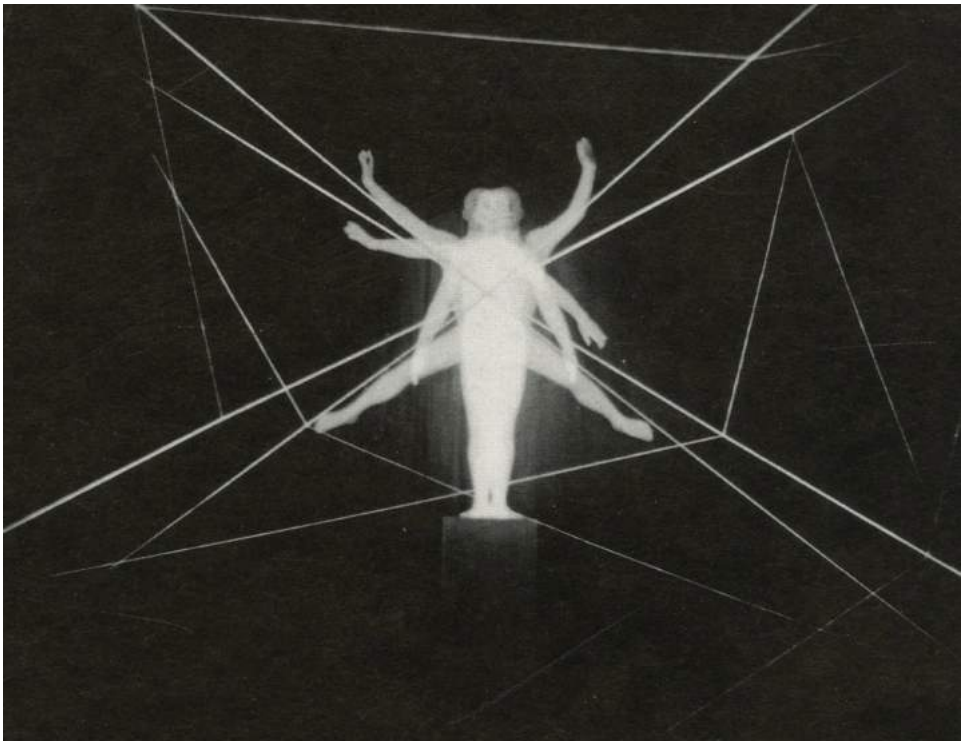
KARAWANE
jolifanto bambla ô falli bambla
grossiga m'pfa habla horem
égiga goramen
higo bloiko russula huju
hollaka hollala
anlogo bung
blago bung
blago bung
bosso fataka
ü üü ü
schampa wulla wussa ólobo
hej tatta gôrem
eschige zunbada
wulubu ssubudu uluw ssubudu
tumba ba- umf
kusagauma
ba - umf

2.20 Sound poem *Karawane* by Hugo Ball (1916)

2.21 Hugo Ball in cubistic costume (1916)

inflationary use of language. The *Ursonate* by Kurt Schwitters has become widely known among others. Significantly, it has not only been handed down as a text, but also as a score and above all as an audio document. The development of a new consciousness for the performative parts of the literary work itself is particularly evident here.

In this early period of the 20th century with it's hunger for the new, Dada was quickly adopted and further developed. The inclusion of Sigmund Freud's research about the dreamlike, the unconscious, the absurd and the fantastic provided new creative impulses - and while Dada was rather satirically influenced, the *Surrealism* proclaimed in Paris by the writer André Breton deals with the exploration of new experiences in a world *above realism*. According to Breton's definition in the *Manifesto of Surrealism* he searched for the *pure psychic automatism* [76]. Automatic writing and painting were just as much a part of it as the immersion in the dream world. Imagination should be the exclusive inspiration. The control by logic and reason became superfluous. Surrealistic works like the *Theater of Cruelty* by Antonin Artaud [3] strongly influenced the later *Theater of the Absurd*.



2.22 *Delineation of Space with Figure*, Oskar Schlemmer (1927)

Bauhaus At the same time the surrealists established themselves in Paris, an academic institution emerged in post-war Germany, in which Walter Gropius - unlike the rebellious surrealists and Dadaists - called for a unification for all arts in the *cathedral of socialism*. The newly founded *Bauhaus* attracted numerous artists from all regions and countries to Weimar, a small town near Berlin with a great cultural tradition. It was the *Bauhaus*, which for the first time ever offered a course in performance, the so-called *Stage workshop*. Initially a continuation of expressionistic ideas, Oskar Schlemmer quickly took over the stage workshop and was able to expand his ideas in the play *The Figural Cabinet I*. Figures that move, stand, flow, glide or roll as if mechanically, created a *Babylonian confusion, full of method, a pot-pourri for the eye*, as Schlemmer described it [33]. This series of performances reflected the task the *Bauhaus* set itself, a very successful combination of mechanical devices and pictorial design, in short the combination of art and technology.

Parallel to the more and more frequent performances and activities, which could also take on satirical or absurd traits, Schlemmer developed his own theory of performance. In it he investigated the fundamental problem of combining theory and practice in a teaching institution. In addition, he was not shy to use Greek mythology as an analogy: namely, the comparison of Apollo as the god of intellect and Dionysus as the god of wild festivities as an analogy to theory and practice. In order to illustrate his abstract considerations, he created a notation system for the piece *Gesture Dance*, in which the linear paths of motion and the movements of the dancers were graphically recorded. For Schlemmer, notation was the theoretical space, while the performance itself represented the practical space.

Questions of spatial division, opposition of visual plane and spatial depth moved many of the *Bauhaus* participants, and in discussion the notion of a *Raumempfindung* arose. Schlemmer argued that geometric shapes such as lines, circles and diagonals lead to a stereometric space, whose lines a dancer could follow. He visualized this space experimentally during a lecture-demonstration: together with students, he divided the floor space into geometric figures and then continued the figures upwards using taut wires. The result was a spider web-like structure, the *spatial linear web*, in which the dancers moved along the wires performatively (Fig. 2.22). The *Dance in Space (Delineation of Space with Figure)* could be called *mathematical dance*, or *space dance* or *gesture dance*. In addition, while moving in the net, the dancers were masked and the space was decorated with elements of varieté theatre and circus.

Performance Art as established Art Genre

After the foundations for the performative appearance and presentation of artistic positions and the involvement of the public as an active component of artistic and literary expressions were laid down by the Futurists, this form of expression becomes increasingly recognized as an established way of confrontation and art, also in *Bauhaus*. With live art, happening, interventions, experimental theatre and above all the artistic works of Fluxus, a conceptual and artistic universe was developed that extended to all genres, and signifies the dissolution of traditional perceptions to music and dance.

For the musician John Cage and the dancer Merce Cunningham for instance, the earlier recognition of everyday noises from Russolo is now not only part of modern musical compositions, but also extends to movement sequences. According to Merce Cunningham, actions such as standing, running, bouncing and the full range of natural movement sequences should also be regarded as dance. On top of that, coincidence as a conceptual component of the composition receives its first attention, as can be seen in *Sixteen Dances for Soloist and Company of Three* (1951) by Merce Cunningham.

Many more performative works were to be created in the following years - too many to introduce every single one of them here. Whether it is the singer Meredith Monk, the artist Joseph Beuys, or later even Christoph Schlingensief, the list is getting longer every year.

Herman Nitsch, who can be counted among the Viennese actionists, refers in his works to ritual, involves blood and speaks of Dionysian rites, and in his piece *Orgies, Mysteries, Theater* (1974) resurrects the catharsis in the form of fear, terror and compassion. Maria Abramović works with existential performances on the limits of the body, as in *Lips of Thomas* (1975), in which she excessively consumes large amounts of honey and red wine and then cuts a five-pointed star into her stomach. The artist couple Gilbert George reinvented the concept of sculpture in *The Singing Sculpture* (1969), where they stand on a table, covered in paint, and pose in mechanical movements, singing a song from the Second World War.

Performance Art also finds its place in the interface of the art world and music scene. While Laurie Anderson plays pre-recorded samples on her self-developed violin to experiment performatively with words and storytelling, as in her piece *Ethics is the Aesthetics of the Few (ture)* (1976), Cosey Fanni Tutti and Genesis P. Orridge experiment as *Throbbing Gristle* with punk performances and highly provocative exhibitions, such as the exhibition *Prostitution* at the Institute of Contemporary Art in London, in which a documentary of Cosey's activities - as a model in a pornographic magazine - is shown.

In the intersection of the genres, large-scale works such as Wilson's *Einstein on the beach* (1976) emerge - a five-hour spectacle of extraordinary proportions, featuring music

by Phillip Glass and dance and choreography by Andrew deGoat and others. In dance, the works by Pina Bausch stand out as the ultimate dance theatre. They combine classical ballet, natural movements and the means of repetition. Using methods of collage and montage, she created a series of images at the border between reality and dream, demanding enormous mental resilience and the ability to perceive nuances from the spectator, like for instance in *The Rite of Spring* (1975). In Belgium, Jan Fabre develops performances such as *The power of Theatrical Madness* (1986), which unite expressionist drama with both physical and metaphysical violence and imagery projected behind the actors.

And although the discussion of this topic is infinite, I would like to leave the general study of Performance Art and focus on the interrelationship between performance and technology, and introduce some selected artists who explicitly used modern technologies to convey their visions.

Performance and Technology In the history of Performance Art, maybe the first huge collaboration of technicians and artists takes place at Bell Laboratories in New Jersey. Performances were shown that were not only developed by artists, but also required the expertise and collaboration of engineers and scientists. Coordinated by Robert Rauschenberg and Billy Klüver, 10 artists and 30 engineers worked together for 10 months on a pioneering program, a series of works entitled The *9 Evenings - Experiments in Art and Technology (EAT)*, which for the first time create and use new technology for art and theatre. The participants included John Cage, Deborah Hey, David Tudor and Robert Whitman. I would like to emphasize the work *Open Score* (1966) by Robert Rauschenberg. The two-part performance first shows a tennis court in which two tennis players compete against each other. The interaction of the racquets with the balls, the moment when the ball hits the racquet, is recorded acoustically by highly modern technology, transmitted via radio waves and played back over large room systems. At the same time, the impact of the balls triggers a system of 36 floodlights that periodically tear the room out of darkness. In the second part of the performance, 500 people are led into the darkness of the hall to follow instructions from Rauschenberg. They are filmed by infrared cameras whose image is projected onto three large screens in front of the audience.

This performance achieved a consolidation of technology and artistic concept that was ahead of its time. The effect on the audience is hard to imagine, given that most of them had never seen anything like this before. The *9 Evenings* mark the beginning of a tradition in which performance and technology enrich each other.

Even though ten years earlier Atsuko Tanaka, a member of the Gutai Group in Japan, was already working with electrical elements in his wearable installation *Electric Dress* (1956), the then growing influence of technology on human life was now increasingly taken up by pioneers like Nam June Paik, as in his work *TV Cello* (Fig. 2.23), in which he commented on simultaneity, transmissions and mass media. Stelarc also discussed the implications of modern technology on the human being, as for instance in the performance *Third Hand* (1981), which also showed how the idea and vision of the Mechanical Doll in the *Bauhaus* of the 1930s had now become reality.

The mutual influence between technology and performance since then has increased and consolidated, as has Performance Art in general. Influences such as the concept of *cybernetics* in art, first summarized and publicly shown at the exhibition *Cybernetic Serendipity* (1968), demonstrate the power of mixing art and technology. Publications such as Marshall McLuhan's *Understanding Media*, Roy Ascott's *Behaviourist Art and the Cybernetic Vision* and others try to explore and analyze the field. Interactive art, kinetic art, computer art and new media art in general continue this development.

2.23 Charlotte Moorman performing on *TV Cello* by Nam June Paik (1971)

2.3 Performative Spaces

In this section I will try to give insight into a small number of theories and assumptions about the construction of public space, in which performance art also happens, as this is the place where *Homo Restis* is mostly performed.

The appearance of *Homo Restis* in public places changes the place temporarily and creates a new space of its own - a temporary stage, a comprehensive situation that dissolves with the end of the performance and releases the audience into their everyday life.

Now there are different perspectives on what a place, a space or public space is. I will try to sum up a classification, in which it will be possible to illustrate what we are dealing with.

The Public Sphere

The question of what a public space actually is, initially appears to be answered easily: it is a social space which members of society have access to and can participate. Spaces of interaction, such as streets or parks, places where people shop, places where they celebrate. But what actually constitutes a public place and how can one derive a general concept from it?

According to Jürgen Habermas' concept of the public sphere, its emergence is linked to the development of democracy [37]. Ancient Greeks had laid the foundation in the *Polis*, a structure that is defined by its political participants. As Hannah Arendt explains in her book *The human condition*, the *Polis* is a place of political activity and confrontation, also called the political sphere, while natural needs, retreat and contemplation are attributed to the private sphere. In the course of time, however, the concept of a private sphere expanded by manifestation of *individuality*, summarized as *ascension of the social* [2], into the public sphere as a metaphorical and superior place of earlier family structures. According to Arendt, the public sphere is characterized by *that which is common*, which means what is seen, perceived by everybody, and which also means the world that is common to us all, which *assembles all of us* [2].

The sociologist Henri Lefebvre takes on a different approach to the explanation of public space, stating that space itself is not a matter, object or thing, but a manifestation of social relations. He continues to assume that we are *confronted not by one social space but by many - indeed, by an unlimited multiplicity or uncountable set of social spaces which we refer to generically as 'social space'.* [49]. According to him, social spaces can be shopping malls, marketplaces, schools or parks that are constituted by human and social activities such as for instance shopping, strolling, sitting or selling. These spaces can also overlap, are immaterial and boundless and are connected with all other areas of society. They are created only through practice, through the activities of social individuals, in which even *every society[...] produces a space, its own space* [49]. When asked what exactly occupies a room, what exactly creates this production process of space, Lefebvre answers *A body - not bodies in general, nor corporeality, but a specific body, a body capable of indicating direction by a gesture, of defining rotation by turning round, of demarcating and orienting space.* [49].

Fictional Space

Public spaces, however, can be regarded not only in terms of their public character, but also in connection with a concept of space from philosophy: the concept of heterotopy, analyzed and described by Michel Foucault.

With this term Foucault describes spaces, also public places which deviate from reality or the system reflecting them, as *l'espace autre* [31]. Heterotopias are difficult to grasp. They can be places that contain other places, or that suspend time and install a new time.

It is not utopia to which Foucault refers, because while *l'espace autre* still intersects with a real place, utopias are completely detached from a connection to the real. And even if utopias have a general relationship to society, if they have a direct or inverse analogy to the structure of society's reality, they are always unreal places. Places that don't exist anywhere.

It is obvious that there are spaces that exist in real society and develop in its midst, but that are still *counter-spaces*. Spaces in which a utopia has been realized or in which a counter-reality exists, parallel to the prevailing culture. These are places which, due to their nature, can almost be described as fictitious spaces. Places where even the time continuum is different. *I call them heterotopias, unlike utopias*, says Foucault in 1984 [31].

These quasi-fictional spaces can appear everywhere and in all societies. They can also appear and disappear again. They can alternate with other fictional places, such as theatrical scenes within the rectangle of the stage or movies in the cinema.

Yet another aspect of Foucault's heterotopia is the dissolution of traditional time. The accustomed course of time is interrupted and replaced by a new time and speed, or alternatively by eternity. Entering the cemetery is accompanied by a departure from the usual time and a confrontation with a Christian eternity. Foucault terms this shift in time perception *for the sake of symmetry, heterochronies.* [31].

He also talks about a system of opening and closing as a constituent principle of heterotopias , i. e. the fact that heterotopias are generally not freely accessible, such as public places. These could be admissions that are obligatory, such as in prison, or submissions to specific rituals or purifications, or the necessity to make gestures or show permissions.

Also Foucault's heterotopias always have a function in relation to the remaining places and spaces. These can also be extreme positions: either the task of creating an illusion that supports and highlights the real place, or the creation of an ideal place that is tidy and perfect whereas reality is unclean and dirty, as a kind of compensation for the imperfection of the world.

Heterotopias can perhaps be seen as manifestations of fictional spaces in reality, paths that take us into a fictional world. And the fictional world can begin at any place, for instance rituals, as already mentioned, can open access by transforming the whole place into a heterotopy. Theatre performances in found places work according to this principle. There the found places are transformed by the presence of the theatre, they become temporal heterotopias, temporal works of art as *ready-made spaces* [80], as they are called by Liina Unt. Spaces that can therefore possess various layers of meaning, a representation of a utopia within a real world, with a fictional time or fictional rules.

In literature there are many works in which writers create heterotopias. For example Haruki Murakami, who in his books succeeds in mixing reality with a pervasive counter-reality, as in *Hard Boiled Wonderland*. [58]. Surrealistic situations arise in the middle of an everyday world. In the style of a *magical realism* he describes how parallel worlds begin to mix. Murakami cites Franz Kafka as one of his role models, whose book *The Transformation* also puts the protagonist into a heterotopic situation.

In art, among others, Manaf Halbouni creates heterotopias when in his work *Nowhere is Home*[1] he presents modern nomadism as a result of displacement in the form of a fully packed small car. Or if he places, as with *Monument*[2], three buses upright to central places of remembrance in Germany, as a reminder of the siege of Aleppo in Syria.

The Dresden artist Marten Schech builds houses, among other things. Houses that are located in unusual places and that either have no roof or are otherwise detached from their function. In 2011 he built a house from bricks found on the property of the Dresden Academy of Fine Arts under the title *Pfotenhauerstraße 86a*[3]. Most of the bricks came from rubble from the Second World War. The house looks as if it has been standing on the property for more than 100 years. It is a place that is not what it looks like, and a house that cannot be used in the true sense of the word.

Julius von Bismarck creates *posterior heterotopias* with his work *Image Fulgurator*[4], in which he retrospectively modifies the moments of memory and details of reality. Jim Whiting creates changing spaces in a completely different way with the help of air pressure and mechanics. He animates tables, chairs and cabinets, which dance unexpectedly in *Bimbo Town*[5].

Ryoji Ikeda also creates an audio-visual heterotopia with his installation *Test Pattern*[6], in which the audience moves in a rhythmic world of black and white geometries and associated sounds. This audio-visual appearance has again similarities with the performance piece *Apparition*[7] by Klaus Obermaier from 2002, in which the performers partially disappear into the projections in front of a projection screen.

The Croatian *Sea organ* in Zadar can be considered *architectural heterotopia*[8]. Built by the architect Nikola Basic, incoming waves push air through tubes underneath the marble stairs, creating harmonious sounds.

Heterotopic Interfaces

In the context of places and situations where reality and utopia overlap, I wonder if there are also heterotopic interfaces in the form of human-computer interaction? How could heterotopic interfaces be described? Perhaps as machines, tools or devices that manage to reorganize and reinterpret places in the sense of Foucault through their construction and operation. These could be temporal structures, spatial orders, illusionary spaces or compensatory spaces.

In order to do this, they would have to be able to intervene in and transform certain aspects of human and social perception. Musical instruments that engage with the circumstances of the places in such a way as to create new, higher-ranking places or non-places. Aspects of this could be variations of entrance rituals or the conscious creation or destruction of spaces that deal with the conventional experience of the world.

Virtual reality comes to my mind as the first technology to create any kind of reality through the highest degree of virtual immersion and interactivity, for example the *Oculus*

[1] https://www.manaf-halbouni.com/work/nowhere-is-home/
[2] https://www.manaf-halbouni.com/work/monument/
[3] http://martenschech.tumblr.com/
[4] http://juliusvonbismarck.com/bank/index.php?/projects/image-fulgurator/2/
[5] http://www.bimbotown.de
[6] http://www.ryojiikeda.com/project/testpattern/
[7] http://www.exile.at/apparition/
[8] http://www.zadar.travel/en/city-guide/attractions/19-04-2007/sea-organ

Rift[9]. But also the Amsterdam multi-channel audio station *4DSOUND*[10], in which spatial sound and sonic environments are created in an immersive way.

A musical example of a heterotopic interface could be the bed-like constructions of Josefin Lindebrink in her work *Habitat*[11], on which the visitors can lay down and then flood their bodies with sound waves in a feedback loop. Another heterotopic interface is the *Fire Organ*[12] by Bastiaan Maris: an arrangement of several steel pipes of different lengths and heights, which resonate through explosions of gas and create sound. The *Fire Organ* fills entire city parks with its dimensions and can still be played over two midi keyboards.

2.4 Summary

With the short excursions in the first part of this chapter into rituals, theatre, spectacle and marionettes, I wanted to show that the combination of masks, costumes and dance goes back to the early beginnings of human civilization; that greek mask dances can be regarded as the origins of modern theatre and also as the origins of modern performance art. The use of masks thus not only touches on the subject of disguises, for example during the carnival season, but also evokes much older symbols and ritual practices. The wearing of masks is nowadays permitted in public when it is an artistic context or when it is necessary as workwear. The covering of one's face is forbidden at public meetings and gatherings in Germany[13]. The Guerrilla Girls group[14] uses masks to focus viewers' attention on content during performances and actions and to protect the actors through anonymity. The masks and costumes created by Sarah Leimcke for *Homo Restis* are also reminiscent of early forms of masking. The face and the whole body are hidden and create space for interpretations and fantasies.

The theatre, in turn, condenses and transcends the earlier mask dances. In its 2,000 year history, it has undergone ruptures and changes up to the present day. In connection with *Homo Restis*, the cross-references that are visible in the described stages of the theatre's history seem to me to be particularly exciting.

Be it the transition from Dionysian masquerade dances to the tragedy in ancient Greece or the emancipation of theatre in the 19th century, the radical alienation effects of Brecht, the absurdity of Antonin Artaud, or the dissolution of traditional elements from theatre to collage-like, performative pop culture, in a way, these historical events and changes correspond to the allusions and motivations behind *Homo Restis*. Inspiration also came from recent theatre makers like the Belgian company *Peeping Tom*[15] with its hyperrealistic aesthetics or the *Cie. FREAKS UND FREMDE*[16], a Dresden company that celebrates the unusual and the encounter with the foreign as a threat and opportunity.

Homo Restis' analogies with masks and theatre history extend to the question Debord poses in his *Society of Spectacle*: whether art can find a new way of dealing with our society. The fact that Sarah Leimcke and I try to recycle our materials, for example for

[9]https://www.oculus.com/rift/
[10]http://www.4dsound.net/
[11]http://www.josefinlindebrink.com/habitat/
[12]https://www.youtube.com/watch?v=Jn4kGWaYc8I
[13]http://www.gesetze-im-internet.de/versammlg/VersammlG.pdf
[14]https://www.guerrillagirls.com
[15]http://www.peepingtom.be/
[16]http://freaksundfremde.blogspot.co.at/

the costumes, that we try to produce our own equipment by knowledge acquisition and manual work, that we try to oscillate (unpaid) between work, research and play, perhaps even shows some exemplary ways to escape from consumerism and supersaturation. Plus *Homo Restis* as a performance in public space can also be seen as an anti-spectacle, as an attempt to transcend kitsch by exaggeration.

In the second part of this chapter I introduced *Performance Art* and its various precursors and characteristics. The word performance itself has undergone a change of meaning and today stands for many different activities, which is one of the reasons why the excursion to Futurism, Dadaism and Bauhaus is enlightening. In these revolutionary art movements at the beginning of the 20th century, performative elements are part of a new perspective on art and society and are situated between fine arts, literature and poetry. *Homo Restis* is related to the resilience of these early surprises and provocations. The use of absurd moments and the break-up of expectations are attributes that this artistic avant-garde prepared 100 years ago.

Both Russolo's attempts to recognize noises as an equivalent sound basis, or the replacement of actors with mechanical puppets, such as in futuristic ballet, are clear references and traditions of a reinterpreted open style of theatre and performance.

Especially the historically first performance class under Schlemmer in the Bauhaus is interesting with regard to *Homo Restis*. His geometric spatial analyses are related to the structures that emerge temporarily in public space during the performance of *Homo Restis* and its string-based interfaces.

The references between *Homo Restis* and the public spaces and fictional spaces are no less exciting. When I describe with Hannah Arendt the appearance of individuality as the origin of the public sphere as an extended family, the costumed adventures of *Homo Restis* actually correspond more to counter-individualities, whose costumes and interfaces create space for temporary heterotopias, for the transformation of places into *other places*.

It is also interesting to apply Foucault's concept of heterotopia to interfaces, also because the interfaces in *Homo Restis* contribute a large part to the transformation of the performance space.

PART 3

NEW MUSICAL EXPRESSION

Over the last 100 years, the way we understand music and the use of musical instruments has changed profoundly. This is largely due to the technological revolution, the development of digital technology and the opening up of electronic and scientific concepts to the interested music community.

Today, the possibilities and the courage to find one's own ways in musical expression are much broader and more comprehensive than was possible for a long time. Sensor technology, computer interaction, networks and modern concepts have become a foundation on which to develop a new design language, to realize new concepts and to test new theories, based on the experience of several generations of developers and musicians.

However, new developments are always based on a long tradition and technological-artistic predecessors. Dealing with new instruments one should be aware of the origin and specificity of instruments and approaches in order to position oneself within the broad spectrum.

Therefore, leading towards the realization of *Homo Restis*, I will first talk about the encounters of early human beings with sound itself, and exemplarily about the development of individual instruments, with a focus on those instruments that make use of electric currents. Subsequently, I will talk about topologies, interaction modes, portable technology and other aspects.

3.1 Traditional Instruments

Early Sounds

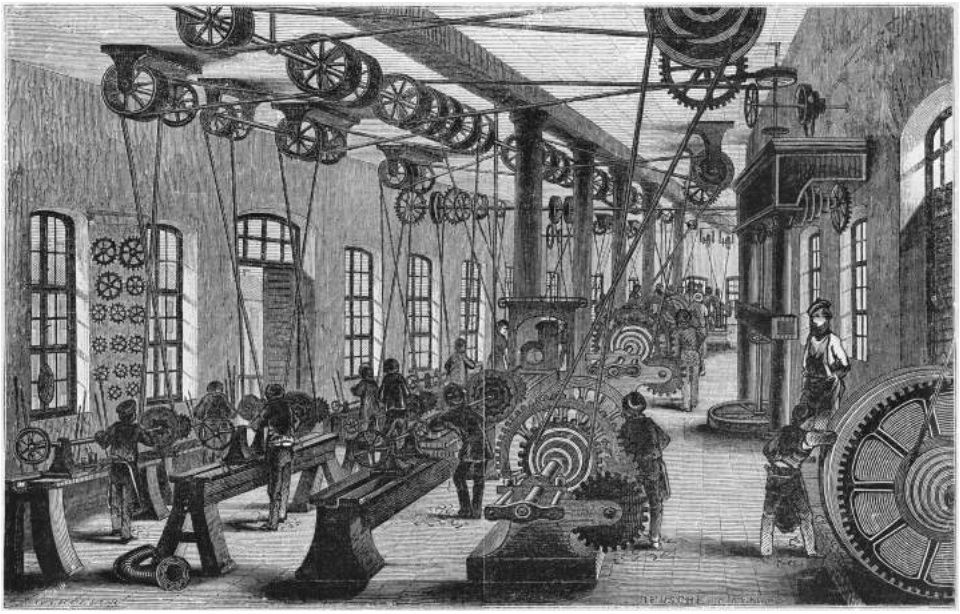
The making of music, the producing of sounds or making of sounds is historically proven from to the beginnings of mankind. Man has always wanted to express himself musically. What probably started with the voice as the only instrument in the beginning was quickly transferred to external tools of sound generation. The reasons why early humans began to deal with sound production are unknown. Maybe it began with the hunt and the realization that screaming or drumming is suitable for driving animals together and therefore better for hunting. Perhaps it was also a protective function or warning function that was originally intended to drive away animals and dangers - just as gorillas beat their chests, wolves growl, and rattlesnakes indicate danger by the rattling of their tails. It is also possible that the creation of sounds early on was a kind of communication that enabled the organization of the human being in his community, which shaped the exchange of information and social interaction.

Whatever led early man to recognize the creation of sounds as useful, it continued. Probably, with the discovery of tools as an aid for practical everyday life, an intuition that tools can also be used to create sounds arose quickly. These might have been simple wooden sticks that were used to drum on other pieces of wood or stones.

First Instruments Apart from the human voice and the human *percussive* limbs like hands and feet, historical findings show that instruments such as flutes (see Bone Flute, Swabian Alb, 35000 BC.) and drums (Neolithic alligator skins, 5000 BC.) [51] were among the first instruments of human history.

However, the first instruments probably date back much further into the past, but have not yet been discovered. In Schöningen, a small town near Magdeburg in Germany, archaeologists made a spectacular discovery in the 1990s: they discovered several almost completely preserved spears. The age of the spears is estimated at about 300000 years. They were made with such efficiency and precision that it was possible to achieve throwing distances of up to 100 meters. Sport scientific investigations and experiments with replicated spears prove the craftsmanship in the construction of hunting weapons 300,000 years ago. It seems obvious that the people of that time used their tools not only for hunting, but also to create sound. In view of the fact that fireplaces, hunting equipment, eggshells and lice [78] were found at the same excavation site, it is assumed that paleolithic man was culturally developed far higher than hitherto assumed.

Temporal Artform But let's first go back to the beginnings of music and historical instruments. Music is a temporal art form. Sounds are products of time, phenomena embedded in the moment. This includes today's scientific consideration of sound waves as temporal physical events, but also the cultural perception of sounds as accentuations and emphasis of the moment in festivals, celebrations and rituals. As already described in the chapter on cult dances and celebrations in the worship of the god Dionysus in ancient Greece, in early ritual festivities, besides masks and dance, sounds were used to signal a special moment and to make the participants of the rituals aware of the meaning and mood of the festivities taking place. In this respect, playing music had a metaphysical meaning very early on - as an adjunct to religious and ritual acts. This importance and significance has also sharpened the attention for the tools of making music and directed the focus on the artful production and creation of instruments - as can be seen in the ornaments and other artistic accessories (cords, pendants, paintings) on the instruments of human history.



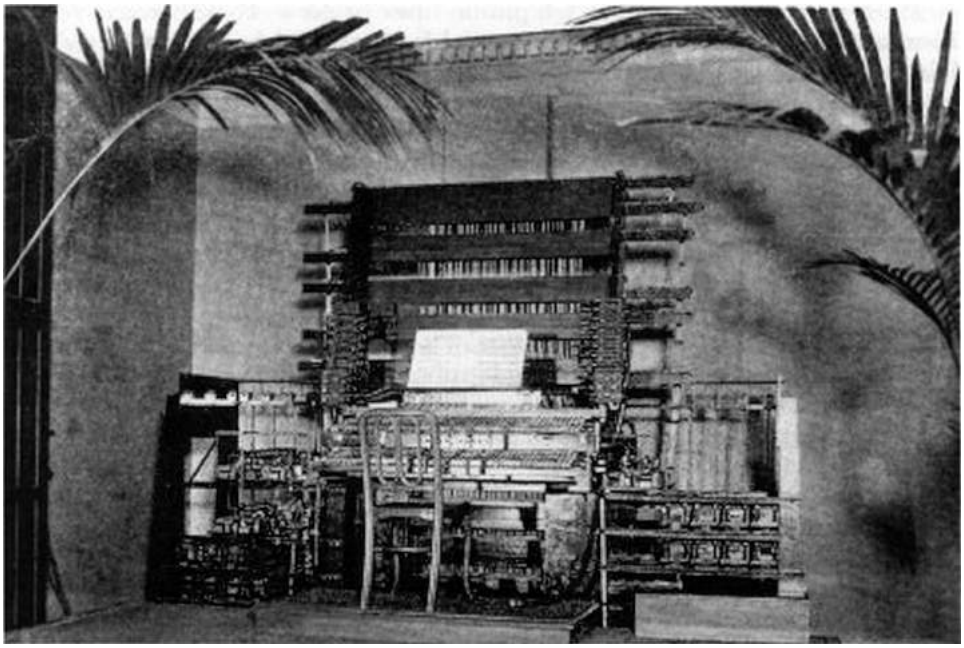
3.24 Transmissionen in Fabrikhalle Maffai bei München (1849)

The ambition to devote oneself to the production of instruments came from a spiritual attitude and worship, so to speak. It was not only the desire for sound itself that drove the developments, but also the perception of sound as a sacred action. It is therefore not surprising that this ambition was aimed at further developing these instruments according to the respective possibilities in order to consolidate and raise spiritual practice anew.

Technological Correlations The development of musical instruments has always correlated with current technological developments. Here, the technical understanding must be considered as embedded in a cultural nature, such as Phytagoras' analysis of the frequencies of tones in ancient Greece, or the dynamic sound generation on the piano in industrial modern times using hammer mechanics (see section 3.2).

The discovery of electricity, which created a new genre of instruments, was not only a technical breakthrough but also marked by cultural social conditions. In the 19th century, a socio-cultural revolution took place in addition to the technical revolution. The mechanization of everyday life, electric light, the emergence of factories, conveyor belts or telephone systems has created the basis for a new perception of the world. Man was open and eager to reflect this new world artistically (Fig. 3.24).

It is an interesting question to what extent this dynamic - the dedication towards playing and developing instruments as a spiritual task and reflection of the technical and cultural circumstances - applies to our present time as well as to the beginnings of the human communities of the past. If one assumes that the suppression of religion as the dominant reference point in modern Western society has created a vacuum that has now been replaced by faith in progress, technology orientation, consumption and cultural events, then the occupation with music and the development of new instruments ultimately takes place for a similar reason as thousands of years ago: the dedicated creation of meta-physical moments in a condensed reality.



3.25 *Telharmonium* by Thaddeus Chaill (1897)

String-based Sound Creation

Human innovation has brought about a multitude of instruments. The classification at Hornbostel-Sachs gives an overview of the different sound generators, which are categorized according to the type of their sound generation [41]. Until the beginning of the 20th century, there existed four large groups: the idiophones, membranophones, chordophones and aerophones. The most common and well-known group among them are undoubtedly the chordophones or string instruments, instruments that use the vibrations of a string to produce sound. They are mainly divided into two groups, those that can be played in principle without a resonating body, such as piano or zither, and those in which the resonating body is necessary to produce tones, such as the lute or violin.

The string itself has a long history. In ancient Greece Phytagoras examines the frequencies on the basis of the division of the *Monochord* [18], an instrument with a single stretched string. A combination of instrument and weapon is the *Berimbao*, an instrument that uses both a string to produce sound and a resonating body that amplifies the sound of the string. It is played with a mallet that hits a long string, while with the other hand the length of the string is shortened to produce altered pitches - similar to later instruments such as the sitar, guitar, violin or cello.

As a flexible sound generator, the string has proven its worth to this day. In addition to electric versions of traditional guitars and violins, there are also new instrument developments such as the *Yaybahar* (2014) by the musician Görkem Sen. This instrument combines the use of several single strings and resonators and can be played with both the hand and the bow. The sound is unique, rich and is reminiscent of alienated synthesizers.

The string as an electronic controller for sound generation appears for the first time with the *Trautonium* (see section 3.1), where touching a metal string defines creation and pitch of sound.

In his piece *Music on a Long Thin Wire* (1977), the composer Alwin Lucier uses only a single string, which is stimulated by an electromagnet across the room. The vibrations are picked up electronically and played back by a loudspeaker. A comparable set-up took place in 2013 in the exhibition *Architecture and Sound* curated by Andre Zogholy at Architecture Forum in Linz called *afo*. Under the title *SHARP SINE SQUARE WIRE CHAMBER TRIO* Clemenz Bauder and Ilpo Väisänen fixed several strings to the walls of the gallery room and thus let the architecture create sounds through their oscillation[1]. In digital sound generation the *Karplus-Strong algorithm* tries to emulate the acoustic sound characteristics of the hit and vibrating string [57].

The digital network in form of the Internet can also be associated with a network of individual strings. In works like the *Soundnet* or the *Global String* by Atau Tanaka these virtual conditions are materialized and made visible [77]. A modern version of the *Monochord* and an instrument which combines the production of analog and digital sound material is the *String-Board Controller*, which takes up the topology of a single string, but also makes the vibrations available and processes them as digital data [56]. Chris Chafe even tries to use the virtual network connections as sound platforms with works like the *Network Harp*. [12].

Another example is the use of the string in a modified form in artistic performances, such as for instance the artist group *Jung in Jung* and their piece *Thermosperic Station*[2] (2014), a performative examination of space and movement with the help of strings as distance sensors, which assign sounds to the movements based on the spatial positions as mediators between physical and digital spheres.

Electrophones

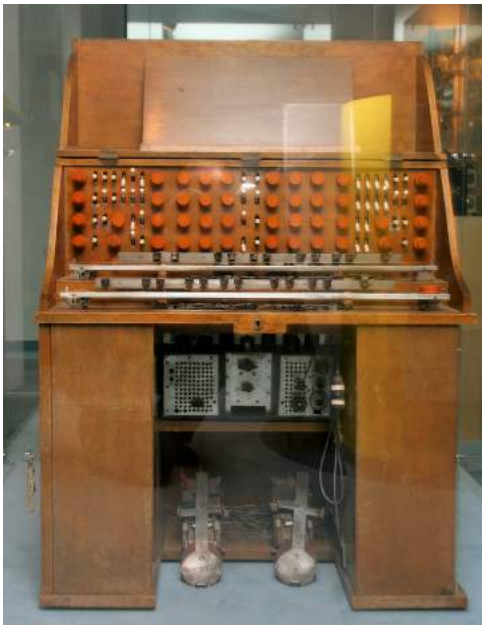
The development of traditional instruments was revolutionized with the advent of electric currents. Electric current as a starting point and inspiration led to the invention of a series of new musical instruments, the so-called electrophones, which were also included as a new genre in Hornbostel-Sachs in 1940. The first examples date back to the 18th century, such as the *Clavecin Électrique* by Jean-Baptiste Delaborde from 1759 [87], an instrument that uses a warning-bell system to generate sound, a kind of electric carillon with electrically controlled mallets.

A first example of the synthetic production of sound is the *Telharmonium* built in 1900 by Thaddeus Cahill (Fig. 3.25), an instrument weighing up to 200 tons, reminiscent of an organ. Sounds were generated electrically, by a complex system of gear generators, alternators and transformers [83]. It was able to produce different tonal colors by means of additive synthesis, whereby the tones could be played with the help of several keyboards and velocity dynamics.

In the following period at the beginning of the 20th century, many other new electronic instruments were developed, the operation of which was more or less oriented on the keyboard of the piano. These include the rather exotic and today difficult to find *Ondes Martenot*, the *Subharchord II*, the *Heliophone* or also the *Magneton* [17]. With Robert Moogs *Minimoog D* (1969), the development of electronic instruments reaches a moment in which these new instruments become portable and economically affordable. The *Minimoog D* is the first portable analog synthesizer to be used by musicians in the home studio and on stage.

[1]https://afo.at/programm/architektur-und-klang
[2]http://www.junginjung.com/thermospheric-station

3.26 Alexandra Stepanoff playing the *Theremin* on NBC Radio (1930)



3.27 *Mixtur-Trautonium* by Oskar Sala (1952)

This development is surpassed by the incipient computer technology, which represents a next development step. One example is the *Fairlight CMI I* (1979), an eight-part digital sampler and synthesizer that features a keyboard in addition to the monitor and computer keyboard.

Theremin The development of new kinds of interaction with musical instruments at the beginning of the 20th century is exceptional, as for example with the *Theremin* (1920) by Russian engineer Lew Termen, named after its inventor, later also known as aetherophones or thereminvox (Fig. 3.26). It is the first instrument that is not played by touch, but by precisely positioning the hands in the air in front of the instrument. In addition, it was possible to play tones of over up to 7 octaves on the *Theremin*. The induction principle through which the *Theremin* works was also used by Lew Termen to develop alarm systems that would indicate whether an intruder is in a secure room.

The *Theremin* has a wooden body with two antennas, one horizontal and the other vertical. These are the control antennas for pitch and volume. The pitch can be increased by approaching the pitch antenna, while the volume is reduced by approaching the volume antenna. The instrument is controlled by the electric capacity of the body. The sound is generated by means of two oscillators and their differential frequency, one oscillator being constant and the other variable and high-frequency. Positioning the right hand near the pitch antenna changes the capacity of the variable oscillator and thus the pitch. Positioning the left hand in front of the horizontal antenna changes the volume by changing the voltage.

The sound can be described as especially ethereal, supernatural, similar to the *Singing Saw*. One of the first performers was the violinist Clara Rockmore, who quickly brought it closer to a larger audience in large concert halls, such as New York City Hall in 1938. Later on many pop musicians used it in their albums, like the Beach Boys on their single *Good Vibrations*, Jean Michel Jarre, Led Zeppelin or The Rolling Stones. It has become

particularly well known for its use in films such as *Spellbound* (1945) or *The day the Earth stood still* (1951). The familiar sounds feature as announcements of tension or a mystical atmosphere. To this day, there are performers who give *Theremin* concerts all over the world, such as Dorit Chrysler and Lydia Kavina. Nevertheless, it has never really established itself as a popular mainstream instrument, probably because of the long learning process involved in mastering the *Theremin*. However, the instrument has inspired many modern instruments such as the *Otamatone*, a toy instrument from 1998, or even Bert Schiettecatte's *Audiocubes* in 2004.

Trautonium The *Trautonium*, developed by Friedrich Trautwein, a radio technician at the Hochschule der Künste in Berlin in the 1930s and Oskar Sala, a student of composition at the same university, is also a particularly noteworthy new development. The *Trautonium* is a revolutionary source of sounds previously unheard of, also with regard to the interaction of the instrument.

The instrument was controlled by a single string that lay over a metal bar and could be pressed down, a so-called ribbon controller. It could produce sounds in different pitches, depending on the position of the point pressed. The volume of the tones was also regulated by the pressure resistance. To produce the sound, a resistance was regulated by touching the metal string and the rail, which regulated the current intensity. With the help of a tube and a capacitor, very high overtone oscillations could be generated. It could be used to produce sounds similar to wind instruments. However, just like the *Theremin*, it needed an external amplifier or loudspeaker.

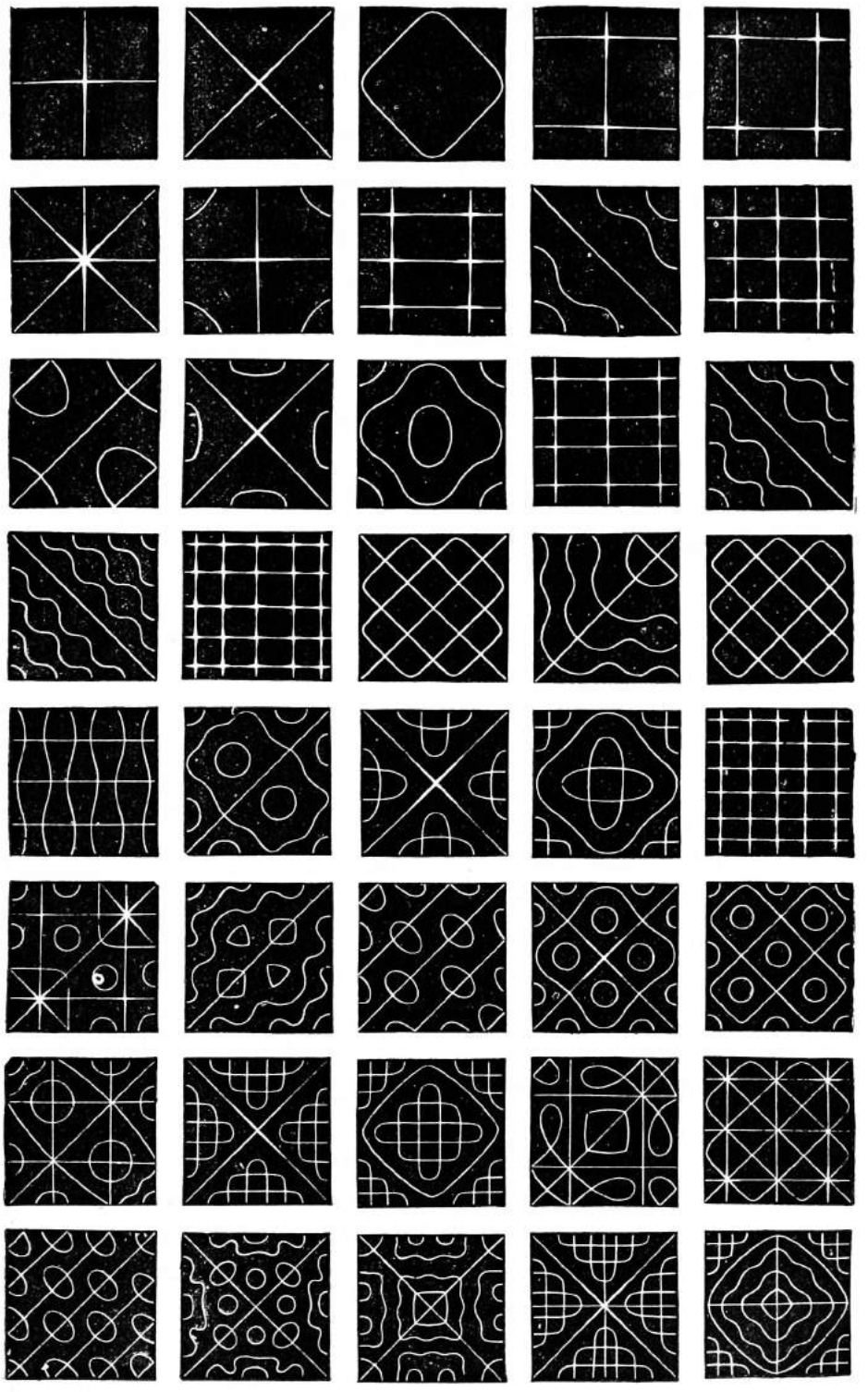
There were initial successes, for example the production of the *Volkstrautonium* by Telefunken, but its production was quickly stopped due to low demand. Nevertheless, Oskar Sala developed the initial idea further into the *Mixtur-Trautonium* (Fig. 3.27). There also emerged some compositions for the *Trautonium*, for example works by Paul Hindemith, Carl Orff or Harald Genzmer. Despite this, Oskar Sala remained one of the very few musicians who played the *Trautonium* for a long time. He composed several film scores on it, for example for Alfred Hitchcock's *The Birds*, or for Fritz lang's *The Indian Tomb*.

Fortunately, musicians such as Peter Pichler have preserved the memory and still play concerts on the *Trautonium*. Jürgen Hiller and his company *Trautonics* continue to produce customized variants of the trautonium on request.

Electric and Digital Strategies on Sound

The generation of electric sound has evolved since its discovery through many iterations. I would like to summarize this development briefly here. The investigation of tones as frequencies goes back a long way into the past. Already Euclid was engaged with the analysis of frequencies of vibrations as part of a music theory in 300 BC. [60]. 2000 years later Ernst Friedrich Chladni made frequencies visible with his *Chladnic Sound Figures* [13]. These are patterns that become visible when a metal plate covered with sand is set in vibration. As a result of natural resonances, the plate begins to vibrate, including its modes, i. e. those parts of the metal plate that do not vibrate or oscillate weakly. The sand is pushed away from the strongly vibrating parts of the plate and comes to rest on the less vibrating parts. In this way, nodes and oscillations can be made visible within the material of the metal plate (Fig. 3.28).

In early electronics, it was possible to create sounds using oscillators. Oscillators simulate, similar to the *Chladnic Sound Figures*, the principle of resonance, the vibrations in the material of the instruments. In the form of an electrical circuit, oscillating circuits are



3.28 *Chladni Figures* - modes of vibration on resonating plates

used which can generate periodic signals, such as sine waves, sawtooth waves and others [71]. In combination with amplifiers, filters and noise generators it was possible to create more complex sounds and to modulate them. These sound generation principles are used in the first electronic instruments, such as *Theremin* or *Ondes Martenot*, and are still used today in analog synthesizers.

A further development of these principles is the discovery of FM synthesis by John Cowning in 1967 [14]. This produces extremely overtone-rich spectra through the interaction of two oscillators, with one oscillator acting as carrier and the second as modulator. The modulations can produce both harmonic and disharmonious tones. This synthesis method became popular with the *Yamaha DX7* synthesizer.

Amplitude modulation, ring modulation, additive synthesis or subtractive synthesis are further principles for obtaining a diverse and differentiated sound image by means of simple electronic components.

The possibility of digital sound generation on the computer has created further possibilities. The abstraction of the processing of sound events as algorithms, which are later transformed into acoustic sounds by digital-to-analog converters, has opened up a new field of experimentation. Methods are sampling or the algorithmic generation of sounds. Digital carriers of audio material are formats such as WAV, AIFF or MP3 files.

3.2 Interaction and Topologies

Nowadays there are numerous instruments. They are mainly classified by the type of sound they produce. An interesting aspect of both traditional instruments and the development of new instruments is the way in which the musician interacts with the instrument. While for playing a flute the sound is generated by blowing into the instrument, for organ or piano a keyboard is attached. This shows a separation, a decoupling of instrument and control unit, the keyboard or manuals. Thereby, the underlying technology is always visible as a sign of its time.

In order to first discuss the aspect of the interaction between musician and sound generator or the separation between instrument and controller, I would like to briefly review the evolution of the key.

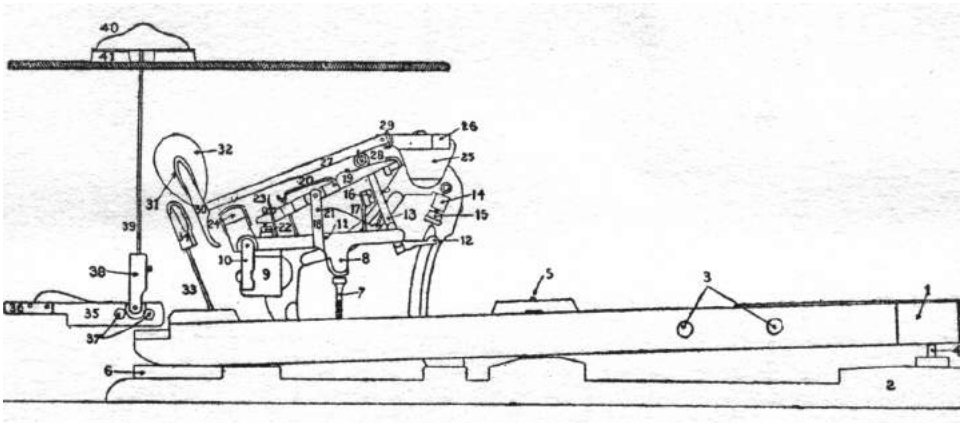
The Evolution of the Key

When associating keys with musical instruments, one is probably first reminded of the piano, an instrument in which strings are struck by small hammers that produce tones through their vibrations. It combines the functionalities of percussion instruments through the hammers and the functionalities of string instruments through the vibrating strings.

The first instrument to use a keyboard to control the sound production was not the piano, but the antique *Hydraulis*, a type of organ that uses water instead of air and bellows to produce even wind pressure [25]. The *Hydraulis* had a keyboard, which could be used to open the wind tunnels to all pipes of the respective button at the same time. Later organs used keyboards, like the *Portative*, a small medieval organ, or the *Big Organ* with its manuals, registers and keyboards.

The piano had more ancestors than just the organ: it is based in its simplest technical form on the ancient *Monochord*. Later, other instruments such as the *zither* developed from the *Monochord*. Also in the 10th century the *organistum*, a preform of the *hurdy-gurdy*, in which string lengths could be changed for the first time by keys, was developed.

By adding a keyboard, the *clavichord* [1] or the *harpsichord* developed in the late Middle Ages. However, the strings of *harpsichord* and *clavichord* were not struck, but plucked.



3.29 Example of piano player mechanism schematic (1909) [85]

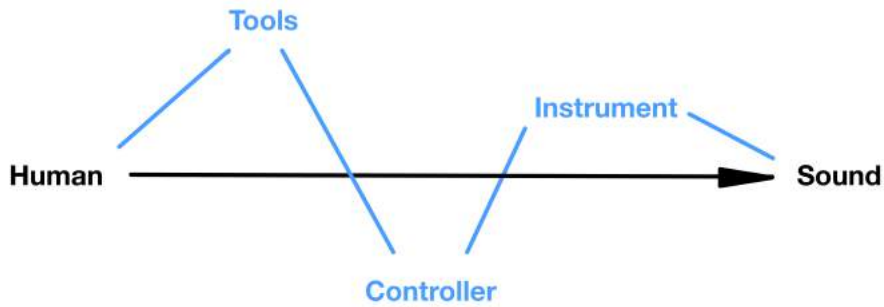
Research carried out by the Italian instrument maker Bartolomeo Cristofori opened a new chapter in the history of the keyboard, as he was the first to develop a hammer mechanism for the piano (1726) (Fig. 3.29), which made it possible to strike strings with different intensity [19] - which meant that composers could now embed the element of musical dynamics in their compositions. After a lack of acceptance and technical immatureness in the early days, the *fortepiano*, which was further developed by Gottfried Silberstein, finally became the preferred instrument. Even the critical Johann Sebastian Bach, who had previously composed mainly for *harpsichord*, played it to improvise at the court of the Prussian king Frederick the Great. He performed a three-part fugue on a musical theme suggested by the king, from which emerged his late work *Musical Sacrifice* (BWV 1079). The *piano* found its way into the instruments of classical music and was quickly used as a solo instrument by composers like Wolfgang Amadeus Mozart, Ludwig van Beethoven, Frédérik Chopin, Franz Liszt and others.

When the first electric instruments were developed at the beginning of the 20th century, the keyboard was used again, either in the form of a combination of several keyboards and manuals as in the *Telharmonium*, or as a simple non-dynamic keyboard in the *Ondes Martinot*, or in the analog synthesizers of Moog and many other digital synthesizers such as the *Yamaha DX7*. For devices such as the *Doepfer LKM II* midi keyboard, the sound generation is completely detached. They are used purely as input instruments for external sound generators such as computers or midi synthesizers and provide only the functionality of a keyboard. Contemporary instruments like the *Seaboard*[3] or the *Haken Continuum*[4] are based on the keyboard, but have developed it further by implementing pressure sensitivity and 3D scanning. They again embed a sound generator into the devices.

During its evolution, the keyboard also inspired other devices such as the *writing piano*, a machine built by Karl Drais in 1821 for his blind father - a predecessor of the typewriter,

[3]https://roli.com/products/seaboard/grand-stage
[4]http://www.hakenaudio.com/Continuum/hakenaudioovervg.html

in which letters were embossed on paper with the help of a keyboard. This led to the development of the computer keyboard as an operating and control element.



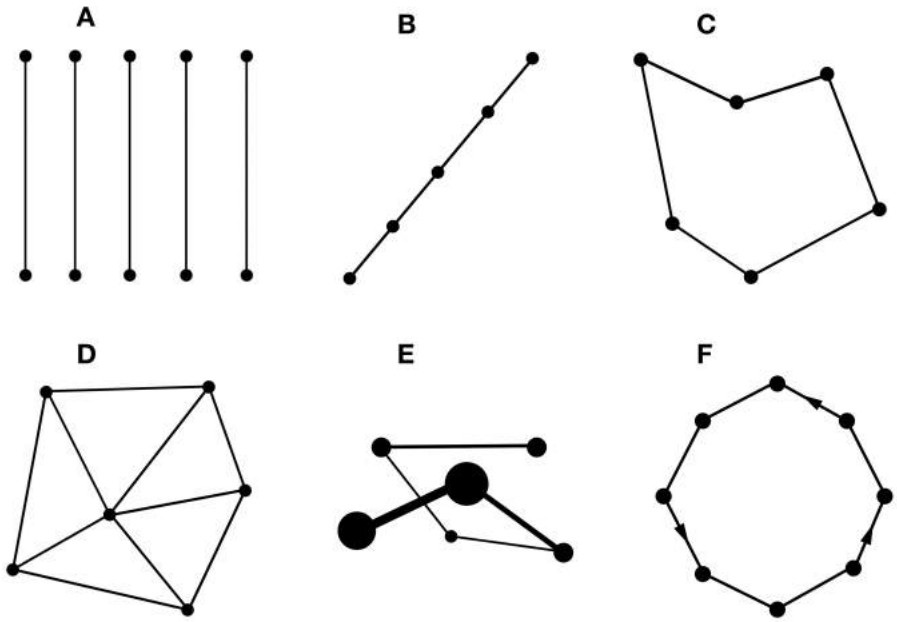
3.30 schematic *Human-Instrument-Sound*

New Interaction Modes

If we look at the development of the keyboard, from historical instruments such as organs and piano to contemporary instruments such as *Minimoog D* or *Seaboard*, it becomes apparent that the physical aspects of keyboard interaction between the musician and the instrument represent a continuity. Obviously, the keyboard itself - i. e. the separation of controller and sound production - represents a form of instrument operation that has not only proven useful in recent history, but also remains adaptable to new developments and technologies. The horizontal arrangement of the individual keys representing the tones and semitones, their velocity dynamics, but also the physical dimensions of the individual keys, their weight and the superordinate arrangement of all the individual keys as a keyboard represent a complex arrangement that is sensitively tailored to the needs of the musicians.

I would like to take this as an opportunity to take a closer look at the forms of interaction between musicians and their instruments. Historically, there are several different modes of interaction between musician and instrument. Depending on the principle of sound generation of the respective instrument genre, the human being either uses his body to create sounds, or he uses tools or controllers such as the keyboard of the piano (Figure 3.30). The body can be used as a sound generator and resonance chamber when singing. The use of mallets or violin bows corresponds to the principle of tools used to elicit a sound from the instrument. Controllers are, as already mentioned, the keyboards of piano or the manuals of the organ. Today's midi controllers and midi keyboards extend the scope of the interaction. In this respect, drumsticks can also be used to play on electronic drum pads, which in turn control a sound generator such as the computer. It is also possible that the surrounding environment becomes part of the instrument continuum and is included in the sound generation. Tracking devices such as infrared sensors, the *Microsoft-Kinect*, camera tracking or similar can be used to generate and forward data input.

In general, today's technology has developed a multitude of new forms of interaction. In addition to the traditional forms of interaction, such as hitting, blowing, stroking and



3.31 Topologies, A - parallel topology, B - axial topology, C - non-symmetric topology, D - mesh topology, E - 3D topology, F - circular topology

plucking, brain activity (EEG) or pure movement of the body and limbs (accelerometers) are included. Modern interfaces can also use sensors to react sensitively to pressure, scratches and moisture emissions. They can also react to other sound sources (live-input-processing). Processes such as bending, kicking, jumping and others can provide input signals for generating sounds. Tracking and infrared sensors can turn rooms into instruments. The possibilities are seemingly unlimited with modern technology.

Topologies of Instruments

Independent of new forms of interaction, the understanding of what actually characterizes a musical instrument has changed over the last few decades on the basis of numerous artistic and musical explorations of sonorities. Whereas traditional instruments were objects that were either held in the hand or were as large as a guitar, piano or organ, the concept of the musical instrument has expanded to much larger structures with the discovery of architecture and nature as an instrumental sound space. The study of architectural space as a sound generator such as Clemenz Bauder and Ilpo Väisänen, or the installation of an oversized steel cable network like Atau Tanaka (see section 3.1) requires new concepts. The artist group *Humanharp*, for example, uses the steel suspension ropes of suspension bridges as a sound body[5], which raises the question of how these new phenomena of musical instruments can be described.

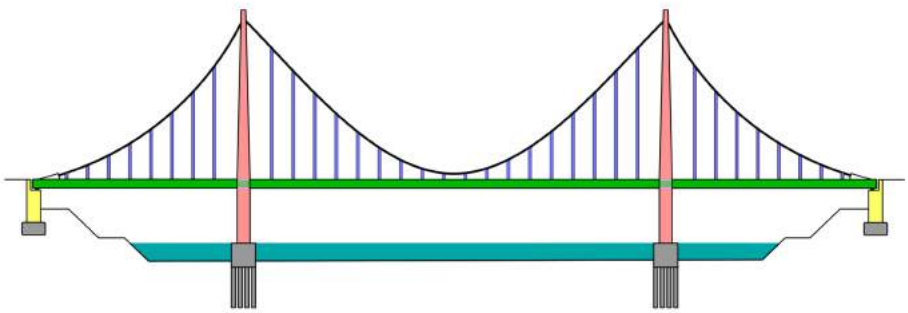
[5]https://humanharp.org/

One approach that helps here is the concept of *topology*. Borrowed from mathematics, geography and computer science, the term refers to relationships and systematic connections. In mathematics it tries to describe qualities such as closeness and aspiration from one point to another and represents a set system consisting of related subsets.

In geography, it is the topological relationship of objects derived from the three dimensional geometric data that allows for the mapping of the earth's surface. The term is also used in electronics to describe circuits (*circuit topology*) or in computer science to describe physical and logical network structures.

However, the term *topology* was used for the first time in philosophy, when Johann Benedict Listing in 1847 attempted to describe the *Möbius Band* as an example of objects that were distinguished by reversible clear and constant distortions [36].

I would like to use this term to investigate new musical instruments, the arrangements of the sound generating elements and the interactions with them. The term *topology* should help to recognize the commonalities that exist between suspension bridges, pianos or the structure of the computer network in Internet acoustics (Fig. 3.31).



3.32 Suspension bridge schematic

The arrangement of the strings for piano, guitar, violin, but also for the suspension bridges used by *Humanharp* can be described as traditional or **parallel topology** (Fig. 3.32). The strings lie parallel in or on top of the instrument case and are arranged in descending order of pitch. Hitting these strings follows the principle of parallel topology. The mechanisms of the piano keyboard, for example, are minutely tuned to the position of the strings inside the piano and represent a parallel topology in their arrangement by means of adjacent keys.

With percussive instruments, however, a mixture can be observed. While xylophones or vibraphone follow a parallel topology in the arrangement of the sounding metal plates and resonating bodies, the structure of a modern drum set can be described as **non-symmetrical topology**. Further examples of unsymmetrical or open instrument topologies are the placement of wine glasses as sounding bodies, but also the interaction with architectures and spaces.

Axial topology is the construction of instruments such as the flute, or more exotic instruments such as the *glass accordion* developed by Benjamin Franklin in 1761. The body of the instrument follows a straight line and represents the different tones as successive and ascending segments.

Contemporary developments of musical instruments dissolve traditional topologies and new architectures emerge, for example, the star or **mesh topology** of modular synthesizers, in which the individual modules can be freely connected to each other. The sound generation can be reconfigured at any time. The individual modules each have inputs and outputs that are compatible with all other modules. The decision as to which arrangement should be linked can be revised and re-decided at any time.

In instruments such as the *Seaboard*, a new type of topology is also visible - a three-dimensional type of interaction made possible by the arrangement of soft keys that can detect both horizontal interaction and vertical pressure as well as depth shifts. Just like the *Seaboard*, the *Haken Continuum* also recognizes pressure and displacement in all directions with a keyboard-like controller - and thus offers a **3D topology**.

3.33 Music box (ca. 1980)

For instance, a form of **circular topology** is represented by a barrel organ or music box (Fig. 3.33), where pin rollers contain the compositions as data carrier, later also replaced by tape. Modern, physical digital instruments, such as the drum sequencer *Rhythm Ring* [6], the *Tangible Sequencer*[7] or the *XOXX Composer*[8] resume the idea of circular arrangement.

These different instrument topologies can also be mixed with each other, for example in the *Wintergatan*, one of Martin Molin's music machines, which is set in motion by a crank handle. This mechanism activates hundreds of marbles that create sound by dropping down to acoustically sounding materials [55]. In this case, a circular topology, as with the barrel organ, meets a parallel topology such as the vibraphone.

[6]https://www.youtube.com/watch?v=uKtisFD3PHE
[7]http://murderandcreate.com/tangiblesequencer/
[8]http://xoxxcomposer.axelbluhme.se/

Tangible Interaction

Long before the concept of tangible interaction became popular in research, design and human-computer interaction, Max Matthews, a pioneer of computer music in the eighties has developed the *Radio Baton* [9]. This is a controller that was able to operate the computer program *MUSIC* [53] written for the IBM 704 by means of physical mallets and a prepared support.

This interface was intended to make the digital control of data physically tangible and to enable the linkage of physical objects and digital music production. Later, the interdisciplinary approach of *tangible interaction* uses these aspects as a field of research and begins to describe the qualities of user interfaces and interaction approaches, such as tangibility and materiality of interfaces, physical embodiment of data, whole-body interaction or the embedding of the interface and user interaction in real spaces and contexts.

The concept of tangible interaction encompasses a variety of topics such as human-computer interfaces and interaction design, but it focuses on interfaces or systems that are physically embodied in some way, such as physical objects and artifacts or entire environments. New developments in the fields of mechanics, robotics, sensors and ubiquitous computing can also be applied here.

The work with tangible interaction arose from dissatisfaction with traditional screen-based interfaces within a new virtual reality. The inclusion of physical materials, objects and forms opened up a new approach to the interaction and representation of digital content. The underlying vision was the ability to literally touch data with one's hands and thus unite representation and control, whereby the objects are now also called *tokens*.

One of the pioneers in this field is Hiroshi Ishii, who, in his CHI'97 conference paper *Tangible Bits* [43] examines human-computer interaction through physical objects and speaks for the first time of *Tangible User Interfaces* (TUI). His predecessors include the *Marble Answering Machine* by Durell Bishop, one of the first examples of interfaces, that interlinks the physical and digital worlds.

In software development, the principle of Model-View-Controller (MVC), a programming approach that processes program control based on data input from different sources, already existed before. It serves as an architectural model whose task is to be able to react as flexibly as possible to changes in the rest of the program. The task of TUI can be derived from this, namely model control representation. Physical objects can control digital processes (model). They contain mechanisms to control them and represent the current digital information in their physical appearance and possibly also through physical change.

A well-known example of tangible interaction is the *ReactTable*, an electronic musical instrument with a tabletop tangible user interface [45]. As a user interface, it has a translucent table on which a graphic image is projected. It shows the different functions of the software. So-called *tangibles* or *tokens* can be placed on the table, which can trigger musical functions as soon as they are physically placed close to the corresponding graphics. The computer recognizes these tangibles by means of fiducials, which are located on the underside of the objects and are picked up by a camera underneath the transparent cover plate. Thanks to the specially developed open-source software *reacTIVision*, the computer can assign the movements and functions of the various objects in real time.

There are meanwhile numerous other examples of projects related to the approach of tangible interaction in the musical-artistic context, regularly discussed at conferences like

the *TEI* [9] and the *NIME* [10]. These include tangible sequencers such as the *BeatBearing* [7], the *Bubblegum Sequencer* [40], the *Beatblocks*[11] or the already mentioned aesthetically appealing *XOXX Composer*, whose main component is a rotating spindle on which magnets can be applied as tokens.

There are also musical instruments being developed that not only handle the haptic control of digital data, but also process acoustic information and inputs, such as the *Lattice Harp* [66], a hybrid between instrument and controller. This instrument has 10 strings crossed on top of each other and can be played acoustically. At the same time, however, they also carry a small amount of current and first generate analog signals, then digital signals when strings touch each other at intersection points.

To introduce a further variation of the theme, it is also possible to use the nature of material itself as a starting point for creating digital control, as in the case of *Tangible Scores* [79] by Enrique Tomas. Surfaces in the form of engraved structures can be used as a musical notation system.

Even non-musical interfaces such as *inFORM* [30] investigate the field of tangible interaction. *inFORM* is an interface developed at the Massachusetts Institute of Technology (MIT) by Daniel Leithinger and others, which allows new possibilities of physical shape modification, called *shape display*. For this purpose, it uses horizontally arranged motorized blocks on a 30x30 surface that can produce or simulate various physical shapes, for example, to communicate haptically via the Internet.

3.3 Constructive Modularity

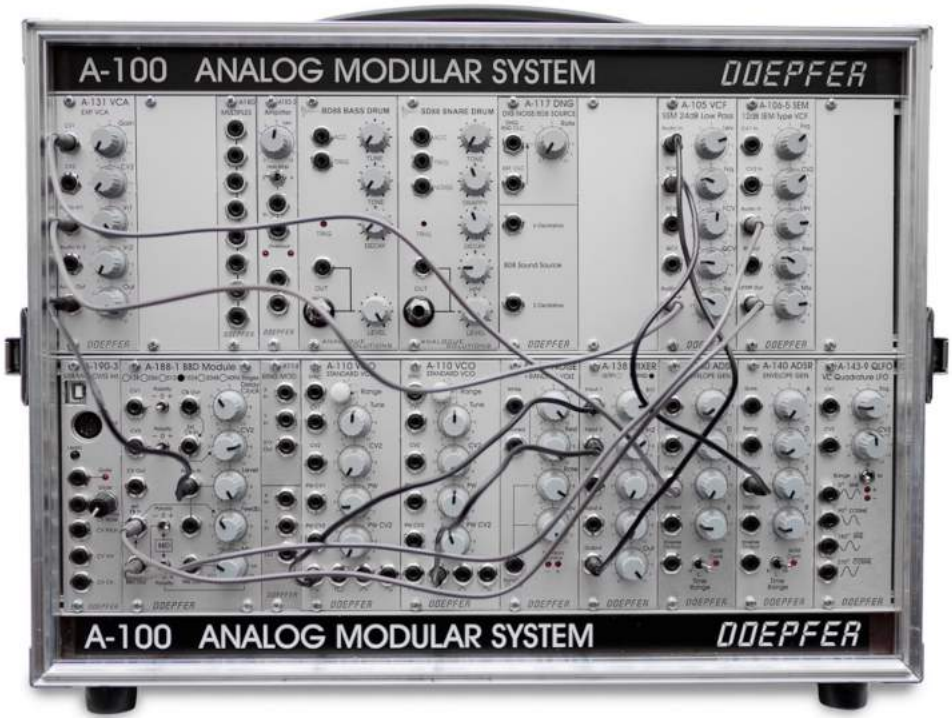
Two approaches that do not usually feature the narrative of musical interfaces are important to me: constructionism and modularity.

Constructionism is an approach derived from learning theory that emphasizes the importance of active action. This category was founded by Seymour Papert [64], which deals with the introduction of children to computer programming language. The idea behind it is that learning becomes easier as soon as you become active yourself, so to speak reconstructing the learning content yourself[12].

This strategy could also be interpreted as an attention-gaining exercise, as a means to fully focus one's attention on the present object or task. This *interaction* and *touching* matches the theme of musical interfaces. Apart from the idea of *playing* a musical instrument, more and more new musical interfaces open up the possibility of continuously changing the overall state by means of configurations - including haptic or tangible configurations. This practice leads to increased attention to changes within the system and the musical output. The intervention in musical processes is not least a process that shows the spectator or audience the spectrum of activities of musical performance - and thus creates a connection point between performer and audience.

In addition, it is an interesting question in regard to artistic autonomy to what extent the music interface remains shapeable and flexible during a performance, i. e. how many configuration options are possible within the performance at all. Creating and configuring

[9] http://www.tei-conf.org/
[10] http://www.nime.org/
[11] http://www.beatblocks.com/
[12] see Lego Mindstorms https://www.lego.com/en-us/mindstorms



3.34 *Doepfer A-100* modular synthesizer

your own instrument over and over again doesn't always have to be an advantage, of course, but it can certainly be an expression of musical modulation and performance.

Examples of this are performances in which it is part of the process to build a stage or assemble an instrument gradually during the performance. These include, on the one hand, the performances of analog modular synthesizers (Fig. 3.34), whose main stylistic means consist of continuously reconfiguring the flow of the current, not only by interfering with the course of the current at potentiometers and controllers, but also by the continuous reconfiguration of the cables connecting individual inputs and outputs.

On the other hand, contemporary live coding concerts can also be considered as part of this list, whose content and aim is to constantly change and vary the configuration of a computer program live on stage. Re-configuration is also practiced here as an essential part of the program, and by projecting your own computer screen into the auditorium, viewers and audiences can participate in the permanent alteration of the program.

In both cases, musicians and performers become the creators of their own instrument, live on stage. In some cases, a sort of choreography can take over the task of the score as a compository guideline. In addition, the entire work, the entire performance, manifests itself in the continuous design of the instrument, whereby single aspects can also be passed on to the audience. Musical methods such as improvisation, i. e. the freedom to articulate oneself intuitively within certain limits, are creatively and artistically mixed with pre-fabricated courses of action and compositions.

Self-Empowerment

One aspect of learning by doing is certainly the increasing *do-it-yourself* (DIY) movement of recent years. DIY as an attempt of self-empowerment, on the one hand as an answer to the excessive industrial production of ready-made patterns and on the other hand as an opportunity to explore development and manufacturing processes as individual possibilities. The creation of projects and the realization of ideas is thereby transferred from large corporations into the hands of the many small users, who can experience the fun and the creativity of the own creation.

This movement is documented and supported by numerous workshops, tutorials and platforms that make knowledge available free of charge in the spirit of DIY and Open Source, in order to circumvent previous access restrictions such as university or technical training or high development budgets. A source of inspiration is for example the *Make Magazin*[13], but also numerous books like *Handmade electronic music* by Nicolas Collins [15].

Many artists work at the intersection between art, technology and DIY empowerment, such as Gijs Gieskes[14] with his experimental audio and video modules and installations or Wolfgang Spahn with his sound modules *Paper Bits*[15]. The sisters Ewa Justka[16] and Kasia Justka[17], for example, research electricity as an artistic raw material for self-made instruments, projects and performances.

With regard to new technologies for musical expression, there exist platforms for the construction of micro-controller-based systems, such as Arduino[18], which make it possible to realize electro-technical ideas quickly and easily. The Arduino, as a programmable interface between computer code and electrical and sensor technology, is a field of experimentation that makes it possible to explore the interaction between the physical world and electronic or algorithmic reality without much prior knowledge. Meanwhile there are also numerous tutorials, examples and also extension boards and sensors available. Since the appearance of Arduino in 2005, countless projects based on this platform have been created in the artistic context.

Algorithms for Musical Expression

The same applies to the acquisition of computer programming languages. Whereas it was initially necessary to complete special training to learn the complex programming languages, Arduino has shown how to simplify complex programming languages and make them accessible to non-specialists - and artists are often amateurs when it comes to computer programming.

As far as musical applications are concerned, since Max Matthews and his program *MUSIC* (1957), independent computer music programs for the production of music have developed. Matthew's *MUSIC* can be seen as the father of programs like *Pure Data*, *Max/MSP* or *SuperCollider*. These programs try to open up their use to a wide range of interested people from different educational backgrounds. Particularly through the open source approach like the graphical *Pure Data* or text-based *SuperCollider* and the presence of nu-

[13] https://makezine.com/
[14] http://gieskes.nl/
[15] http://paperpcb.dernulleffekt.de/
[16] http://ewajustka.tumblr.com/
[17] http://cargocollective.com/K
[18] https://www.arduino.cc/

merous forums, tutorials and literature an appropriation is possible (see *The SuperCollider Book* [86]). Applications such as Sam Aaron's *Sonic Pi*[19], a simplified version based on *SuperCollider*, allow to playfully introduce children to computing and music lessons.

An interesting development is the practice of live coding, an algorithmic live performance in which computer programs are written live on stage to create music. Artists such as Alex McLean, Renick Bell, Sam Aaron and many others can be seen live at increasingly popular live coding festivals such as the *Algorave* concerts, the *AlgoMech* Festival in Sheffield and others[20]. In the meantime, programs have been developed especially for this purpose to make live coding even more bundled and effective, such as Alex McLean's *TidalCycles*[21] and *Overtone*[22]. Current research in this area is presented at annual conferences such as the *ICLC*[23] (International Conference for Live Coding) and the already mentioned *NIME* conference.

3.4 Fashionable Technology

Another branch of new possibilities of human-computer interaction are wearable technologies, which aim to transform clothing and portable materials, or rather the body itself into interfaces. These include commercial products such as Google Glasses, Apple Watch, Nike's *Fuelband* bracelet or the *Myo*, a bracelet that can control computers by muscle movements.

The application of this new direction of wearable technologies to artistic projects and ideas is obvious. As Sabine Seymour wrote in her book *Functional Aesthetics* [73], the combination of fashion, technology and science called *Fashionable Technology* covers the vision of a real future as previously known only from science fiction films: the combination of digital technology, mechatronics, physical computing, nanotechnology or wireless technology on the one hand meets fashion design, arts, textile design and craftsmanship on the other hand.

While for some years now, many artists and designers of fashionable technology have been opening up to new technologies in terms of fashion and design and experimenting with new technologies, portable technology, networking and fashion is also gaining ground in the field of musical interfaces.

Musical Body Instruments

A special case in the wearable interfaces are certainly musical body interfaces. They attempt to expand the forms of interaction of traditional instruments with new technologies and the results of scientific research. Bioelectric signals are used for this purpose, as well as suits or entire exoskeletons with new nano-materials. Wireless Gesture controllers belong to this new genre as well as sensor and actuator technologies, haptic and force feedback and real-time computing.

Early musical experiments include for example Benoit Maubrey with his *Audio Ballerina*[24] (Fig. 3.35), a dance performance with solar-powered wearables that transform

[19] http://sonic-pi.net/
[20] https://toplap.org/
[21] https://tidalcycles.org/
[22] http://overtone.github.io/
[23] http://iclc.livecodenetwork.org/
[24] http://www.benoitmaubrey.com/?p=1

3.35 *Audio Ballerina* (2002), Benoit Maubrey

interactions to sound by means of light sensors and embedded loudspeakers. The musical interface *BioMuse*, developed by Hugh Lusted and Ben Knapp and used by Atau Tanaka for numerous performances, works with biosignals (EEG, EMG, EOG). It translates biosignals into serial data and MIDI and can thus be used as a music instrument [77].

In the *Gloves Project*, [72] researchers around Stefania Serafin developed gloves as musical interfaces that, thanks to technologies such as 3-axis accelerometers and wireless transmission via Bluetooth, convert the movements of the hands as control signals for sounds. The musician and singer Imogen Heap uses it as part of the practical research in her live shows.

The artist Constanza Piña develops portable fashionable synthesizers like the *Cinturón amplificador* or the piezo-controlled *Ratabari* under her pseudonym *Corazón de Robota*[25].

[25] https://corazonderobota.wordpress.com/

The Viennese artist Ulla Rauter even used her arm as *electrodermal interface*[26], when she used a modified violin bow to generate data for the generation of tones with the help of copper strings and electric body currents.

3.5 Summary

Just like the chapter on *Performance Art and Public Spaces*, this chapter intends to provide a theoretical and historical contextualization of the underlying motif in the classification of the various aspects of *Homo Restis* in a larger context.

To this end, I would like to draw as much attention as possible to the technological aspects of cultural history. The chapter on *Early Sounds*, for example, is intended to sensitize the reader to the fact that the use of instruments has been practiced since the beginning of mankind and is therefore not only a phenomenon of today. Likewise, that sounds and music have historically not only been treated and used profanely, but also transcendental and spiritual. I hope to have shown that the development of new instruments has always correlated with the technical development of the respective epochs. The excerpt about the evolution of the key stands out in particular and represents not only the further development of instruments, but also the detachment of the controller from the sound generator. The sound interfaces of *Homo Restis* can also be seen in this context - a separation of controller and interface from the actual (digital) sound generator.

I have tried to show that sound generators that operate on the basis of electricity are relatively young in history and have brought with them a number of special innovations, in addition to sounds that were previously unheard of. The special feature lies above all in new forms of interaction. Here too, there are parallels and correspondences to *Homo Restis* and the operation of the instruments by means of strings, as a new form of interaction.

With the arrival of technology, electrification and digitalization, new instrument topologies have emerged in addition to traditional topologies, which is also a focus and research area in the design of the interfaces of *Homo Restis*. The related field of *Tangible Interaction* concerns exclusively digital instruments and the modern interface between physical objects and digital data processing.

The excursion into *Constructive Modularity* is intended to show the potential that lies at the intersection between instrument, learning and performance, the possibilities that can be embedded conceptually in new interfaces. This approach is also a constitutive part of the interface system of *Homo Restis*. Furthermore, *Self-Empowerment* and the playful use of programming languages are aspects that have made the realization of the *Homo Restis* instruments possible.

And finally, I introduced the approach of *Fashionable Technology* with emphasis on *Musical Body Instruments*. I have given examples to illustrate the use of portable music technology. The electronic digital interfaces in *Homo Restis* are also portable and mobile, a development made possible by the advances in wireless transmission and microelectronics, especially in recent years.

With this I would like to conclude the theoretical, philosophical and technological introduction and contextualization of the project *Homo Restis*. There are many more things to discuss, there are many more pioneers, practical examples and results of scientific research

[26] http://www.ullarauter.com/

that could be mentioned to explain the project. It would also be possible to broaden the topics addressed in each case. On the one hand, there is not enough space in this work, on the other hand, these areas could become the basis for further research, such as the outlined reflections on the evolution of the key.

In the following chapters, I will deal with *Homo Restis* and some of the previous projects and give insight into approaches, technological concepts and implementation.

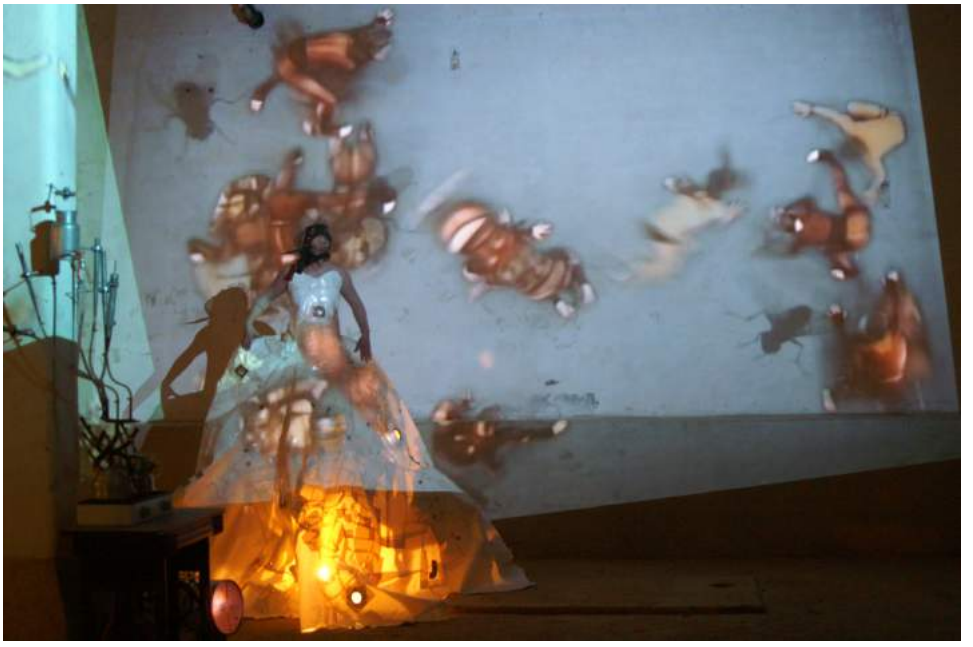
PART 4

PREVIOUS WORKS

Now I will comment briefly on some of the work and projects that preceded the project *Homo Restis*, have had a decisive influence on it and are thus central to a more comprehensive understanding of the present work *Performative Topologies for musical Expression*. I would like to present three realized performance projects, which are results of the collaboration between Sarah Leimcke and myself. I would also like to present two of my own works, which can be regarded as direct precursors for the technical and conceptual realization of *Homo Restis*. The works represent the artistic and technical background for *Homo Restis*, both in regard to performances in public space and the way in which individual interfaces for sound creation are handled.

4.1 Homo Drosophila

To begin with, I would like to explain the cooperation between myself and Sarah Leimcke and speak about the beginning of our cooperation. Our working relationship goes back more than ten years. Our first joint project was the soundtrack of an art film by Sarah Leimcke. In this film entitled *Fliegenmetamorphose* (2007), she shows a quasi-fictional-heterotopic situation, an area in which humans and flies crawl around in the same size. There is no narrative except for the constant activity of the actors - people crawl, run or pause while the flies also move continuously through the image. In this first collaboration I created a sound collage as a soundtrack which underlies this abstract situation through musical means of repetition and distortion.



4.36 *Homo Drosophila* Ostrale'07

4.37 *Homo Drosophila* Ostrale'07 Instrument Set-up

Our first collaboration gave rise to the idea of realizing this cinematic situation as a real performance. This resulted in our first performance project, which we presented for the first time in 2007. It's title *Homo Drosophila* is derived from the film and the masks used in it. The film-set was composed of a room installation and two actors, myself included, wearing hand-made fly masks by Sarah Leimcke and equipped with self-made, functional-mechanical musical instruments. This first performance took place in a specially constructed installation during a Music Open-Air in Dresden.

Ostrale'07 The next performance grew bigger and was shown during the art festival *Ostrale'07*.

With the help of various elements a dense atmosphere is created in which performers and dancers wearing fly masks move around (Fig. 4.36). This includes several room projections from the film *Fliegenmetamorphose*, various pieces of furniture and other installation objects, such as a set of water vapor-powered organ pipes. A television connected to a camera shows a real-time image of the room.

Masked as one of the performers I am part of the room installation and perform synthetic and prerecorded sounds on a specially developed instrument: the *drum comode* (Fig. 4.37). The *drum commode* is a piece of furniture equipped with dishes. Invisible from the outside, these dishes (bowls, cups, tablets) are equipped with hidden piezo pickups and connected to a hardware sampler. Percussive beats on the objects trigger prepared sounds. The sounds are conceptual field recordings from inside and around the rooms in which the performance takes place.

The performance begins with the opening of the rooms to the public. As soon as the audience entered the exhibition space, about 7 performers - many of them trained dancers - enter the space. It is dark apart from the projections, isolated floor lamps and the surveillance monitor, the outlines of the space are difficult to see. As the first sounds appear, the performers begin to move between the audience and along the room. The set-up of the installation creates a surreal atmosphere, which is supported by the repetitive movements of the performers. The performance takes place on several consecutive evenings and is enthusiastically received by the audience.

Wasserinszenierung This performance was also shown at various festivals in the following months. We were given the opportunity to stage the show in a more complex manner on water at the old harbor in Dresden in 2008. Again within the framework of the art festival *Ostrale'08* we started to realize *Wasserinszenierung* in the form of several self-built floating islands. The islands - constructions made of wood with barrels of plastic as floating elements - were decorated by us with furnished everyday situations (Fig. 4.38). These included cabinets, couches, tables, chairs and lamps. All in all, we created four swimming islands, three of which were free to swim in the harbor basin and were intended as a stage for the performance, while another island was anchored permanently on the shore and served as a sound laboratory - a covered stage for the instruments and devices of the sound performance. The three islands, designed as living room, bedroom and kitchen, functioned as autonomous sculptures in which all pieces of furniture and visible elements were painted white, giving them a delicate and fragile appearance. During the day, the installation rested in the water of the harbor basin, but during ten consecutive evenings, it became the stage for the performance.

During the performance, a sound collage of spoken texts and synthetic sounds was to be heard from the sound lab - texts about the protection against insects. Excerpts from the film *Fliegenmetamorphose* were projected onto the harbor basin and the floating islands. A total of up to 30 performers in fly masks and white suits got on the islands, some of them acting

4.38 *Wasserinszenierung* Ostrale'08 - 4 swimming platforms

as fly people on the islands, imitating everyday movement patterns and in the course of the performance, transforming human behavior into insect movements. Other performers were swimming and diving in the water and move the islands through the harbor basin. Every now and then, they climbed onto the installations and interacted or disturbed the events taking place.

Through this multitude of interactions, projections and sounds coming from the edge of the harbor, a strange world was built up that surrounded the seaside audience. Towards the end of the performance the sounds slowly faded away and the performers disappeared from the islands, leaving the audience in a kind of vacuum.

4.2 Hühnerfrikassee

Based on the work with *Homo Drosophila*, we realized several other performances in the following years, among them *Homo Formicidae*, which showed *ant people* who occupied public places in order to build a kind of anthill with everyday objects, always following imaginary ants' roads. Another performance was *Homo Corvus*, which was about crows, showing performers who interacted with bizarre objects in crow masks naked on the roofs of houses and caravans. The performance was inspired by crows that collect sparkling objects and carry them into their nests. These performances were also accompanied by music and live improvisations.

Finally, the idea for the performance *Hühnerfrikassee* was born, a work which no longer relied on numerous performers, but rather focused exclusively on Sarah Leimcke and myself. It was the first performance in which we decided to sing live.

The performance *Hühnerfrikassee* takes place in the installation of a kitchen with a stove and musical instruments. The furnished situation is fenced in with a low golden fence. Depending on the location of the performance, Sarah's film *Hühneraerobik* is projected in the background. It shows eight women in fitness gear moving in a manner of fitness videos from the 1980s. The images are overlaid with human-sized chickens that run through the picture and peck for grains. The overlapping raises the question of who the people and who the chickens are.

In the actual performance, Sarah and me, dressed in with handmade golden full-body suits, equipped with a filled shopping trolley and a ladder, enter the setting of the installation. That's where our storylines separate. As I begin to create music on my instruments, Sarah begins to prepare the ingredients for the dish *Hühnerfrikassee* at the prepared kitchen table with knife, stirring stick, bowl and cookware. She has to climb the ladder repeatedly in order to reach the elevated oven (Fig. 4.39). Meanwhile, we both sing songs about the various stages of the cooking process and focus on excerpts from the lives of chickens in factory farming. The texts contain metaphorical references to human life. At this point, ambiguities become apparent, parallels between the girls in the projected film *Hühneraerobik* and industrial poultry farms .

4.39 *Hühnerfrikassee* at Oktogon 2009

4.40 *Inkognito* 2010

The performance is over when the dish is served to the audience on a table outside the fenced performance situation. Then we both leave the stage and the audience can eat the finished dish with prepared plates and cutlery.

We have performed *Hühnerfrikassee* 18 times in 2009 and 2010 at various venues and festivals, including the *Oktogon* of the Dresden Academy of Art, a Zittau Cinema Hall, a street theatre festival in Berlin and an art festival at the Mozartplatz in Salzburg. In most cases, the dish was eaten by the audience. As ingredients, we paid particular attention to using either chicken from leftover containers of supermarkets or organic chicken.

4.3 Inkognito

We attempted a new approach with the performance *Inkognito*, reducing the number of our instruments and work on space installations, projections and the collaboration with external dancers and performers to two whole body costumes exclusively (Fig. 4.40). The costumes are similar to those of *Homo Drosophila* or *Hühnerfrikassee*, but have moved away from an animal component and now involve a more technical and synthetic expression. The wearers of the costumes now seem more like machine-people, the costumes are more like armor. They are equipped with technical components and sensors and are therefore able to translate the movements of the carriers into sounds. One of the costumes is equipped with sound tubes reminding of a carillon. Sudden movements of the arms and configurations of the arm positions, analyzed by accelerometer sensors, generate strokes on aluminium tubes with the help of solenoids. They produced different tones because of the different cross-section and length of the tubes (Fig. 4.42).

On the second costume there are two cymbals stimulated by motors - the waves of the motors grind the edge of the cymbals and thus cause the cymbals to vibrate loudly. The motors are driven by distance sensors in the hand pieces. These sensors are setup to supply the motors with current as soon as the carrier approaches external objects or humans, or as soon as something approaches the carrier (Fig. 4.41).

Our performance with these costumes took place mainly in public space, through which we moved with abrupt, mechanical movements, for example in the Dresden *Zwinger* or at the Festival *Erscheinungen010* in Bautzen in 2010. The appearance of *Inkognito* had a suggestive and again surreal effect on the viewer, the mobile sound costumes were able to develop a deafening noise without electrical amplification. They were also highly interactive, which gave the performers a moment of surprise when they encountered the audience.

The collaboration with Sarah Leimcke has resulted in further projects after the performance *Inkognito*, such as *Zucker* (2012), a performance that picks up on the theme of sweets in the form of a staged coffee drinking and comments on the consumption and danger of sugar as a food product with music and texts. Another performance was the *Liebesboten* (2014), where we performed as costumed *ambassadors of love*.

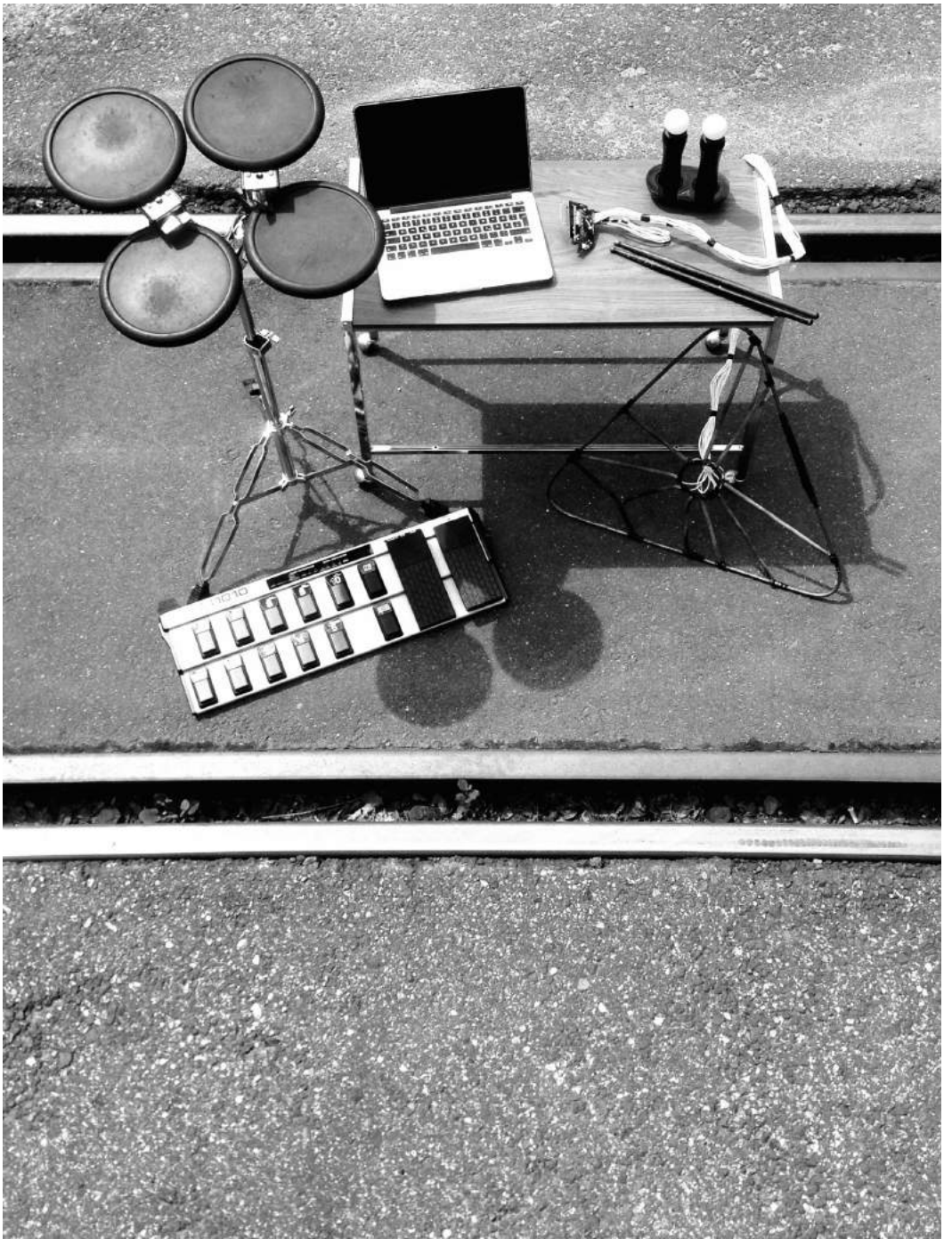
4.4 Looper

Now I would like to present two other works of mine, which I realized during my time at the University of Art and Design in Linz and which can be regarded directly as technological-conceptual precursors of *Homo Restis*. I would like to start with the project *Looper*.

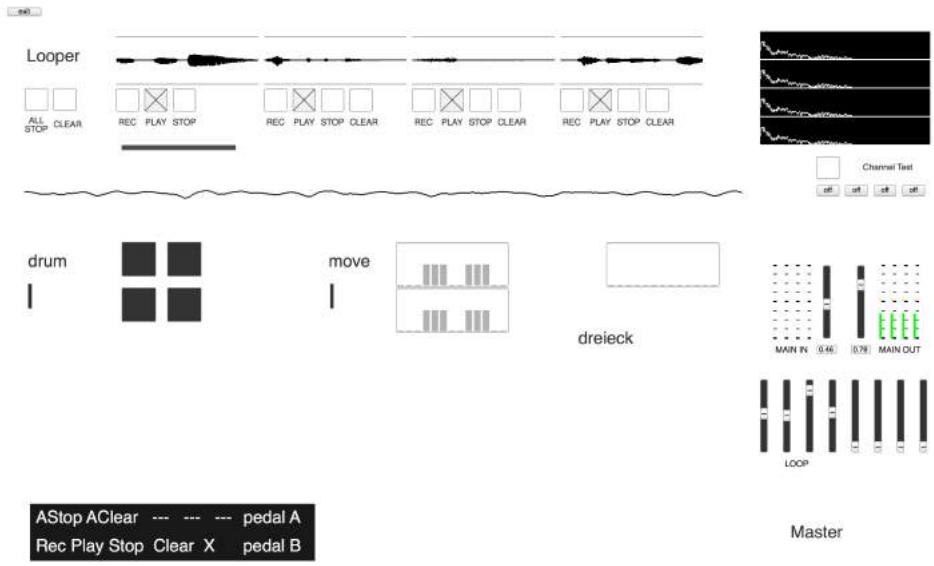
I realized the *Looper* project during a residency at the *Computer Music Studio* (CMS) of the Bruckner University Linz 2015. It is the first more complex work, in which I have combined different interfaces and a specially developed software. The interfaces consisted in part of available MIDI controllers, like an arrangement of drum pads and a foot control bar, but also of devices from gaming like the PS3-Move controllers (Fig. 4.43). I have also developed an interface that uses tension and stretching movements on rubber bands to interact with the sound software. This interface, the *Dreieck*, was a direct precursor of the later technical developments for *Homo Restis* and was part of the research process for appropriate and adequate technical solutions to transform the movement of elastic physical materials into sound. A further component of *Looper* was a software especially developed for this purpose, based on the programming language *SuperCollider*, which has taken over

4.41 *Inkognito* (2010) - Modul 1

4.42 *Inkognito* (2010) - Modul 2



4.43 *Looper* (2015) - instrument set-up



4.44 *Looper* (2015) - Software GUI

both tasks of sound generation and the organization of sounds in the form of loops (Fig. 4.44).

The practical setup consisted of a computer on which the data flows from external devices were processed in the form of MIDI signals and serial signals and translated into OSC signals, for which I also used the Javascript platform *Processing*. In the software, the signals of the interfaces were then translated into 4-channel synthetic sounds in real time, as well as sampled live and played back in the form of loops. There were 4 different loops available, 3 of which were internally synchronized and one loop could operate asymmetrically and tempo-independently. The samples were recorded to the individual loops using a MIDI controller on the floor, which could be controlled by pressing a button with the feet, leaving the hands free to interact with the other interfaces, such as 4 external drum pads mounted on a stand. The entire instrumentation including the PS3-Move Controllers, the *Dreieck* interface and the software represented a combination of individual components as part of an overall instrument arrangement.

I presented the system live at the *Sound&Vision* Festival in Bruckner University and used components from it in other projects in the following years. For example, the PS3-Move Controllers, which I used regularly for performances with the *Bureaumaschine* project during live concerts.

4.5 Netz

In the year 2016 I created a sound installation, which uses the interaction forms of elastic rubber tubes, just like the *Looper* project. This project is also related to the exploration of haptic interaction through elastic materials and sound and is a further precursor of the technical implementation of the later performance *Homo Restis*. The *Netz* project focuses

4.45 *Netz* (2016) - Ars Electronica

on a spider-web-like arrangement, which is mounted in a metal frame. In the centre of the net a round box with a loudspeaker is placed (Fig. 4.45). The individual strings forming this net are equipped with strain sensors inside. Interacting with the strings triggers a real-time generation of sounds in the built-in mini-computer Raspberry Pi. As with *Looper*, the sounds are created by a custom developed program based on the programming language *SuperCollider*. The sounds are simple cascaded sine waves whose pitch changes with the degree of stretching and which can modulate each other during their sounding. The sounds are transmitted to the audio amplifier via a sound card and then played back via the built-in loudspeaker.

The interaction with the *Netz* is mainly characterized by the haptic experience of touching the individual strings. The pressure and the noticeable elasticity are a physical feedback for the sound creation procedure. Likewise, the physical extent and size of the arrangement of the strings in the net generates an experience of positioning sound in relation to movements of the whole body. Through this body-sized net topology I wanted to artistically explore the interaction with larger interfaces for musical expression. With *Netz*, the entire body including the arms and torso had to be moved in order to generate a sound output. Observations of visitors playing with the *Netz* have demonstrated to me that this approach,

i. e. forcing a whole-body interaction, generates a high degree of attention from the player and increases awareness of the causality between movement and sound.

I have shown the *Netz* at various festivals, including the Ars Electronica 2016 and the Kiblix Festival in Slovenia.

PART 5

CASE STUDY: HOMO RESTIS

Now I would like to get to the main topic of this work and introduce the sound performance costume project *Homo Restis*. This project is the result of a two-year development process between Sarah Leimcke and me, which began shortly after starting my studies at *Interface Culture* at the University of Art and Design in Linz.

Homo Restis is the most recent collaboration between Sarah and me and brings together the different aspects we have already combined in previous performance projects: Costumes, installations and sound. In *Homo Restis*, I have once again focused on the development of custom technology for creating sounds in the performance context and designed a mobile, tangible multi-channel system that allows for the transformation of body movement into sound.

The process of development went through several stages and some by-products and independent works were created (see section 4.4/ 4.5).

I will give an insight into the different stages of the development process, the changes in our initial performance concept and finally the completion of the project and its performances at different festivals and locations.

5.47 *opposite:* *Homo Restis* (2016) - Sarah Leimcke, Jens Vetter

5.1 Homo Restis - Introduction

To begin with, I would like to give a general introduction to *Homo Restis* and its most distinctive features such as costumes, sound interfaces and performance sequences.

Homo Restis is a sound costume performance, developed in the years 2014-2016 by Sarah Leimcke and me as the most recent performance project of our ten-year collaboration. The project consists of two protagonists dressed in handmade full-body costumes made of two-layer golden leather (Fig. 5.46/ 5.48). Strings can be attached to these costumes using hooks. The counterparts to the strings are sound boxes that can be placed in the surrounding space and can bridge a distance of up to 8 meters from the costume with the strings. The movements of the strings (distance, direction and speed) are then converted live into sounds on micro-controllers mounted within the boxes.

All sound boxes are wirelessly connected to each other via radio-communication, which makes it possible to change the sound presets of 2 groups with 5 boxes each using sewn-in touch sensors on the costume. A total of 3 different sound presets is available. In addition to the functionality of changing the presets, the costume's remote control allows dimming or muting of the audio signals.

All ten sound units are wirelessly connected to a central subwoofer module, which remotely reproduces the sounds produced by the individual units and plays them back. This generates and adds low sub-bass frequencies to the relatively thin sounds of the single units.

The performance consists of moving around in public places at first, then starting to attach the boxes to the existing structures of the public space (street signs, fences, columns, etc.) and connecting them with the costumes. This follows the principle of the marionette, but here the passive state is replaced by an active intervention of the performers. The resulting relationship between the protagonists and space is translated into multi-channel surround sounds. Mechanical movement patterns, jerky changes in position and repetitive movement sequences are performed. The audience is part of this temporary setting by their presence.

Costumes The costumes were created during a development period of 2 years. Sarah Leimcke crafted them by hand and customized them according to our body sizes. She used gold-embossed leather as the outer layer and recycled leather from used jackets and trousers as the inner leather layer. Other materials include eyelets, rivets, belt buckles as closure mechanism, foam, hangers, wire, carabiner and sanitary acrylic. The particular challenge was the complexity of the geometric structure of the costumes, which were successively created from individual parts. There were no templates or drawings to manufacture the costumes. The individual parts were put together one after the other and evolved during the first public performances including some modifications. The costumes convey their own medieval-futuristic charisma, as well as topics such as heaviness, richness of detail, passivity & activity and generate a mixture of fascination and repulsion when viewed.

Soundsystem Apart from performing myself, my artistic contribution to *Homo Restis* is the development of the sound system, an arrangement of 10 satellite speakers and a transport wagon including a sub bass speaker. The sound system also includes two remote controls sewn into the costumes. All individual devices are connected to each other via

5.48 *Homo Restis* (2016) - Sarah Leimcke, Jens Vetter

radio link. They are battery-powered and mobile. The satellite boxes represent the main interface. Its most characteristic feature is the up to 8-meter-long string that is rolled up inside. It serves the purpose to interact with the costumes and the environment. When the string is moved, commands are executed on a built-in micro-controller, which, depending on the type of movement, can produce or stop sounds. The Subbass-Transport-Box serves as a physical storage and transport container for the satellite boxes, but at the same time it is also responsible for playing the generated sounds using the Subbass-Box to amplify the loudness and sub-bass portions of the sounds. The remote-control devices are sewn into the two costumes and are used to change sound presets, dim the volume or mute the corresponding speakers during the performance unnoticed by the audience. The satellite boxes are divided into two groups of five modules each, so that the respective remote control on the costume can control the corresponding boxes regardless of what the remaining boxes execute.

5.2 Evolution of the Project

The beginning of the development of *Homo Restis* is marked by a meeting in 2014, in which Sarah and I agreed to develop a new performance in which we wanted to create sounds based on body movements in a haptic way (see section 1.3). This concept already included the development of a body costume during our first discussions. Also we wanted the concept of creating sounds based on body movements to be aesthetically appealing.

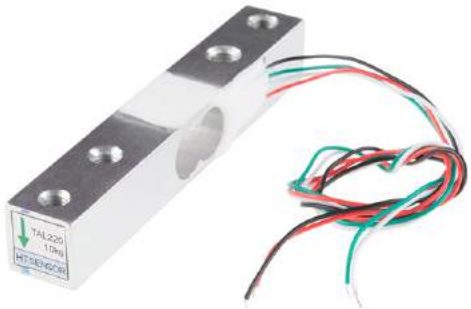
Initial Intentions

For my part, I was inspired by the performances and works by the Italian artist Marco Donnarumma and his project *XthSense* [24], which enabled him to transform his muscle traction into input data for sound production.

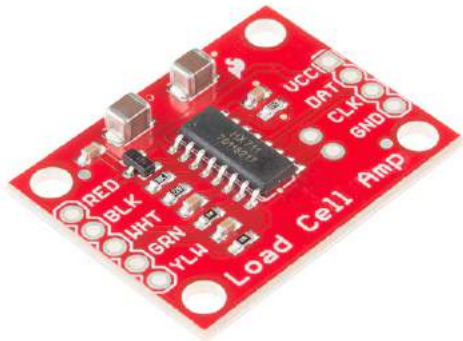
In contrast to Donnarumma, however, I was not looking for a way to translate the force exerted by the individual limbs from within the body, but from outside the body, by means of an appropriate and investigative technology. The intention behind this was an interest in externalization of measurements, which in my opinion through current developments in sensor technology had increasingly migrated into the inside of the body. This seemed to me uninteresting, but also challenging.

At first, our ideal was a performance situation in which the performer is prevented from moving by the costume. Movement or changing body position would only be possible by a significant exertion of strength. This concept is certainly reminiscent of S/M practices, straitjackets or similar means to limit freedom of movement.

5.49 *Texentes* (2015) - conceptual approach



5.50 Load cell



5.51 Load cell Amplifier

As a result of these first considerations, Sarah began to develop the first pieces for an adequate costume. I would like to mention here that the working practice between Sarah Leimcke and me since the very beginning has been less a concept-oriented approach than a process-oriented one. We were accustomed to the situation, that ideas and approaches change and new possibilities and variants show up in the course of the project.

Thus our initial working title for the new performance was *Texentes* (lat. for tension), a title that should take into account the fact that we tried to instrumentalize the physical tension of the confined body (Fig. 5.49).

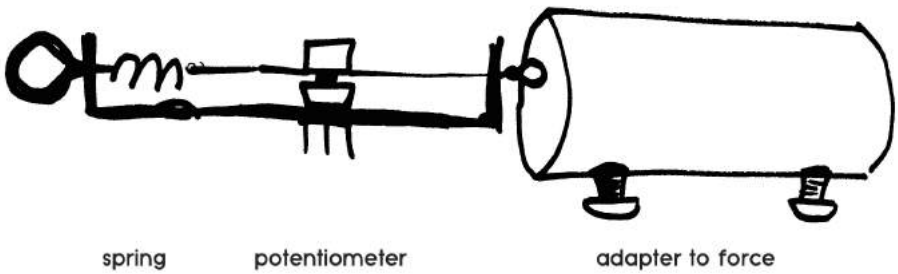
Measuring Tension

The biggest challenge in developing an adequate interface was to clarify the principle of force measurement. Our starting point was the measurement of the forces of limbs that move against a resistance, for example elastic rubber strands. Furthermore, the interfaces were to be mobile, i. e. battery-operated and portable. They were also to be as small as possible to fit into the costumes, and as well as robust and relatively unaffected by vibrations. The aim was therefore to develop a system that could fulfill the following tasks:

- Measurement of the application of force
- portable and battery powered technology
- small dimensions/sizes to be incorporated into the costumes
- robust against vibrations

However, these four requirements initially concerned only the technology for measuring emerging forces, but not the generation and playing of sound. To implement the requirements, I first started to experiment with weight sensors, so-called load cells[1] (Fig. 5.50). Load cells are often used in personal scales, as a coupled arrangement of 4 load cells as rectangles, which are read out together via a load cell amplifier circuitry[2]. The circuit with

[1]https://www.sparkfun.com/products/13329
[2]https://www.sparkfun.com/products/13879



5.52 Sketch of distance sensor with spring

several load cells enables a more accurate measurement result compared to the measurement with only one load cell. In our case, however, I only experimented with a 10kg load cell and the corresponding amplifier board *HX711* (Fig. 5.51). Internally, load cells work with a strain gauge to record and measure minimal strains in the material of the load cell. The load cell amplifier registers this strain in a fixed sampling rate. First of all, I found out that the preset sampling rate of 10 samples per second (SPS) is too slow for musical use - resulting in a high latency, boycotting realtime musical applications. The amplifier offered the possibility to increase the sampling rate to 80 SPS, which resulted in a significant improvement of the latency. Here, however, another problem occurred: the amount of noise in the measurement also increased. The measurements performed jumps beyond reasonable force measurements, which also made further processing of the data as a basis for musical applications more difficult.

Although I could still imagine working with the weight sensors in spite of the restrictions, the whole arrangement - using load cells and amplifiers including a stable support at the costume - had increased the setup in size, so that the use as wearable technology in costumes would cause space problems, especially because we needed several of these measuring units in each costume. Understanding this I left the idea of load cells and started exploring other alternatives to measure physical force externally.

Tension Analog A friend of Sarah's from Dresden, who worked as an electrician, gave me a good hint. He told me to assemble a metal spring, a string and a potentiometer, whereby the rope is attached as a loop above the potentiometer head (Fig. 5.52). The idea behind it was the strategy of balancing the traction force with the help of the spring. The resulting effects on the potentiometer head would be measured and later digitally converted from linear to logarithmic measurements to sense the increase and decrease of the applied force.

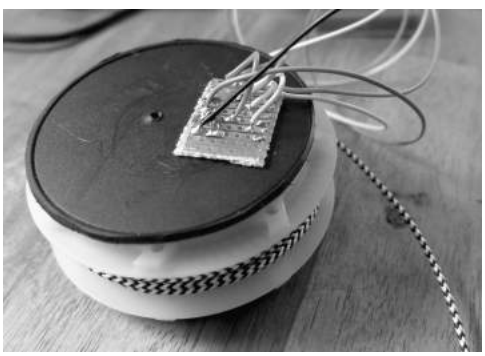
After a few prototypes of this concept, however, it became obvious here as well that the mechanism was not suitable for coping with higher forces and, more importantly, longer distances, as they occur for example through arm movements. I also left this path again.

Measuring Stretching As a next attempt I started to deal with conductive rubber tube stretch sensors[3] (Fig. 5.53). With the help of a metal mesh inside, these conductive rubber tubes were able to electronically measure changes in their expansion as changes in resistance - the functional principle is similar to that of a potentiometer. I did some initial tests

[3]https://www.adafruit.com/product/519

5.53 Conductive rubber tube stretch sensor

5.54 Magnet-based String Sensor - disk



5.55 Magnet-based String Sensor - enclosure with hall-effect circuit

with it and was initially satisfied. These first tests resulted in two works, the *Dreieck* used within the *Looper* setup (section 4.4) and the *Netz* (section 4.5). After the first successful tests, however, the disadvantages of this type of sensors quickly became apparent: these conductive rubber tubes were only available in relatively short lengths (max. 1 meter), could not withstand high forces (which is why I had put them into larger rubber tubes in the *Netz* to protect them) and quickly worn out after a few stretches. I left this approach as well, because it did not seem to me to be sufficient for our requirements.

Measuring Distance

After all previous attempts to find a technical solution for the measurement of physical force failed, I re-examined the concept itself. It became clear to me that it was not possible to measure the force exerted by the limbs under the parameters defined above. I began to think about whether there might be another suitable solution that would provide a way to

measure the movements of the limbs with reasonable technical effort. I came up with the idea that instead of looking for sensors of force, I rather should consider the distance.

Distance or spacing is the shortest line between two points. Applied to this project, this means the measuring of changes of distance between the limbs and the body. Measuring distance with physical tools is difficult. Sensors such as infrared sensors or ultrasound sensors were unsuitable because the body is constantly moving and my goal - a continuous measurement of the varying distances between limbs and body - was impaired. Remembering the design with spring and potentiometer (Fig. 5.52) and partly still thinking of a measurement of the force, I searched for possibilities to measure distances with springs. I discovered the mainspring, which is installed in flexible dog leashes. They ensure that the lead is pulled back into the housing with a permanent traction force and thus does not sag.

I bought various appropriate keychains and Flexi leashes from pet supplies and started experimenting with the leashes and feather mechanisms. The keychains helped me to understand the potential, but they were too fragile and had a much too short leash to work with. It soon became clear that the Flexi leashes were a suitable means to enable the kind of measurement that I had been looking for for a whole year. They were small, mobile, had a large distance range and were economically affordable.

However, the question of how to convert the mechanical turns of the Flexi leash into sensor data remained unanswered for the time to come. After several attempts I found out that it makes little sense to attach a potentiometer to the shaft of the mainspring, because the mainspring does not allow drilling through the middle of the housing. I solved the problem by using magnets, which I glued to the inside of the movable pane, and whose movements I could then measure with the help of hall effect sensors (sensors for magnetic field measurement) from the outside. This new approach was the central breakthrough regarding the development of interfaces for *Homo Restis* (Fig. 5.54/ 5.55).

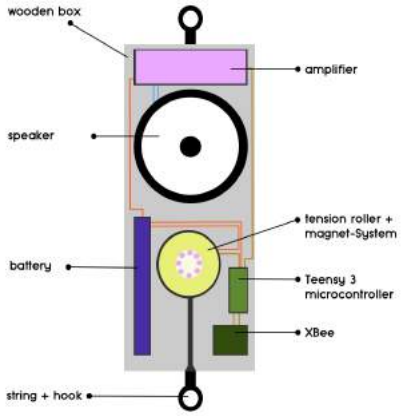
I used an Arduino to measure the data. In order to interpolate the data of the hall effect sensors, I programmed a library for the Arduino, which was able to read the speed, direction of the rotation and the distance.

5.3 Developing the Interface

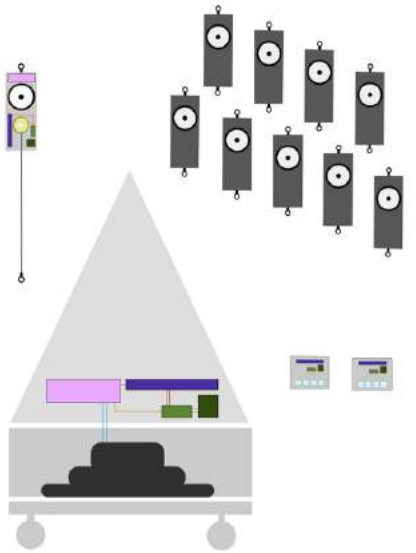
After the development of the string sensor based on spring-driven Flexi leashes, the development of a complete interface concept could begin. The development of the soundbox system of *Homo Restis* was my next task. Here again, the focus was on a number of key design aspects:

- the satellite boxes should be mobile
- it should be possible to combine individual boxes in a modular way
- the audio amplification should be as loud as possible
- the strings should allow the largest possible radius of action

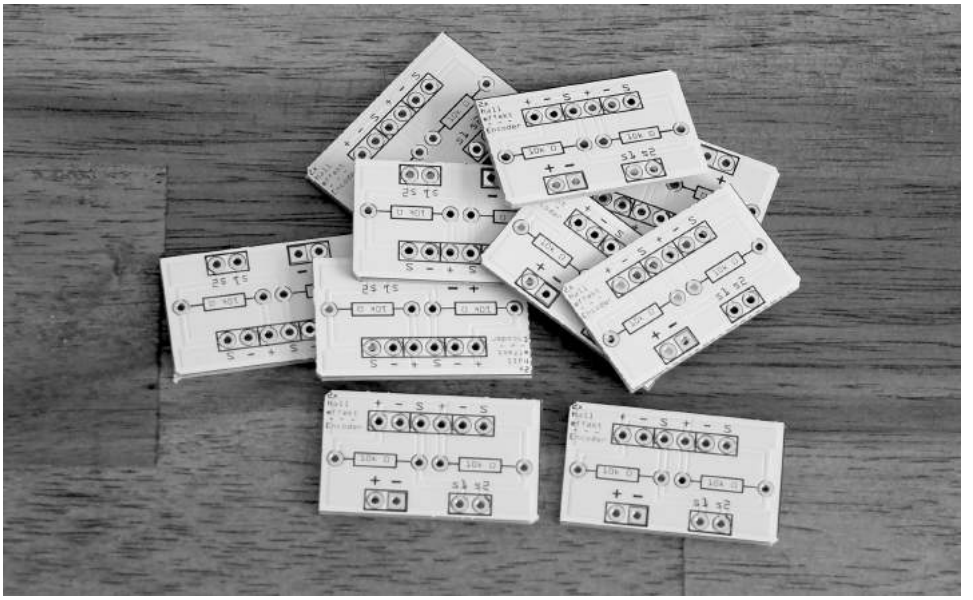
This gave rise to a number of considerations. A) First of all it became clear that we needed a sufficient number of these boxes. We quickly agreed on the number of ten boxes, the decision was also driven by financial considerations. B) the combination and therefore the joint control of several loudspeakers required a wireless connection C) the volume that the relatively small amplifiers could achieve was too low, especially in the bass range, even with ten loudspeakers. So I decided to consider a combination of satellite speakers and a sub bass module.



5.56 Sketch including parts of sound module



5.57 Sketch showing collection of all devices involved



5.58 Circuitboards for magnet-based String Sensor

The resulting individual parts of the satellite boxes were accordingly the following (Fig. 5.56):

String-based sensor

The combination of spring based Flexi leash (8 meter) and a magnetic sensor system. I produced circuit boards for the hall effect sensors, which were later glued onto the outer shell of the rollers (Fig. 5.58).

micro-controller
I chose the Teensy, a version of Arduino. Unlike the Arduino, it has an analog DAC output, suitable for analog audio output.

XBee
I decided to use the XBee for radio transmission because it allows sending and receiving of data to multiple devices in a mesh network.

Audio Amplifier
The amplifiers didn't need to have a lot of power because the speakers were also small. I chose amplifier circuits that offered 15 watts.

Speaker
Visaton 2.5" full range driver as loudspeaker.

Batteries
TOPFUEL LIPO-AKKU 20C, with a capacity of 2400 mAh.

Enclosure
Each box was built with a waterproof plywood enclosure, produced on the CNC machine.

Prototypes

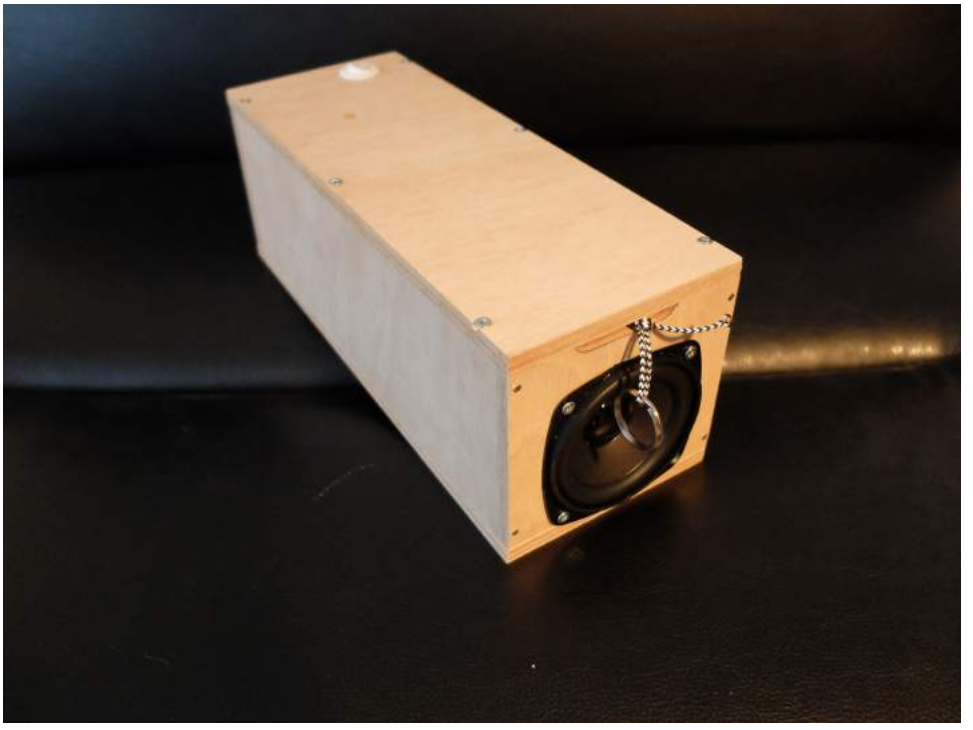
From the above mentioned components I have developed different prototypes. The challenge was to determine the ergonomics of the cabinet, the resonance capabilities in terms of sound reproduction and the responses to the physical strain exerted by the string and implement them within the cabinet. At first I concentrated on an oblong housing shape, in which loudspeakers and the string were accommodated on the head side (Fig. 5.59). I tried to hang it on the back, but this caused gravity to pull down the whole body of the case. As a result, it turned out that this kind of housing form is difficult to handle. Therefore I changed the type of housing to a more compact design (Fig. 5.60).

The more compact design now allows both hanging and stacking several boxes on top of each other. For hanging, I no longer used only one eyelet on the back, but one eyelet on each side. This also resulted in the option of hanging several boxes side by side. Another motivation for the more compact design was the search for a way of accommodating the now much stronger Flexi leashes in a space-saving way. The need for those stronger mechanisms and thus larger rollers has arisen after the first tests with the first prototype. It turned out that smaller mechanisms were too weak to hold the string tension over a length of 8 meters.

System Architecture

The entire system architecture resulted in a combination of 10 handmade satellite boxes (Fig. 5.62) and a subwoofer module (Fig. 5.64). In addition, I created two remote controls that were later sewn into the costumes[4]. They consisted of a combination of Teensy microcontroller, XBee radio unit and a LIPO battery (Fig. 5.57).

[4]the remote controls were connected with metal buttons. Capacitive measurement made it possible to use the buttons as touch sensors



5.59 Prototyp A - sound module

5.60 Prototyp B - sound module

Subwoofer-Modul A special component of this system was the subwoofer module. It consisted of two parts: 1) a micro controller box with radio receiver and 2) the subwoofer consisting of speaker and amplifier.

The micro controller box is of interest here. It not only used one micro controller, but a total of 11 micro-controllers (Fig. 5.63). The purpose of those 11 micro controllers was on the one hand to receive the radio signals of the satellite speakers and on the other hand to reproduce the individual signals for playback as sub-bass sound.

In this regard, it has to be said that the internal data processing in the satellite boxes was designed to follow a certain procedure: Firstly convert the interactions with the strings into data messages, then secondly send them via the radio channel out in the network to be received by the subwoofer module and only then thirdly make the data messages available locally in order to feed them into sound synthesis.

This procedure enabled the subwoofer box to receive and assign all data signals of the respective satellite speakers. After receiving, the signals were internally forwarded to the corresponding micro controller assigned to the respective satellite box. On it, the sound generation of the satellite speaker was reproduced and sent as a separate audio signal to the subwoofer amplifier.

To sum it up: if you interacted with a string, the data was measured locally and then sent to the subwoofer module. Only after that, but almost simultaneously with low latency, was the corresponding sound produced both locally and in the subwoofer box.

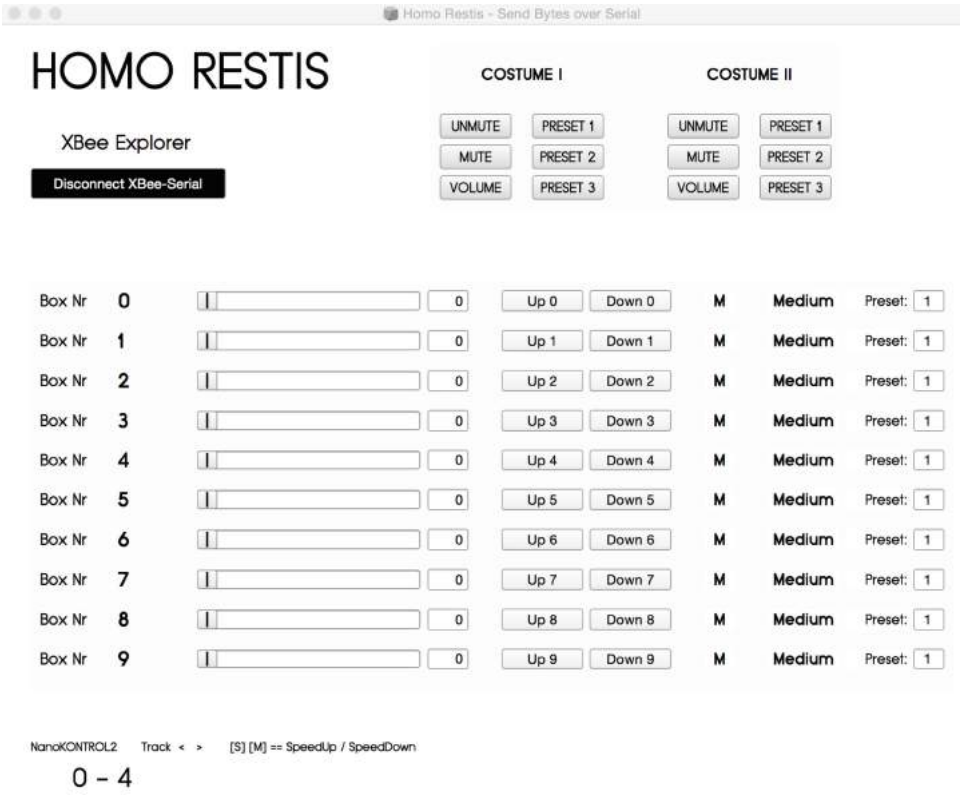
This made it possible to create a wireless multi-channel audio system with relatively low latency [5] to generate the audio signals both in the satellite speakers and in the subwoofer module at the same time.

Wireless Network

Control and communication between all devices is realized by *XBee 802.15.4 Series 1* wireless modules. Communication takes place via transmission at a transmission rate of 115.200 Baud on the serial interface. Since radio transmissions have a data limit and 11 transmit-receive devices potentially generate a large amount of data, I had to reduce the number of individual transmitted messages to a minimum in order to ensure the stability of the radio network. This means, for example, that I did not permanently transmit the absolute position of the distance of each string-based sensor, but only transmitted the events of increasing or decreasing the distance. Each satellite box had reserved 8 serial messages within the wireless network:

1. string moved one step forwards
2. string moved one step backwards
3. lower the volume
4. mute the volume
5. reset internal calculations
6. activate Preset 1

[5] I didn't make any accurate measurements, but the latency was low enough to be usefully used for musical interactions



5.61 Screenshot *SuperCollider* GUI

7. activate Preset 2
8. activate Preset 3

With a total of 11 units this results in a sum of 88 different signals or patterns. Like this I could reduce the bandwidth of all radio communication to 256 patterns, thereby increasing the reliability and speed of the radio communication.

A limiting circumstance was the range of the XBee modules. Interferences or room modes could cause satellite boxes to lose their signal. Apart from that, the choice of XBee's resulted in a reliable work base. For debugging and for testing the sounds I used a twelfth XBee module to hook myself into the wireless network with my computer (Fig. 5.61). I could imitate the string movements with a MIDI controller, which helped develop the sound presets.

Interface Wagon

For the transport of all modules during the performances and thus also as an extension to the costumes, we decided to construct a transport wagon. The wagon had room for the subwoofer and audio amplifier as well as the car gel battery, which we used to power the subwoofer and the micro controller module. We also installed an extra discharge protection to protect the gel battery from deep discharge.

5.62 Sound modules

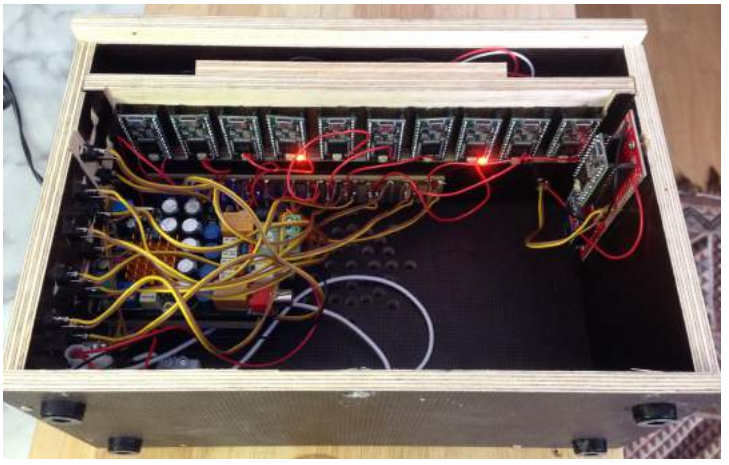
The wagon has a size of 110cm x 60cm x 50cm and a weight of about 70 kilos. It consists of various individual parts that can be joined together using clamps. These include the basic body, the base plate with air-cushioned heavy-duty wheels (protection against vibrations) and two side parts which serve as a support for the ten individual satellite boxes. For this purpose, the satellite boxes can simply be inserted into the compartments from above using a rail system. Each side panel can accommodate five boxes. In addition, the side panels also have extra storage space to carry additional rubber straps and strings that allow us to attach the boxes to the environment during performance.

Sound Presets

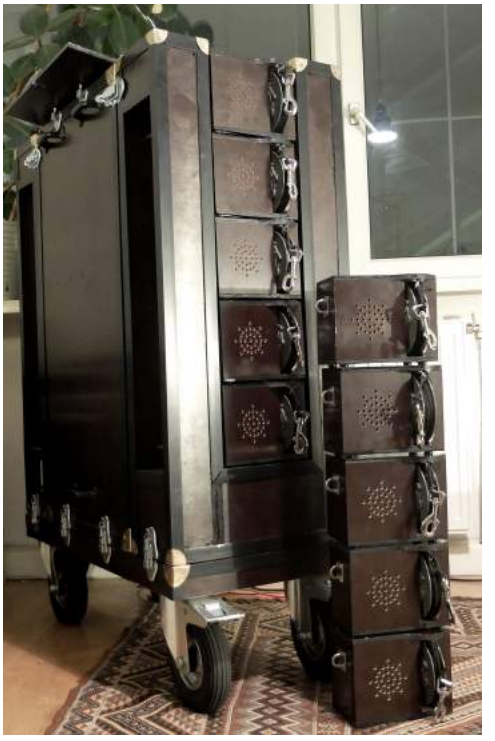
The firmware for all micro-controllers used was based on Arduino code. In particular, by using the *MOZZI*[6] library it was possible to perform audio synthesis directly on the Teensy in real-time. The firmware was programmed to switch sound presets via incoming radio signals, e.g. by the remote controls.

Altogether I used three different sound presets. The presets were based either on the generation of percussive beats at different velocities or on the alienation of atmospheric prerecorded samples including modulated sine waves. The individual presets ran simul-

[6]http://sensorium.github.io/Mozzi/



5.63 Subwoofer module circuits



5.64 Subwoofer transport-box and sound modules

taneously in the background in the program and were activated by interaction from the remote controls.

The boxes were divided into two groups of 5 boxes each and could be controlled separately. This also made it possible to overlay different presets, such as the combination of percussive and atmospheric sounds.

The interaction with the strings could trigger various sonic situations. Fast dragging turned on continuous sound playback, while fast flipping back turned it off. Repeated fast dragging triggered various effects. The distances in which the strings were pulled out of the box controlled parameters such as pitch, playback trigger for sample playback or phase shift in oscillators.

1st percussion

In the first preset, the dominant motif is a sequence of percussive tones in a 4/4 measure. The sounds are generated from noise and envelopes. By interacting with the string, the speed can be gradually increased (rapid pulling on the string). Overlays of sounds of several boxes create polyrhythmic sound figures.

2nd atmosphere

The second preset consists of a mixture of generated sounds and prerecorded samples. After activating the preset by pulling on the string, an audio sample is played back. The sample is a variation of an underwater recording whose playback speed is modulated. In addition, when the string is moved, a single sound from a modulated

sinus tone is activated, which fades away as soon as the string stops for more than two seconds. The pitch is generated by the distance.

2nd Noise

The third available preset is a combination of saw oscillators and noise generators. Altogether this results in a noise-like sound with a sharp bass, in which modulations are caused by interference. The distance of the string controls the pitch of the different SAW oscillators in different ratios.

5.65 *Homo Restis* at Ars Electronica (2016)

5.4 Performing in Public Spaces

The performance *Homo Restis* was shown at various festivals in the months following its completion. Among them are the Ars Electronica *Radical Atoms* 2016 (Fig. 5.65), the *Speculum Artium* in Trbovlje/ Slovenia 2016, the symposium *Media Art and the Art Market* at the Bruckner University Linz 2016 and the transnational project *Kunstzug* between Dresden and Wroclaw 2016.

Preparations

A few words regarding the preparations of the performances. First of all, all batteries had to be charged in preparation for the next performance. Charging the LIPO batteries took at least 8 hours. Since the LIPO batteries used internally consisted of three different layers of individual batteries, the chargers had to charge the individual layers continuously one after the other, otherwise the entire battery would have been destroyed. The battery charge lasted for one day. After the batteries were fully charged, they had to be installed in all the devices (satellite boxes, remote controls, subwoofer carts).

Next followed the process of getting dressed in the costumes. This was not possible without assistance, as the costume consisted of various individual parts which were fastened together with the help of belt buckles. A total of about 50 belt buckles had to be closed for each costume during dressing-up (fuselage, arm parts, leg parts, shoes and head part).

While we were dressed in the costumes, it was also not possible to go to the toilet. In addition, the costumes were heavy and very warm, which became problematic at high outside temperatures, e. g. during the Ars Electronica. In the beginning it was not possible to take off the gloves or remove the headpiece. But it quickly turned out that it was necessary

to get some air between performances. Sarah modified the costumes slightly, so that we could easily remove the headboard and take off our gloves.

Another aspect of the preparations was the question of transporting the costumes and the interface including the transport-wagons. The weight and dimensions of the equipment not only required a car for transport, but even a small van. We not only had to transport the costumes, but also the interface wagon, disassembled into its individual parts. At least three people drove in the car, i. e. two performers and one person as an assistant for dressing.

5.66 *Homo Restis* at Ars Electronica (2016)

Procedure

The sequences of the performances have thereby always been similar: both performers, dressed up in the costumes, started to walk with the interface wagon (Fig. 5.66). One of the performers, the female figure, was usually already connected with the strings from five boxes (Fig. 5.67). Already on the way to the performance venues, a strong image emerged: the female figure first appeared, followed by the strings and their attachment to the interface wagon. Finally the second performer appeared, the male figure who pushed the wagon through the streets and squares.

5.67 *Homo Restis* at Ars Electronica (2016)

In the costumes we had only a limited view through the headpiece. However, the view was sufficient to recognize the situation, roads, etc. and to orientate oneself. We looked for a suitable place to begin to begin our performance. This place was characterized by the fact that it provided the opportunities to fix the satellite boxes to available structures. To do this, we had prepared further rubber bands with carabiner hooks hanging on the wagon. This made it possible to mount the boxes flexibly in found situations.

The male figure was in charge of the task of mounting. When a satisfactory distribution of the boxes across the environment was completed, the male figure began to attach the female figure, who had waited motionlessly until then, to the mounted boxes. After that, the female figure was attached to the environment with up to ten strings. Thereupon the female figure began with puppet-like movements, mechanical turns, forward and backward movements. The strings continued to trigger the different sounds.

Regarding the sounds we often used the second preset as background sound for the period of relocation. This preset consisted of atmospheric sounds that responded to the changes in string movement with a soft melody. When the female figure was prepared in the found situation, we changed the sound preset to a percussive sound using the remote control on the costume. The percussive preset was interactive and able to accelerate the rhythm. After a while, the female figure was able to generate an oppressive, fast rhythm by moving her limbs quickly.

Often we then changed the sound preset to the third sound preset, whose phase shift caused an intense sub-bass. With this preset, the male figure began to undo the strings and gradually remove the satellite boxes and carry them back into the interface wagon.

At the end the boxes were stowed away again, strings were again attached to the female figure and we headed for the next situation. This process was repeated several times during performances.

Versions of the work It is an interesting artistic question, if alternate versions of one work are the same work. When does the performance *Homo Restis* transform into a new work? Could it still be considered the same performance, if we change elements of it? What would happen, for example, if we were to change our choreography, the procedures we follow. Or how about reprogramming the sounds to provide new inspiration for actions and expressions? Would it be a different performance if we changed our concept and suddenly put ourself on a music stage instead of performing in public space?

In my opinion, it remains the same performance as long as both of us wear these specific costumes and interact with sound modules. This means that even if we use completely different sounds or choreographies in a few years, or if we move around in other situations, it will still continue to be *Homo Restis*.

Follow-Ups

When the performances were finished, we went to our accommodation in the costumes. Both performers were already relatively exhausted at this point. The undressing, loosening of the belt buckles and dismounting the individual parts also took a short time, but not as long as dressing. With some practice we managed to free ourselves from the costumes even without assistance.

The next step was to remove all batteries from all devices, as the LIPO batteries were not allowed to consume electricity beyond a certain limit - they were not allowed to discharge completely, because otherwise they would have destroyed themselves.

5.68 *Homo Restis* at Kunstzug Dresden (2016)

5.69 *Homo Restis* at Kunstzug Görlitz (2016)

Intentions and Reactions

The intention behind the performance was, among other things, to temporarily transform everyday places by staging our performance. The appearance of our costumes and the sounds often did not match everyday situations (Fig. 5.68). Our locomotion stood in contrast to other processes and activities at the respective places (Fig. 5.69). But we didn't want to present our show exclusively for an art audience, but in between people of the city's everyday life.

Obviously there were many reactions to our appearance. The nature of the reactions was not so much dependent on the social class as on the cultural atmosphere of the places in general. In Linz our appearance was perceived with curiosity, openness and interest. Passers-by in the streets of Linz were often amused and attentive, and even homeless people, e. g. in the Volksgarten, followed our activities with interest and a smile.

In Slovenia, we were actually greeted with enthusiasm and gratitude. The people of Tribovlje felt thankful that someone took up the effort of performing something artistic and special in their streets. We were then also invited to coffee and cake during a rain shower by local residents and shopkeepers, of course only after they had gotten their photograph taken with us.

On the train from Dresden to Wroclaw, our appearance collided with the private sphere of the other travelers, although the concept of the *Kunstzug* consisted of making an everyday transit place more interesting and inspiring by art. I myself had the feeling that, by extroverted statements, as with our performance, I was entering the privacy and also a retreat for the other passengers. But there was also a predominantly positive feedback from other passengers on the train.

During our stopover in Görlitz we experienced enthusiasm and interest in the form of a television interview and feedback from guests, families and friends. Our performance in the station hall in Görlitz caused a relatively large crowd of spectators to gather around us and also children got involved with us, for example in holding the individual string boxes.

But in the city of Dresden itself, where we performed for a while in and in front of the main station, the reactions were much more mixed. There was a group of guests who had come to the main station especially for our performance, but we also experienced a lot of skepticism and negative comments. This included the mistrust of the security forces at the main station, who did not know whether our performance was permitted under their regulations and therefore harshly interrupted and addressed us. Likewise, passers-by confronted us with disparaging remarks and made fun of the costumes.

Highlights

One of our highlights was the performance *Homo Restis* in front of the *Dom* in Linz. In 2011, the artists Nicole Six and Paul Petritsch had already installed their work *Das Ding an sich - eine Erscheinung* at the Cathedral Square. It symbolizes a fountain and consists of two metal tubes with integrated high-pressure nozzles. It creates a fine mist of water, which then spreads in different directions. We used the two metal tubes to hang an arrangement of string boxes on them, whereupon the female figure moved in the free space between the fountain installation and the interface wagon positioned further away. The haze of the fountain, as well as the presence of the Cathedral, made our appearance an atmospherically remote and wonderful moment.

5.70 *Homo Restis*at Speculum Artium (2016)

Another highlight was the performance during the festival *Speculum Artium*, when we were on our way through the city of Trbovlje. Interacting with socialist architecture, e. g. in front of the theatre *Delavski Dom* (Fig. 5.70), and entering the weekly market on *Liberty Square* in Trbovlje were absurd but great moments. Especially the sequence at the *Memorial of the Revolution*, when we were surprised by rain. The simultaneity of stone soldiers above us in combination with our golden futuristic costumes created a surprisingly surreal aura.

5.5 Evaluation

I will try to evaluate the results of this long-term working process from various angles. Since this project is an artistic project and not a research project, like in sociology, and since we had neither the time nor the resources during our performances, we did not conduct a methodical survey of the spectators, e.g. through questionnaires.

However, in order to be able to evaluate the results to some extent, I will try to compile all the clues, feedback and statements that have nevertheless emerged over time, such as our own subjective perception, conversations with viewers, comments from acquaintances, etc. I will discuss the technical aspects, the costumes and the performance as a whole.

The following questions need to be clarified: whether the performance project including costumes and technology was implemented in accordance with our own expectations?

Whether the technology met our initial requirements, as we wanted it to be mobile, robust, intuitive, loud. How the audience received our performance? And whether there are ways in which we can further develop the project.

Resumé of Costumes Technology As I have already explained, the whole project *Homo Restis* changed in the course of its development. From the first ideas to the final version, it was subject to various transformations (see section 5.2). The final version containing the costumes and the associated sound interfaces is a result of our working process, including the development of the technology. It was great to see how easily we were able to respond to the changes. The idea of the marionette, *Homo Restis* as *men on strings* was a result of these transformation processes. The combination of costume and interface resulted in a coherent overall picture. The interfaces were not only an arbitrary element to create sounds, but rather a constituent part of the entire performance project. This aspect seems to me to be an important sign of a successful development.

Another important point is the use and interaction with the constructed technology. Built as a music interface, its task was to create and control sounds intuitively by means of interaction through strings. The interaction capabilities were limited to different variations of pulling and pushing the string. The interactive control of the sound synthesis by the strings has proven to be practical and applicable. This is demonstrated by the fact that Sarah Leimcke as a non-musician was able to grasp quickly and intuitively how to control the interface.

In its final programming, the system allowed for substantial control and intervention in sound sequences, but remained below the possibilities of a truly virtuoso musical instrument. The modulations and different triggers for samples and sounds are more focused on reliable interaction, less on virtuoso solo playing. Nevertheless, it would still be possible, within the limits of the interaction capabilities, to enable a more virtuoso style, for example by modifying the firmware on the micro-controller.

A comment on the above-mentioned aspects of robustness, mobility and loudness: the technology and designs have proven to be extremely robust and reliable. Despite rain, vibrations and frequent transport, none of the boxes has been damaged or had other faults. Neither the hardware nor the software. The system has also proven itself in terms of mobility. We were able to transport it well thanks to the wheels of the subwoofer wagon. The batteries have lasted sufficiently long. However, we had initially hoped for a system that would be less heavy compared to the final version. Our boxes including the car had reached a weight that imposed restrictions on us, in the case of hills, steps or stairs.

As far as loudness is concerned, we can say that it has fulfilled its function as a dominant sound generator in public space, especially by adding the subwoofer. The limitations regarding the loudness of course were weight, case size, available battery power and budget. It would have been desirable to have reached a higher overall volume.

Audience Feedback The impact of the performance on the audience can only be reconstructed from conversations and by comments from video recordings. All in all, the performance attracted a great deal of attention. This was mainly due to the costumes. The actions (tensioning of strings, mechanical movements that produce sound, the removal of strings and moving on to the next place) were closely followed by the audience. We were described by different viewers as aliens, knights, fighters or warriors.

Often viewers asked about the *meaning* of our performance. Since we deliberately did not offer any narrative moments or explanations, this question often remained open and unanswered. Feedback that arose after a performance at Bruckner University, namely that the performance is sexist because the male leads the female around and ties her up with

wires, remains open for interpretation and discussion. However, we did not actively pursue or focus on this effect. Even though often no explanation for our actions and the meaning of our appearances could be found, we generally noticed that passers-by in public space were grateful for this artistic appearance and the effort we went through.

Further Development Options Our own area of development with *Homo Restis* is the choreography of the performance. During the planning stage, we didn't have enough time to deal with choreographic concepts and expressions and would like to go into more depth.

We are also interested in the use of costumes and technology as a basis for designing a future version of *Homo Restis* as a show in a stage context, i.e. as a music project on the stage of clubs or festivals. We could also imagine to deduce a play from it, in which an entire room is equipped with other - possibly also interactive - objects, and in which we also work together with other actors, performers and dancers, as we have done in previous projects.

As far as the interface system is concerned, there will soon be an update of the sounds and sound presets. It is also possible to adapt the firmware regarding virtuosity and thus to enable more sensitive sonic expressions.

Budget and Costs I would also like to comment briefly on the financing of *Homo Restis*.

A fictional similar project in business, industry or research, usually would involve a variety of costs. These include renting and setting up workplaces, purchasing a wide range of tools, wages for working hours during the different project phases (conception, analysis, design, implementation and validation), budgets for technological development and materials.

The realization of *Homo Restis* required the work of 2 people for 2 years and involved the use of many different materials. This could easily have resulted in the following (lowly estimated) costs: 2 times 20,000 Euro annual salary, 10,000 Euro per year for room rental and tools and a total of about 12,000 Euro for materials. This equals 112,000 Euro.

As artists, however, Sarah and I realized and finished this project entirely by ourselves, without any grants, scholarships or other funds. We worked in our own rooms, used our own tools, were paid no wages and financed all the materials ourselves. Materials included large quantities of gold-stamped leather from the U. S. and all other materials for the costumes, such as eyelets, rivets, carabian, etc. Furthermore, all materials for the technical development of the interfaces and also the production of the 11 final modules, including micro-controllers, amplifiers, Flexi rollers, batteries, wood, strings and much more. During the 2 years of development and including the final costumes and interfaces, the project *Homo Restis* cost us about 12,000 Euro. We reached the limits of our private budget.

So in addition to artistic and conceptual processes, the implementation of such a project is a considerable financial expense, which in our case, was carried by ourselves. We are glad that we were somehow able to realize this project. At this point I would also like to thank my family, who made it possible for us to produce the modular boxes by securing credit in the last phase of the project.

However, it is not possible for us to finance such a large project by ourself on a regular basis, even if we wanted to. And so it remains to be seen whether other and new methods of financing may arise in the future. Methods, that would reduce the financial efforts for future artistic projects. Perhaps *unconditional basic income* could make life and work as an artist easier.

5.71 *Platzhalter* 2016, by Sarah Leimcke

5.6 Publications & Outcome

The project *Homo Restis* was published in several catalogues, among others the catalogue for Ars Electronica 2016 [75], the catalogue for *Kunstzug* Dresden-Görlitz-Breslau 2016 [47] and the catalogue for *Speculum Artium* 2016 [65].

Furthermore, the filmmaker Elisa Unger accompanied the project *Homo Restis* over a period of 3 months and created a documentary film called *"Homo Restis"*[7] (30min), in which the project, as well as the working relationship between Sarah and me over the last 10 years, is examined in more detail.

Another publication is the paper *Homo Restis - Constructive Control Through Modular String Topologies* [81], in which I write about the sound interfaces. It was published at the *NIME* Conference 2017 and presented as a demo during the conference in Copenhagen.

I also gave a workshop on the sound interfaces of *Homo Restis* at the *Soundstudio Lectures* at the University of Art and Design in Linz, where I presented and discussed the hardware and software for students.

[7]http://parolefilm.com

During an artistic intervention initiated by Prof. Eberhard Bosslet at the *Lipsiusbau* on the *Brühlsche Terasse* in Dresden, Sarah realized a work entitled *Platzhalter*, in which she showed documentary photos of the performance *Homo Restis* printed on towels (Fig. 5.71).

CONCLUSION

More than 12 months have passed since the first public performance of *Homo Restis*. During this time, and especially during my research on this book, I had the opportunity to gain distance from this relatively large project and its many years of development. But the memories of the preparation phase and the excitement during the first public performances are just as vivid.

However, this project does not only stand for itself, but also accompanied me throughout my entire studies, from the start in 2014 up to my final thesis now in 2018. I am still incredibly glad to have had the opportunity to realize this collaborative project, both in terms of the repeatedly fruitful cooperation with Sarah Leimcke, as well as in terms of input and the great, always forward looking support within Interface Culture. Otherwise the project would not have been possible.

In this book I have attempted to examine the project *Homo Restis* not only under the aspect of its technical and physical details, but to attempt a broader view. That is the reason for my studies on Dionysos, philosophy and the heterotopias of Foucault, Indian masks and the Futurists' and Dadaists' confrontations with the establishment. I have tried to give our work *Homo Restis* a foundation on which it can rest appropriately and be seen in an adequate light.

Dealing with these issues has made me aware of new issues and cross-relationships, as was to be expected, and aspects that I previously have not perceived so clearly. This includes, for example, the excursion to heterotopic interfaces - this mixture of heterotopia and new musical instrument, whereby I could only briefly outline the course of thought here. This point of view emerged during the writing process as being very exciting and, under other circumstances, worthy of further research.

Likewise, the question of the evolution of the key has answered some interesting questions and raised new questions, which I also think require more intensive research in order to answer them properly.

I hope my thoughts were clear and I was able to successfully contextualize *Homo Restis*. I also hope that the chapters on the technological aspects of *Homo Restis*, as well as background information on system architecture and sound programming were understandable.

Unfortunately, the results of my technological research on the subject of *measuring tension* could not be incorporated into the final study. Nevertheless, I am still fascinated working with weight sensors for musical interfaces. I am curious and open towards the use of this kind of interaction in future instruments or artistic installations. I actually already a specific idea: *tension-space instruments* that assist in feeling (more than seeing) spaces and relationships between objects. Instruments that translate the feeling of tension, pressure and body exertion into a musical output that could enable a new way of playing.

An interesting development with regard to these sensor types could also be an arrangement of strings that is both elastic and tension-sensitive as well as electronically conductive, a mixture of Oskar Sala's *Mixtur-Trautonium* and my installation *Netz* as well as the string interfaces of *Homo Restis*. One could then interact with the instrument with both tension and an electrically determined positioning of the hands on the string.

However, this string of thought and reflections on *Homo Restis* shall be saved for further development and the next performance of the project. I hope that in the next few years I will be able to realize other similar or related projects in an equally inspiring environment.

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