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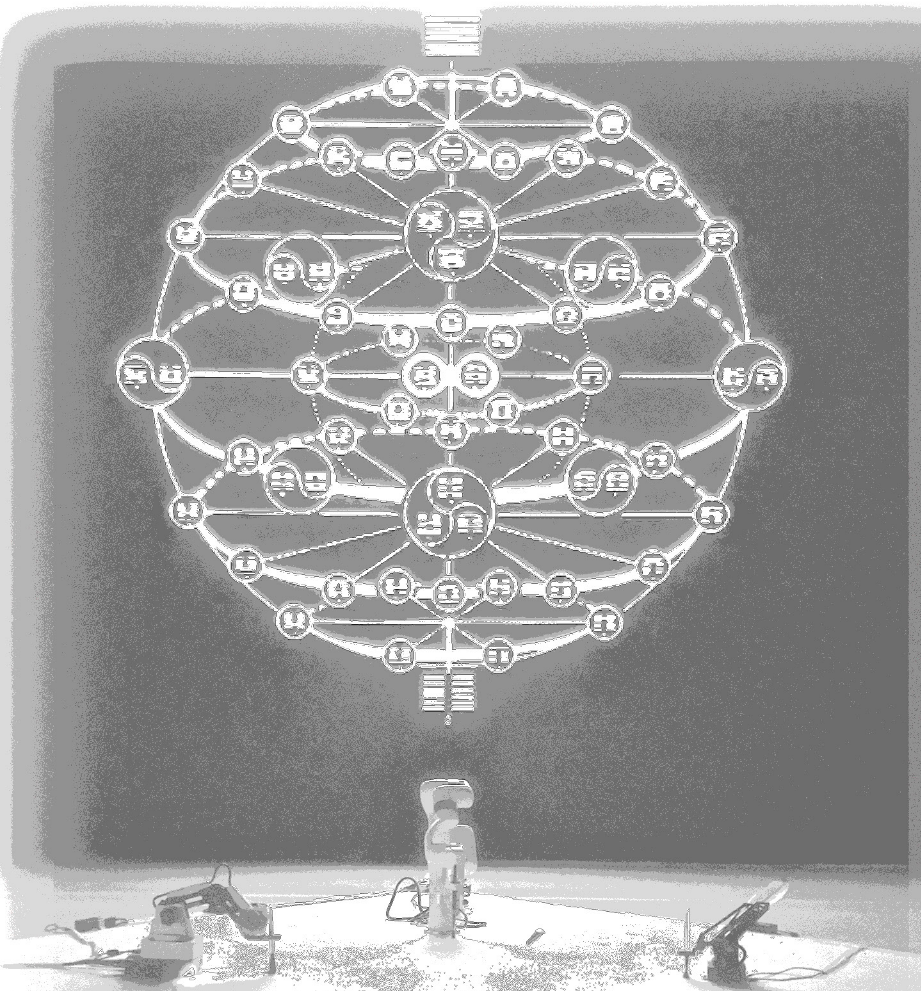

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Abstract: The digital revolution and technology has led us towards a more intimate understanding of the acoustic instrument and its sound. What was the modern piano for Chopin was a tape recorder for Schaeffer. Today, there is little distinction between the sounds of acoustic, natural or electronic. In this paper I describe the shift of musical perception throughout recent technological developments. My starting point of exploration is the spectral attitude of 1979, which inspired further sonic evolution and changed our perception of the sound, performance and instrumental body or instruments, as well as introducing the computer as an essential instrument for composing. Further, I highlight the importance of software and discuss the ways in which software-generated musical ideas can incite human creativity and influence a post-digital vision of *gesamtkunstwerk*. The evolution of hybrid instruments and real-time audio-visual interactive software has led to changes in temporal freedom and created a multisensory experience. I explore how this transmission breaks down the barriers and limitations of the human creative mind and discuss how this can potentially lead to the new musical era. Finally, I reveal some art experiments within the concept of transmedial composition in recent times.

Keywords: sound spectrum, musical language, transmedial, gesamtkunstwerk, composition, software, creativity, multisensory, perception, human-machine collaboration

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The technology evolution has gone hand in hand with human creations; better yet it creates a hybrid process that does not imply an exclusion of tradition, but instead evokes its extension and includes an expansion of creative possibilities. In the domain of musical sounds, the refinement of digital synthesis and real-time processing, alongside the creation of interactive software and hybrid instruments,

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has opened up wide new territories, offering different points of view. As Douglas Kahn stated “both sound and listening have been and continue to be transformed through the cultural elaboration of technology” (Kahn, 2001, 15). The traditional use of instruments and the understanding of acoustic sound needed liberation, and in this context, that classical instrument of the new age – the computer – became the point of liberation and personalization.

The creation of spectral sound analyzers was followed by newly developed technologies which inspired composers in the last hundred years, ever since they gained the ability to directly manipulate every characteristic of sound. The task of a composer became not only to compose music for instruments, but to create and generate the very sounds themselves. This change in perception of both sound and creation announced the era of a diverse collaboration between composer, the acoustic instrument, and computer software (OpenMusic, AudioSculpt, Max/MSP, SuperCollider, Processing etc.) (Holmes 2002). Furthermore, the power and possibilities of software language emphasized the importance of sound as a part of various artistic practices, alongside other media and cultures that cut across genres of music, rather than allowing it to become its own sui generis field. Throughout the modern period, sound has wanted to break free from the historical constraints of music and become accepted amongst other creative media. Musicians’ deep engagement with technology, far from being merely a search for “new sounds,” constitutes one of the primary vectors through which music in the 20th Century opens out into other fields of thought and action, from aesthetics to politics, science, and philosophy. Therefore, developments of the digital era influenced the natural need for multisensory experience:

> Just as the new sound technologies brought together artists of opposing aesthetic positions, so too did they throw open the gates separating the various forms of art. One of the most remarkable effects of the technologization of sound was to draw music into the synesthetic gyre of the early 20th Century. This multi- (or inter-)media impulse, too, belonged to the spirit of the age. (Patteson 2016, 7)

The hybrid or multimedial character of the artwork is not the invention of our contemporary culture. Instead, increased awareness of the multimedia form could be already found in the works of many 19th Century writers and artists such as the visual poems of Mallarmé or the musical dramas of Richard Wagner. In his 1849 essays *Art* and *Revolution and The Artwork of the Future*, Wagner used the term *gesamtkunstwerk* to describe the concept of total work of art or all-embracing art form. He applied this concept for creating the ideal artwork throughout the use of different media as a unity in his musical drama.

> Wagner thought that the separate artistic media – music, text, dance, painting, architecture – which represent the different human senses – auditive, visual and kinesthetic – could only fulfil their original function if they interact in perfect harmony with each other. (Lajosi 2010, 44)

Besides the multisensory experience, the concept of the *gesamtkunstwerk* affects the traditional roles of creator, performer, and receiver, and considers composing process as a complex, social, and intermedial act. He thought of it as an artwork of the future and it seems that today artwork is, in some way, a reflection of his giant vision.

I Composing *into* the sound

After the new tonality and the new simplicity (alongside neo – romanticism/impressionism/serialism) it seemed like composers remained stuck in the *isms* and reproductive applications (duplication, dissemination) instead of invention and generative or productive uses (Moholy-Nagy 1985). Cage came up with a similar conclusion about the habitual practice of music and composers whose approaches to creating music mostly began with existent figures – melodies snatched from the great fragments of musical memory and finished by giving these figurative patterns personalized time frameworks. These automatic thought processes could only be transformed by the creation of new or different methods of listening to the sound, rethinking and exploring the unformulated.

The 1970s was a decade of radical shift in perception of sound, mainly concerning the idea and possibility of *observing* the sound regarding to technological developments within composing processes. This was the process of liberating sound, an intuitive transition from relations of pitch between tones to the microcosmic world of frequency ratios within a single musical sound. Since Helmholtz, it has been understood just how sound comes into being, that it owes its existence to the simultaneous sounding of many tones, and there has been knowledge as to which elements affect its transformation in time. Before the application of technology in music, one could not apply these theories and turn them into creation or, hopefully, a new language. In that vein, Wittgenstein's remark bears an important perspective:

> What a Copernicus or a Darwin really achieved was not the discovery of a true theory but of a fertile new point of view (Wittgenstein 1984, 18).

This could also apply to the impact of technology on Helmholtz's theory. About 75 years after Helmholtz published *On the Sensations of Tone*, Cage foresaw the potential evolution of musical thought and recognized the very beginnings of a sonic expansion to be achieved with electronic technologies. Apart from predicting the availability of the "total field of sound," including noise, Cage also imagined the precise modification of the harmonics, frequency, and intensity of this sonic spectrum, years before digital technologies were developed (Cage 1961).

Spectral attitude and musical material

In the time of technological growth, beside electronic music, the force that evoked a re-birth in perception of sound was the spectral approach to music and composing. Features of spectral composing include process preferred over development, frequency and temporal space, continuum of timbre and harmony, a global approach to form, the use of approximations, and perceptual and psychoacoustic aspects of sound. Murail introduced the subject of the spectral attitude to the music,

> Our conception of music is held prisoner by tradition and by our education. All has been cut into slices, put into categories, classified, limited. There is a conceptual error from the very beginning: a composer does not work with 12 notes, x rhythmic figures, x dynamic markings, all infinitely permutable; he works with sound and time. So why do we always have to speak of music in terms of notes? (Murail 2005, 137).

When Pierre Boulez came back to Paris in the mid-1970s to open or 'establish' IRCAM (*L'Institut de Recherche et Coordination Acoustique/Musique*), spectralists saw themselves as an anti-institutional group within the field of contemporary music led by serialism (Smith 2000, Murail 2004). This is important in the context of the perception of musical material. While serialists composed within the processes of fragmentation of existing musical language, spectralists went one step back to the question of what the essence of existing language is. Spectralists questioned some elements of serial music, such as the idea of the parameter, and claimed that there is theoretically no difference between diverse musical parameters because they perceived sounds as correlated ensembles of energies. They have returned to the origins or to the pure nature of sound, which Grisey named as the 'ecology of sound' (Heile 2009).

Spectral attitude and technologies

The relationship between spectralism and the rising post-industrial Zeitgeist was clearly seen in the spectralists' commentary concerning technological impact on musical practice and perception. Grisey, Dufourt and Murail claimed that more than anything else, new technologies (mainly the spectrograph and computer) revealed the unseen dynamism of sound. Murail, for instance, underlined how the spectrograph (which made possible to visualize and manipulate complex sounds) opposes the illusion, presented throughout musical notation, that sounds are detached, fixed objects:

> With new methods of sonic analysis, one immediately discovers that a sound isn't a stable entity and doesn't remain identical to itself, as

> the abstract notes in a score might lead one to believe. All of our musical tradition is based on this assimilation of the real object by its symbol, while it is actually the case that every sound is essentially variable, not only from one iteration to another, but also within its own duration (Murail 2004, 12).

Technology has always played an important role in the development of spectral music and models derived from electronic processes such as frequency shifting, ring modulation, frequency modulation, or tape delay, can be found in any number of spectral pieces:

> Spectral analysis means an approach to sound materials and musical structures which concentrates on the spectrum of available pitches and their shaping in time. In embracing the total framework of pitch and time it implies that the vernacular language is confined to a small area of the musical universe (…), it is sound recording, electronic technology, and most recently the computer, which have opened up a musical exploration not previously possible' (Smalley 1986, 61).

The desire for mastery of the sonic continuum led naturally to the use of the digital computer. Because of tradition and manual habits, a composer's or a performer's relationship to the computer was opposed to the traditional acoustic instrument, although both are artifacts made by human beings. As a matter of fact, the spectral analysis of the sound and further technological developments in terms of music brought an even more intimate understanding of the acoustic instrument:

> As the development of techniques for spectral analysis and synthesis techniques led to new ideas of how to write for the piano in the 20th Century, the 21st Century has seen the creation of interactive software and hybrid instruments designed to explore further the unique inner metaphors of the original acoustic instrument (Nonken 2014, 141).

A good example of the transition from traditional to contemporary perception of sound and the use of electronic resources to expand natural instrument's capacities is the piece *Tombeau de Messiaen* for piano and electric tape (1994) by Jonathan Harvey. With piano part inspired by Messiaen's leitmotifs and the electric tape created according to new technological approaches, this piece could be perceived as Janus-faced. In *Tombeau de Messiaen*, the pre-recorded tape consists of 12 pianos all tuned in harmonic series, each on one of the twelve pitch-classes. It adds resonance to the piano chords which evoke the tape's 'reaction,' articulating the "same" sound. In an ideal performance, for both the pianist and the listener, both parts should perceptually fuse. In this way, Harvey created "an inner life" of a sound and an effect of meta-piano since it is not clear to the listener what is a sound of piano and what is part of an electric tape. He wanted to make a musical material which could be perceived and heard on many sensory levels. Harvey has shown that technology has come to classical music not to replace old instruments but to free them (Harvey 1999).

Spectral attitude and instrumentarium

> Suddenly, one day, it seemed clear to me that the full flowering of music is frustrated by our instruments. In their range, their tone, what they can render, our instruments are chained fast, and their hundred chains must also bind the creative composer. […] It may be that all the possibilities of traditional instruments have not yet been exploited, but we are certainly well along the way of the path toward exhaustion. Where then do we turn our gaze, where does the next step lead? The answer, I believe, is abstract sound, unbounded techniques and technologies, tonal limitlessness. All efforts must push in this direction, in order to bring about a new, virginal beginning" (Busoni 1907)

More than any other figure, Busoni, with his treatise Sketch of a New Aesthetic of Music (*Entwurf einer neuen Ästhetik der Tonkunst*, 1907), influenced the intellectual foundation for the technological experiments of the 1920s and 1930s. Further, while Luigi Russolo denounced the symphony orchestra as "a hospital for anemic sounds" (Russolo 1967, 6), Edgard Varèse already in 1916 wrote about "the great need for new instruments, new technical means which can allow and sustain any kind of expression of thought." (Varèse 1983, 23) It was clear that the exhaustion of the symphonic instrumentarium was at hand and an opportunity for radical renewal raised. The time had come when music and technology entered into a mutually catalytic relationship, impelling each other toward a sea of new possibilities. This shift of instrumentarium began in the early part of the century and, as Elena Ungeheuer argues, was complicated as instrument builders did not wish to change the course of music history with new sounds and means of sonic manipulation, but rather to use electricity to imitate what was already familiar. She emphasized a distinction between the "imitative" instruments of the early 20th Century and the "innovative" sound machines of the post-1950 period. (Patteson 2016) If electric instruments serve as an imitation of acoustic instruments, it is still a large fail in a technological use. The purpose of this instrumentarium expansion or shift should be a call for creative artists to conceive a different compositional style, so that these instruments can become what they ultimately strive to be: instruments for a new music of a new age:

> The deepening engagement with technology in 20th Century music, born of a desire for control, has brought about a centrifugal expansion of the art (and indeed of all art), unleashing an almost incomprehensible multiplicity of sounds, techniques, politics, and practic-

> es. In place of the monolithic modernist vision of a technological promised land, a destination in history where the development of instruments would attain a state of perfection or at least provisional equilibrium, we are now faced with a state of chaotic oscillation or perennial flux, leading nowhere. Accordingly, the challenge for contemporary musicians is by no means a simple matter of remaining technologically "up to date"; instead, it is a question of navigating, at the deepest, cellular level of artistic practice, the unstable force fields spanning the gap between instruments and aesthetics, technology and technique (Patteson 2016, 167).

II Coding the visual sound

The narrative in this section is related to the new musical language born in the digital age. The application of the computer influenced expanding the practical range of sonic possibilities, while also enabling the detailed and empirical study of timbre. It was in fact the appearance of digital sound synthesis that made that new sound vision possible. Max V. Matthews, the computer music pioneer, understood the power and generality of digital synthesis which he described in his 1963 article in Science:

> With the aid of suitable output equipment, the numbers which a modern digital computer generates can be directly converted to sound waves. The process is completely general, any perceivable sound can be so produced (Matthews 1963, 553).

In the 1960s, Bell Labs started to develop and expand the technological tools in an unexpected direction. The essential instrument – digital computer - became more complex and a number of, what were called, unit generators had been added to the set of new possibilities. The user would compose a piece coming up with a series of numbers that became input specifications for the instrument. According to the numbers one gave, the series went into the computer, and the sounds that were generated had characteristics determined by these numbers. With the rapid development of technology, the musical 'system' of the new age became *software*. Software was used to designate the pitch, timbre, amplitude and duration of sounds being played on instruments connected to the computer. Herbert Eimert, one of the founders of the *Studio für Elektronische Musik* in Cologne, described this creating shift from manual to technological:

> The composer, in view of the fact that he is no longer operating within a strictly ordained tonal system, finds himself confronting a completely new situation. He sees himself commanding a realm of sound in which the musical material appears for the first time as a malleable continuum of every known and unknown, every conceivable and possible sound. This demands a way of thinking in new dimensions,

> a kind of mental adjustment to the thinking proper to the materials of electronic sound (Wörner 1973, 122-124).

Besides the concept of computer memory as an adjunct to human memory, one could bring in his/her own sounds, stored as digital information, and control them using patterns and sequences and free-form patch control that is unique to one person's computer. So, with electronic and electro-acoustic music came just about every method of composing imaginable: graphical scores on paper or transparent sheets of plastic; computer-generated algorithms; oral commands; written instructions; audible performance cues; and so on. There were no standards other than those for traditional musical notation but in this case, the composer usually did not have to work with pre-existing material. Instead the composer created and shaped the sound that he/she wanted to hear.

It is important to acknowledge Reas' and Fry's argument that:

> Software holds a unique position among artistic media because of its ability to produce dynamic form, process gestures, define behavior, simulate natural systems, and integrate various media including sound, image, and text (Fry and Reas 2007, 1).

Hence, I would argue that today software represents an essential contemporary digital language. However, it still requires its own terminology and methodological approach.

Since many software environments are programming-based, it is important to understand that programming languages are not just for engineers, but for anyone interested in adapting to contemporary digital language especially connected to innovative creating processes. The computer arose as a tool for fast calculations and has evolved into a medium for expression. To entirely explore the computer as an artistic material, it is important to understand the art of computer programming. As Nelson stated:

> The more one knows about computers, the better his/her imagination can flow between the technicalities, can slide the parts together, can discern the shapes of what one would have these things do (Nelson 1984).

Programming is not the only way, **Max/MSP** for example, a powerful program used for algorithmic composition offering controls over the parameters and performance of digital synthesis and real-time audio processing, is mostly used by many musicians and visual artists as a base for audio-visual creating and is different from typical software languages – its programs are created by connecting boxes that represent the program code, rather than lines of text. Beside Max, there are other important software tools that deserve mention:

- **SPEAR** (Sinusoidal Partial Editing Analysis and Resynthesis), first time demonstrated at the Columbia University Computer Music Center on February 2004, is an application for audio analysis, real-time editing and synthesis (Klingbeil 2009);

- **OpenMusic** (OM) is a computer-aided composition program created at IRCAM which became popular among a wide variety of composers, such as Brian Ferneyhough or Kaija Saariaho. It is a visual programming environment based on patching pre-defined or user-defined objects, however it is does not operate in real-time;

- **PureData** is the open source sibling of Max/MSP;

- **Orchids** is program created at IRCAM, particularly for supporting instrumental and orchestral synthesis. Orchids has access to a huge database of instrumental samples from orchestral instruments to traditional instruments from all over the world;

- **SuperCollider** is a free and open source software tool for audio synthesis and algorithmic composition, used by musicians and researchers working with sound. With different use of its major two components - *scsynth* (a real-time audio server) and *sclang* (a client, an interpreted programming language), the user can constantly explore new sound synthesis methods or connect with other software or controllers;

- **Processing** considers the ideas of computer programming (Java language) within the context of the visual arts. It creates interactive and visual work, building real-time processes to generate form. Processing was created as free and open-source software (FOSS) to be accessible (can be downloaded without cost) and flexible (could be understood by a general audience) (Fry and Reas 2007).

What makes these separated programs more powerful is the point of their synthesis as a cross-program. While, for instance, SPEAR's support for text-based file formats makes cross program data exchange relatively simple; OpenMusic, Common Music, Max/MSP and SuperCollider, can be used to import, manipulate, export, and/or synthesize SPEAR analysis data. OSC (Open Sound Control) is the element that lets different programs run on the same or on different computers while communicating. In this way both audio and visual software can work on the same artistic process. Finally, playing with different algorithms in relation to amplified acoustic instruments and diverse visual presentation of the sound encourages future exploration and a multisensorial approach to musical composition.

III Sounding the transmediality

The new conception of artistic creation was anticipated by both Cage's approach to music as the organization of sounds and events and his chance compositions, and the Fluxus movement as "borderline art" in which the genres are retained. (Kotz 2010) Further, the rapid growth of technology resulted with overwhelming hybridization:

> Each day provides an example of chaos. Either in the form of telephone calls or in the mail coming. We never know what's going to happen. The kind of trouble that people have with the weather, we now have with every aspect of our lives. Everything as a result is interesting. And we're living now more and more not only in a world full of noise, but in one full of all kinds of things that we can perceive through our senses and also a world of more people than ever before (Cage 1961; Bernstein and Hatch 2001, 271).

Composers today live in a moment of extraordinary transition. Omnipresent digital discoveries including media and VR (virtual reality) platforms, as well as the all-embracing habitation of the Internet, will profoundly affect the multisensorial arts. In the second half of the 20^{th} Century, places such as frontal concert stages built for presenting 19^{th} Century music, do not satisfy for the needs of electronic media, multi-loudspeakers, and interactive media. Instead of being staged frontally with the audience seated, immersive aural constructions are usually best experienced interactively, as the audience explores the sonic world by listening at different locations in the space. In the process of composing, artists can explore different ways of hearing, "whether sound is very far away, very close up, vibrating an elbow, appearing on top of their head, or 'inside' their head and streaming out of their ears into space in front of their eyes" (Cage, Bernstein, Hatch 2001, 188). In this way, the composer creates an interactive world within his/her piece. There is a critical need for buildings that are dedicated completely to these new musical and sonic worlds, but the problem with finding suitable space is just one of many. There is also an issue of the performer: who is the performer in the multisensorial artwork? Is it a musician, a listener or the software itself? Since there are no longer limitations to writing notes on paper, neither to writing notes at all, with current sound technologies composers are not working with notes but with numbers, algorithms, MIDI cables, space, microphones and loudspeakers to access real-time auditory experiences. The composer is not operating with material but expanding the perception capacity. A listener has the possibility to individually interact with a piece while changing perceptual viewpoints, expanding visual, auditory, tactile, and motion-based experiences.

This active listener's participation in the creation of the artwork, instead of taking part in a hermetically closed artistic space and passive aesthetic experience, is already revealed in Wagner's oeuvre and Theatre in Bayreuth.

> The theatre – that is the totality of the building, the play, the performance, the actors and the audience – is a medium through which artistic and social perfection could be achieved. In Opera and Drama Wagner also accentuates the dynamic nature of the *Gesamtkunstwerk*, which is not seen as a static art form, but rather as an aesthetic (almost physically experienced) action. It is production and re-production at the same time (Lajosi 2010, 51).

For Wagner, music is specified with the active role of intermediation that binds together the different arts. But all kinds of art forms and mediums have equal rights on the stage and everyone is the creator of the artwork. In that sense, *gesamtkunstwerk* embraces the spirit of free mankind and opens new wide territory for creation. While in the Wagnerian sense it considers the individual arts subordinated to a common purpose within opera and theatre, in a post- digital era *gesamtkunstwerk* takes an even broader meaning, including a synthesis of any discipline, space, and time, and including digital tools manipulated by the creative human mind. What is in common for both meanings is the shift of thinking and vision of new socio-cultural reality.

A cross-disciplinary practice merging the roles of composer, sound engineer, performer, filmmaker, programmer, visual and conceptual artist, results in the concept of a transmedial composition. A transmedial work goes beyond the meaning considering the interfaces between media, their transmissions, interdisciplinary exchange, interaction of wide topics, media forms and schools of thought. The composer of transmedial composition considers the most recent areas in research in music, the arts, science and society.

> Because art serves the function of training man's sensory and other apparatuses for the reception of the new, then creative activities that hope to do justice to the imperatives of their time must explore the unknown rather than simply re-produce the familiar (Mogoly-Nagy 1985, 289-290).

Due to technological developments, the human perception of composing and perceiving music became productive instead of reproductive, broad and synesthetic instead of narrow and unidirectional. It is likely that audio and video processing are not independent in human perception and this is now considered even in wider disciplines. If, as listeners, we are able to describe or visualize what we hear, software fusion would prove to be able to realize that multisensorial vision and, in that way, to inform our own compositional intentions.

Instead of being creative laboratories, art institutions such as music conservatories must follow the rules and limitations of the old educational system that considers music up to the beginning of the 20th century concluding with Schoenberg. To get out of this comfort zone means to try new approaches and ways and to follow global changes. Music academies and conservatories mostly do not consider the computer a real instrument of our age, which is why future generations are probably going to be more interpreters or reproducers instead of creators. This institutional problem affects the transmedial sphere too, since sound is one of its fundamental constituent elements. A good example of the art institution that meets contemporary needs is the Institute for Music and Media at the Robert Schumann University of Music and Media based in Düsseldorf (Germany). It provides an environment that combines artistic, scientific, and technical interests and offers a diverse range of studies (classical music courses, classical music recording and production, media composition, music and audiovisual media, visual music, music informatics (algorithmic acoustics, hybrid sound computing and expanded systems), music and text, sound and reality etc.). This is an institution that opens up the new space for innovation and experimentation and that allows students to follow their unique professional development as artists and creators.

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> As immersive technologies expand and grow to mirror the sensitivity of our responsive energies, will the auditory arts delve consciously into these expansive sensory worlds? And in what ways? (Bernstein and Hatch 2001, 185)

To conclude, I would agree with Winner that "we do not use technologies so much as live them" (Winner 1977, 202). As I have illustrated, the concept of musical creation and performance has become reconstituted regarding to technology, since technology could analyze each of the components of a given activity and reshape it. New technologies are transforming the live experience of music:

> Because we are born into chains in nature, thus there awakes with the spark of spirit the idea of freedom over nature: the idea of technology. Every new invention is a new stage in the freedom attained by humanity through the progress of technology (Zschimmer 1917, 18).

The concept of a concert/exhibition became a one-time event, and every perceiver of modern artworks searches for the maximum of sensual experience. A spectral approach to sound has meant a broader perception of sound and music performance, which has led to the use of software enabling the further evolution of musical language. The use of the sound, space, light, images, chairs, words, movements, lamps, or neuroscientific invention as unified parameters for musical composition or as one common medium would not be possible without the synthesis of software and the human creative mind. This is an important matrix for the future artistic environment.

The interplay between roots and globalization, high tech and high touch experiences, the fusion of auditory, visual, haptic, and kinesthetic media, as well as artworks created with other media through interaction, participation, and collaboration in which the role of the artist is redefined; all leads to the postdigital artwork of the *Future* which is *Now*. It is clear that with the development of technology humankind is changing, and this global cultural change must result with a revolution in the humanization of digital technologies within the new creative processes.

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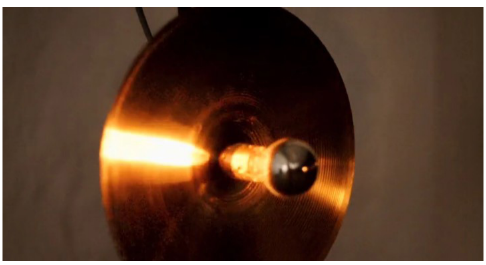
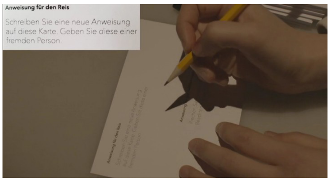
Appendix. Examples of experimental artworks

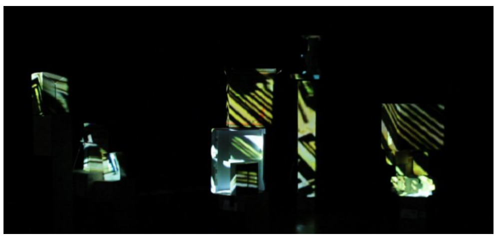
1. *Ich war die Wellen, doch dann sah ich sie an*. [I was the waves, but then I looked at her.] by Lambert Windges is the sound - light installation that takes the emergence, presence and disappearance of varying circumstances in a polyrhythmic structure as its theme. Lambert was inspired by the dualistic interpretation of various phenomena in our lives and in his work he describes a perspective that seeks to observe these phenomena and at the same time to uncouple them from their dualism through the neutral standpoint of observation.




2. Eins and Viel (One and Much) is an interactive installation by Suhyun Park which she describes as "a granular playground consisting of rice, staples, instruction cards and algorithm." These materials, as well as two microphones and four speakers, encourage the audience to interact with the setup while each time the sonic and visual experience is different. The sounds recorded with the microphones are processed by an algorithm in SuperCollider and played over the speakers in real time.




3. *Paketzentrum 47* is the multi-channel sound sculpture with projection mapping by Lukas Truniger. It is inspired by investigations into the origin, manufacture and material composition of a laptop. In this process the starting elements of the work were: packaging material of entertainment electronics, images of the raw materials that are required to manufacture a laptop, and the recordings made by a mini-recorder that was forwarded in continuous operation. The sculptures were developed together with Katharine Hauke, student of the Düsseldorf University of Applied Sciences. For the technical implementation of the projection mapping and the multi-channel sound, a specialist system in the programming environments SuperCollider and Max/MSP was developed.

4. *av@ar* by Manfred Borsch is the interactive and audiovisual installation which focuses of the experience in the relationship between the individual person and their medial reflection. In a monitored closed circuit, dependencies and aesthetic planes of reference can be interactively experienced and controlled with the entire body. A catalogue of emotions is used as audiovisual communication material and initiates reflection by means of the systematic use of feelings. The dance with the medial mirror therefore opens a realm of experience in the field between the non-digital and the digital self – your own avatar.

5. The installation *Transformation in Sync* by Vincent Stange reflects the connection and separation of rooms. Both, the sound and the lighting play a crucial part in this installation. On February 14, 2018 Vincent Stange presented his sound and light composition in two floors of Filmwerkstatt Düsseldorf. The audience was exposed to equally strong auditory and visual stimuli. What they heard was converted to light and back again to sound. The central question in this study is whether a light composition can replace musical elements or whether it remains only a visual event.

6. *Spielraum* is the interactive installation with the aid of motion capture technology made by Sebastian Fecke Diaz, who investigates (im)moral texts and deconstructs them using granular synthesis. The title of the work refers to the process of playful discovery by visitors, in which their own body and its movements serve as the interface for sound control. The Kinect v2 depth-sensing camera transmits images to a large screen that make it possible to look at yourself in a new way from an unusual perspective. The installation deals with (im)moral texts at the audio level and encourages visitors to deal with their own individual, moral margin of freedom.

7. *HomocordiaDisapiens* is a transmedial performance, a future-oriented manifesto about human-technology collaboration resulting with improved social dis/order. This project should not be consumed as an absolute and passive art performance and it includes social dimension of participation by initiating an interaction between audience/performers, creators and

installations. The main idea was an artwork as a result of collaborative creating processes so beside myself, authorship belongs to Yannick Benavides, (project manager and movie director), Suhyun Park (audio installation), Sebastian Fecke (kinect installation), Paul M. Reyes (face morph installation), Leon Eckard (VR installation), Lambert Windges (audioreactive light installation), and Yuni Hwang (stage design).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