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Digital Media and Form – Spatial Spheres at the End of Post-Modern Digitalization

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ABSTRACT
This paper is about the construction and representation of space in time-based media, architecture and the computer. My hypothesis is that a shift has taken place in the construction of image- and architectural space throughout the last century, doubtlessly provoked by the rise of digital computer technology, but eventually also by changing paradigms in art, science, culture and every day life. In my research, I used of the notion of *space* and its construction and representation as a methodological tool to critically identify problems that emerged through the rise of digital media technology. I present examples of visionary artists, filmmakers, architects, designers, scientists and engineers from the 20th and 21st century who created works that attempt to break with conventional notions of space.

Categories and Subject Descriptors
K.4.m [**Computers and Society**]: Miscellaneous

General Terms
Design, Economics, Human Factors, Theory

Keywords
Digital Media, Form, Space, Digital Urban Environments, Time-Based Media, Art, Media Architecture, Design, Computer, Digital History of the 20th and 21st Century

1. INTRODUCTION
Today, in the 21st century, new technologies have taken over aspects of our daily lives to perform operations electronically that were previously carried out manually. Since the digitalization of technology, the speed of calculation has developed into a new dimension that goes beyond human imagination. Gordon E. Moore had already predicted in 1965 that the number of transistors would double every couple of years which is still true for today ([1] p2). Digital technologies or new media have been used extensively throughout the fields of art, design and science since the early 80s. The impact that digital technology has brought to those fields cannot be fully described yet. Digitalization brought on a new dissolution of borders and hierarchies between previously separated fields such as film, architecture and the computer (see figure 2). The result is that many works that have emerged in the fields of art, architecture, design and science are so diverse and yet interrelated that it is hard to draw borders between them.

In the field of Interaction Design, the contemporary challenge lies in Ubiquitous Computing, also called Pervasive Computing, describing the overall presence of digital technologies. These technologies are mostly invisible, interactive, highly networked and human-centered. After Mark Weiser ([2] p6), the dominant form of computing in the future will be Ubiquitous Computing.

In architecture, the use of digital media ranges from the use of innovative software to create architectural models as Frank Gehry does in his work up to the direct use of screens or LCD-panels as electronic décor on the building surface. In Christian Moeller's building *Kinethic Light Sculpture* (1992), for instance, the building has interactive features. It changes its surface color according to the speed of wind and temperature.

Furthermore, in the context of urban planning, digital media is getting increasingly important. Screens, video-boards and interactive digital features have found a great diversification in the cities throughout the last five years, and this not only in the mega metropolises of the world. This trend is also reflected in recent events such as the *Urbanscreens 01 & 02* conference [3], held in Amsterdam in 2005 and in Manchester in 2007, the *Situated Technologies* symposium [4] held in New York in 2006 or the *Media Architecture 2007* conference held in London.

This connectivity of computerized worlds demands new theories about space in the fields of art, architecture, design

and urban planning. A major shift has taken place since the rise of digital media, the shift from *form* to interaction and communication, parallel to the shift from Modernism to Postmodernism (see figure 3). The ideas on form and function that dominated many artists, architects and designers of the twenties of the last century are rarely present in contemporary conceptions of space, and are replaced by invisibility, formlessness and interactive spaces of digital media.

When Frederick Kiesler wrote in the early thirties of the last century: "the 'modern functionalism' in architecture is dead." ([5] p102), he had already predicted the post-modern age. The rejection of hierarchies, the lack of ideas concerning form, the emphasis on pluralism and decentralization fit perfectly to the concepts of postmodernism and digital media.

This paper will focus on the development from *form* to formlessness, from Modern to Postmodern space. In the fields of art, architecture, design and science, the viewer of the Modern era becomes a user of the Postmodern era. Artists, designers and architects have already adapted to the challenge by expanding the notions of space to the notion of relationships between objects in space.

Furthermore, I will provide an outlook into the future about how the notion of space might change through future technologies. For instance, my considerations will go as far as to some examples from neuroscience. A recent example is the stimulation of images no longer provoked by the visual sense, but by stimulation of the visual cortex[1] of the brain through sound waves [7].

2. IMAGE TO SPACE

This paper was developed out of my MPhil-research (2003-2005) in Communication Art & Design at the Royal College of Art in London. From the beginning, it was part of my methodology to consciously leave out theoretical and critical literature and to only draw conclusions from the facts and examples that I have collected throughout the years.

Another part of my methodology was to consciously bring together fields and topics that, at the first sight, are not related to each other. I mainly considered the following fields:

1. Works of visionary artists/architects/designers
2. Technological inventions/innovations
3. Scientific discoveries/worldviews

[1] Visual cortex: the part of the cerebral cortex specialized for vision ([6] p175).

My aim was to gain knowledge about the overall/ubiquitous impact that digitalization had on the last century (see figure 3).

The focus of this paper is to give a short introduction to the different fields that I have looked at. It would go beyond the scope of this paper to present all examples, works and subjects I have looked at and to explore these aspects in depth. For this paper, I picked out examples from time-based media, architecture as well as computer-related themes.

The terms of *space*, *image* and *form* are not always easy to separate from each other. Sometimes virtual spaces are generated through digital images (e.g. in VR). However, time-based images on huge billboards or screens can also be part of urban architecture and thus generate a new appearance, perception and agency of space.

My initial hypothesis was that *Images Become Spaces*, by which I meant that images would expand, on the one hand, into *virtual space* and, on the other hand, into *physical space*.

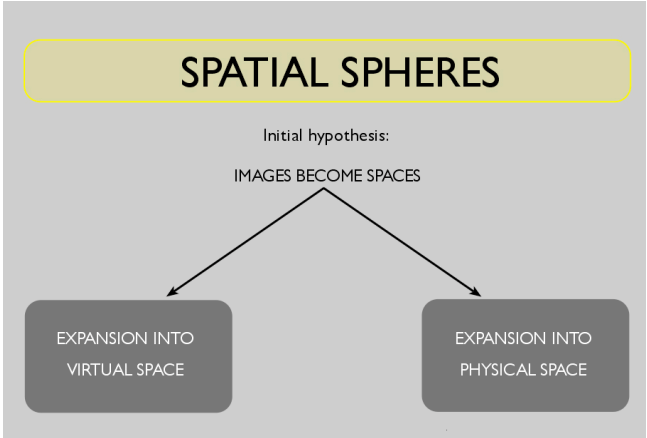

figure 1 Initial hypothesis: twofold expansion of images into space

The first observation I made was that images did expand into virtual space. An example thereof is a so-called *Cave*™, an immersive, stereoscopic and interactive environment. The user is immersed into a three dimensional world and is able to interact with it. This space is often super-illusionist and constructed upon the laws of a (central) perspective. Other examples of the expansion of the image into virtual space are computer games, such as *Vision Gran Turismo* by *Playstation 3*.

At the same time, however, I could observe another shift that was diametrally opposite to the expansion of images into *virtual space*: the expansion of images into *physical space*. The Japanese architect *Toyo Ito,* for instance, built rooms at the *Expo* in Hannover, Germany in 2000, where ceilings, the

floor and every wall were made out of screens – a space made out of images, where every wall serves as a kind of "information transmitter" ([8] p174). The walls transform into screens. Likewise, as already mentioned above, huge billboards and screens have found a great diversification in the cities throughout the last five years (see figure 6 & 7).

Digitalization brought a dissolution of borders and hierarchies between previously separated fields such as time-based media, architecture and the computer:

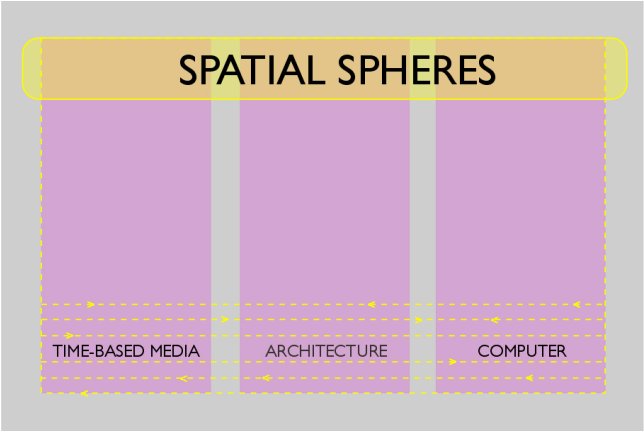

figure 2 Dissolution of borders

My assumption was that the expansion of images into *virtual space* on the one hand, and into *physical space* on the other hand, were part of the same shift.

Finally, after looking at various examples in the fields named above, my initial research concluded in the three following main resulting shifts:

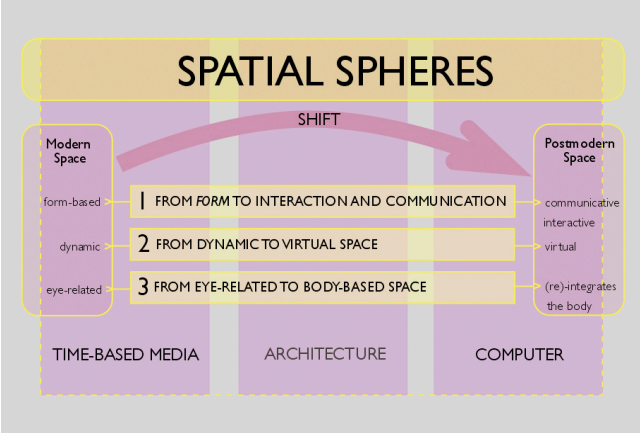

figure 3 Shift from modern to postmodern space

Shift 1, *From form to interaction and communication* means that, through digitalization, we moved away from defining form, design, concepts of buildings etc. through formal or theoretical aspects as it was commonplace in modernity. Theories about abstract design and functionality dominated the early 20th century. Today, in contrast, space is getting more and more defined by its ability to connect, to communicate or to interact. Important are the relationships of objects (or people) in spaces.

Shift 2, *From dynamic to virtual space*, describes the circumstance that the idea of dynamism that dominated the first decades of the last century (for example represented through speed, cars, moving images, futurist manifestos and theories of relativity) has been replaced by the overall concept of virtuality. This virtuality includes using computers, playing games, using immersive stereoscopic environments, etc. Virtuality always has to do with simulation. Dynamism is the idea of realistic action.

With shift 3, *From eye-related to body-based space*, I want to point out that today we are able to move around in and with digital technology (e.g. in interactive installations). The cinematic mass-audience of the 20th century, where the viewer had to sit quietly in a dark room, is no longer necessity. Instead, we move while watching films, for example: on hand-held devices, on screens and interactive billboards in the streets. Contemporary concepts in media art and architecture do more and more involve the body as part of the installation.

2.1 Expansion into Virtual Space: Strategies of Montage and Virtual Cameras

In the following section two of this paper I will give examples of how time-based media, architecture and computer-generated, interactive environments intersect. Through digitalization, those previously separated fields share similar strategies of how space is constructed and represented. The dissolution of borders between those fields can hence be detected in more detailed aspects.

2.1.1 Example on the Construction and Representation of Space in Time-based Media

In his short film *Les Mystères du Château du Dé*, from 1928, Man Ray presents a journey of two strangers travelling through the countryside ending up at the Villa Noailles in France. These two strangers are 'invisible' men. They throw the dice and decide to leave the town for a ride with their car. A text fades in and says: "A throw of dice will never abolish chance". It is interesting that the cubic form of the dice refers to the cubist villa that they will explore later on in the film.

After driving through the countryside to rhythmical music, they pass fields, towns and bridges. In the Lumière film *Train Leaving Jerusalem*, from 1896, a camera is mounted on the

back of a train leaving the station. Similarly, the camera in *Les Mystères du Château du Dé* is mounted on the car, but in the forward direction. This camera-drive marks a movement through space. The impression of the camera on a car evokes a highly subjective form of perception, especially because the two strangers are only visible briefly in the beginning of the film. The journey ends when they finally reach the Villa Noailles. The villa and the property are explored by the camera, first from the outside, scanning the façade, the garden and the walls. After that, the camera begins to explore the interior of the house with quiet flowing camera movements. This fluid and dynamic way of moving through space seems quite unfamiliar and different compared to other films of that time. It is like a continuation of the fluid camera movements that were shown before. Although the camera moves on quite a low level, just a few inches above the ground, the impression that one gains is very subjective, a point of view that one would rather associate with a postmodernist form of vision than with a modernist one. The only film that was filmed completely by a subjective camera throughout the film was about fifteen years later – *Lady in the Lake* (1947) by Robert Montgomery. According to Nicky Hamlyn, this process of a subjective viewpoint in *Lady in the Lake* can be described as "Precisely, a film in which the camera shares one character's point of view, and from whose viewpoint the entire film is shot, so that we never see that character, only, and exclusively, their point of view" (Hamlyn, personal communication, 2005). The impression of high subjectivity whilst exploring the space in the Noailles Villa is further reinforced because the house is empty – the middle part of the film solely consists of the viewer and the architecture being virtually explored. The camera eye becomes the subjective eye of the viewer. In a way, this kind of movement through space in film, as well in the villa and outside in the landscape, can be compared to the movement through a contemporary virtual computer model. Architectural virtual models or games operate with the same subjective camera movements through space.

In real space the movement of the camera is restricted. A dolly shot has certain physical boundaries regarding the way it travels through space. In every computer-animated camera drive, there are no longer any spatial restrictions. Unnatural camera drives, such as in the mainstream films *Fight Club* (1999) or *Spiderman 2* (2004) from the top of a building down to the ground, fulfilling loops, passing through narrow spaces, solely exist in the realm of digital cinema, where parts of the scene are animated.

Montage is still the predominant means of constructing space in cinema, and continuous camera-movements lasting over a longer period of time are difficult to create. This might be the reason why they occur quite rarely in the history of lens-based media. In his film *Rope* (1948) Alfred Hitchcock made a whole film in ten-minute shots. Although the film has ten cuts, it plays in real-time. The actors play ten minutes in a row – the time a roll of film stock lasted back then. The whole film plays in the apartment where two friends kill their best friend and have a dinner party shortly afterwards, hiding the corpse in a chest in the living room.[2] Fifty-five years later, the Russian director Alexander Sokurov shot his film *Russian Ark* (2002) in nearly 90 minutes in one shot. The story line takes place at the Hermitage, the National Museum of St. Petersburg. The Empress Catherine the II began to build up a collection of artworks there in 1746 (Hermitage Museum St. Petersburg, 2005). Throughout the film, the subjective camera moves through the Hermitage, together with a French stranger called Marquis de Custine from the 18th Century, with whom it is in a continuous dialogue. Similar to a theatre stage without breaks, the film is choreographed continuously. Behind every new door there opens up a new scene from a different time period in Russian history. The viewer is virtually guided through the museum and is able to watch three hundred years of Russian history. Compared to *Rope*, *Russian Ark* was shot without cuts due to the digital hard drive that is able to record much longer than a roll of film. Hitchcock had to change his roll of film every ten minutes. The subjective, real-time camera evokes an experience of space that can be compared to the one we have when we are moving through the illusionistic virtual space of a game or in an immersive virtual reality. The viewer is able to retrace the spatial construction of the Hermitage Museum in real-time and with a subjective viewpoint (which is, of course, defined by the director). The camera moves close to paintings so that one can see the details and moves again, through a mass of people as if we were inside a ceremony, a dance or a supper. In contrast to conventional filmmaking, where space is (re)-constructed through montage, this continuous and real-time experience of space allows the viewer to be *in* the film. The fact that most protagonists don't see or notice the Frenchman and the subjective camera causes the feeling that we ourselves are invisible observers moving through space and time. What seems to be an interesting connection with Man Ray's film is that the two strangers that we first see at the beginning of the film are not visible. Their faces are covered up with cloth and as soon as they get in the car, as their journey begins, they are no longer visible. They are invisible men. In *Russian Ark*, the camera is treated as if it were a face, the eye. In fact, in many contemporary computer games such as Tomb Raider, Doom, Myst, Riven, etc. we ourselves are invisible most of the time while playing.

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[2] See also the film *High Noon* (1952) by Fred Zinnemann. This film's 85 minutes of screen time are equivalent to 85 minutes of real time. A grandfather clock that is faded in from time to time represents the time passing by.

The moving image as such is a dynamic space, and through the movement of the camera through the landscape, the impression of dynamism is enhanced. Early cinema used the camera like a photo camera, a stable viewpoint onto a scene. The possibilities of working with film within the screen have changed through the digitalization of images.

2.1.2 Example on the Construction and Representation of Space in Computer Animation

The medium of film has changed with the emergence of new technologies – it became digital. But did digital technologies also become filmic? It seems as if the specific means of creating an illusionary space in cinema and computer intersect at some points. Especially, ideas from the avant-garde cinema and art are influential on computer-technologies. According to Lev Manovich,

> "…strategies of the avant-garde became materialized in the computer" ([8] p306/307) and "one general effect of the digital revolution is that avant-garde aesthetic strategies came to be embedded in the commands and interface metaphors of computer software".

Painting on the screen, layering of images, collage and cutting of images are features that actually appear in strategies of contemporary software, but it can also be traced back to the very early days of the computer. Then, the input of graphical data was directly put in a computer by drawing onto a cathode ray screen with the aid of a "light pen". This then produced a two-dimensional image ([9] p2). The use of a light pen was a direct manipulation of a surface, similar to the act of painting. Through drawing directly onto the screen the computer was able to interpret lines, arcs and curves. Those early systems were purely input screens and not output screens, as it is the case today. They were designed to work like a sketch block.

According to Lev Manovich, not only artistic techniques from the avant-garde became materialized into the interface metaphors of computer software, but also natural phenomena have been digitalized and implemented into software. The lens-flare effect is one example of the aesthetics often used in 2D and 3D animation. Since the material of an animated computer-world has not emerged out of the recording of light passing through a lens, the lens-flare could never occur as a result of recording. Lens-flare can be found in the effects palette of Adobe After Effects and it can be adjusted with different parameters such as light intensity, degree of sunlight and colour spectrum. A natural phenomena has been made artificial and contributes to the illusionism of the digitalized world. Interestingly, Lev Manovich makes the distinction between *'visual illusionism'* and *'simulation'*. According to this thesis, *'visual illusionism'*

> "combines traditional techniques and technologies that aim to create a visual resemblance of reality – perspectival painting, cinema, panorama, etc.", whereas *'simulation'* "refers to various computer methods for modeling other aspects of reality beyond visual appearance – movement of physical objects, shape changes occuring over time in natural phenomena (water, surface, smoke)..."

The difference between *'visual illusionism'* and 'simulation' seems to be in fact difficult. We could say that *'visual* illusionism' refers to constructions of space with means that are not intelligent in itself (as representations, methods of constructing space in cinema) and *'simulation'* inherits a kind of inherent 'self-renewing intelligence' of this representational aspect which goes beyond its visual appearance. Although this is already contradictory again, this concept could also be compared with the soft surface of a digital image - which has a form and finite and physical borders - and the underlying, - intelligent or autonomous -, code - which is a self-contained system that has no potential borders and where the visual appearance is only a result of a calculating process.

In the realm of computer animation, there are many more different filmic features that have been implemented into the construction of space. Animated camera pans, drives and zooms are used to capture animation from virtual objects and later cut together just as in film. The procedure of creating an animated film clearly relates to the heritage of cinema.

In Games such as *Vision Gran Turismo* by Playstation 3 (Sony, 2005), the aesthetics of the trailer and the game itself do not noticeably differ from a lens-recorded film about car racing. The fine line drawn between classically (lens-based) generated images and the ones that were generated by the computer has finally dropped. The slogan of the Vision Gran Turismo trailer in Playstation 3 reads as follows: "From Partial Reality" to "Complete Reality". What does this mean? Does a super-illusionistic, interactive computer-game based on 3D graphics contain more reality than the very first moving images of the 19th century, for instance?

On the level of narration, contemporary computer games such as Doom 3 (2004), Myst (1993), Tomb Raider (1996), Riven (1997), etc. do tell stories just as cinema does – with the difference that the user is able to interact in and with these worlds. In these games, the narrative, film-like introductions establish the background plot of these games.

The cinematic image and the computer-generated image in the world of games have aesthetically approached each other very closely in the last years. The recent simultaneous release of Spiderman 3 as a film and as a game shows that mainstream cinema and the computer game industry already work together commercially. Steven Spielberg recently announced his branching out into video games with the Electronic Arts Company. This seems to be a different strategy altogether.

Spielberg will collaborate in the development of three new video games and has the exclusive rights to develop films or TV programs afterwards ([10] p.25). The development and release of the games comes before their production as films.

2.1.3 Example on the Construction and Representation of Space in Immersive Stereoscopic Environments

In 2003, I worked as a research assistant at the Fraunhofer Institut in Stuttgart, Germany. At the department called IAT-Institut für Arbeitswissenschaft und Technologiemanagement (Institute for Working Science and Technological Management), I had the possibility to experience different forms of stereoscopic immersive environments.

Many problems that engineers and interaction designers are challenged with in VR come out of the separation between the sense of the eye and the sense of the body. The equilibrium sense gets confused by the discrepancy between the space that is seen by the eye and the space that is felt by the body. Normally, when walking through a hilly landscape, let's say, the eye and the body are in tune, because the equilibrium sense feels what the eye actually sees: an irregularly shaped ground and the visual field moves according to the position in space that the equilibrium sense assumes. In stereoscopic virtual reality (helmet-based or projection-based) in contrast, the visual field is fully attached to the eye and the movement of the head. Often it is also possible to move the virtual landscape by input devices.

Another approach to the aspect of virtual, computer-generated environments, persons and objects is the blue-c system at the laboratories of the department of computer engineering ETH-Zurich, Switzerland. (Eidgenössische Technische Hochschule Zurich).[3] I would like to take the blue-c as an example, because it demonstrates a radically different approach of generating three-dimensional images. In contrast to the usual wire-frame construction of virtual objects, blue-c uses a new form of representation that works differently.

Blue-c combines immersive projection and real-time 3D-video-transmission. It is an immersive telepresence system enabling naturalistic communicative working between people who are separated spatially. Sixteen cameras are built up to record objects and persons within the square room of the cave. The cameras film the objects through the walls, which are projection walls at the same time. This is made possible through a new innovation where three active liquid crystal walls are switched from opaque to transparent very quickly. During the wall's opaque phase it is used as projection ground and during its transparent phase the cameras are recording the persons behind it. The opaque and transparent phase of the wall is also synchronized with the liquid-crystal aperture of the three projectors and with the shutter glasses. The object or person in the cave is lit through 10,000 single LED-lamps in order to give the video cameras enough information. Through various different methods such as keying, background subtraction, silhouette extraction, etc., the person is separated from the background and can be projected in 3D into the virtual environment. This method is very similar to conventional lens-based image construction. In effect, it transforms conventional 2D-pixels into 3D-pixels in space.

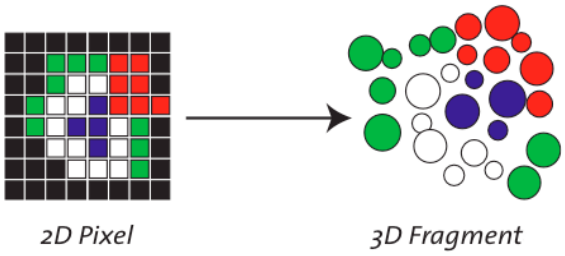

figure 4 Relationship between 2D-pixels and 3D-fragments in the blue-c

Those so-called "3D-Fragments" ([11] p5) possess geometrical attributes, such as position and also colour and texture. However, similarly to conventional methods of recording, i.e. photography, film, video, digital video, the 3D-Fragments are not interconnected. The image that the user sees of himself projected has a similar quality to a video image, with different resolutions (The resolution of the image is not yet brought to an end. Future blue-c images could be as sharp as contemporary two-dimensional images).

[3] I visited the Blue-C installation on the 26th of July, 2005 at the Swiss Federal Institute of Technology in Zurich, Switzerland. I met with two young scientists, the Swiss Dr. Stephan Würmlin and German Dr. Silke Lang, who gave me a demonstration of the Blue-C installation.

figure 5 Video still in comparison to same image as 3D-fragments in the blue-c

This is, however, a new type of image. The characteristics of these 3D images is that they are images originating from the input of lens-based video that are then transformed into 3D-fragments and displayed in a stereoscopic environment. The "3D-fragments" are interpreted according to the brightness and color that the object has reflected. This means that this kind of 3D Video ([12] p200) shows an object according to its natural properties, as recorded by lens-based cameras. They are then transformed through a digital process into data, the 3D-fragments, built up similarly to 2D-Pixels. Through this method, persons or objects appear less artificial than in many other computer-generated environments. The impression is as if video had become literally 3-dimensional. The difference with stereoscopic cinema is that the user is able to see the 3-dimensional world or object from different viewpoints and is able to move and see movements in real-time. In other words, it is more flexible and integrates the aspect of interaction and real-time. But this happens, in contrast to many other concepts in VR, without the obligation of necessarily having an artificial world, which has often to be rendered with great effort. This approach in the blue-c is definitely new and promising.

2.2 Expansion into Physical Space: Media Architecture

2.2.1 Urban Screens

Screens, video-boards and projections can be found in an increasing number in the cities throughout the last decade, and not only in metropolises. Many of them are integrated into shop-windows, or function as an add-on to a conventional façade. Twenty years ago, in an establishing shot of *Blade Runner* (1987), we already saw a spaceship flying by a huge video-board showing a Coca-Cola advertisement.

In many cases the integration of screens has developed out of individual (marketing) strategies and not out of aesthetic reasons in architecture or urban planning. Their content displays mainly silent advertisements, repeating the images one has seen at home on TV. The format of these facilities often is "TV-like", so that this can be considered as the extension of TV into the streets.

figure 6 Screen at the Kurfürstendamm in Berlin, 2004

figure 7 Screen at Liverpool Street Station, London, 2003

Few screens or video-boards have had a size outside the TV-format until recently. Well-known exceptions are, of course, the installations on Times Square in New York and on Piccadilly Circus in London. This video-board near the Kurfürstendamm (the main shopping area – see figure 6) in Berlin is the largest urban screen in Germany with about 30

square meters. Screens can also be found inside public buildings as in London at *Liverpool Street* station for instance (see figure 7). Or, again, as projections in a designed and organised version of the guidance system of the *Cinématheque* in Paris, built by the architect Frank O. Gehry. (Guidance System by Intégral Ruedi Baur et Associées, Paris). Here, the architecture becomes an irregular surface for time-based media.

However, the use of screens as electronic décor has increased in new futuristic cities. Paul Virilio says about the new façades in Asian metropolises that are entirely plastered with screens:

> "No wall out of stone, but screens showing images. The actual boundary is the screen" ([13] p181).

Few contemporary architects have developed ideas in regard to the (urban) screen and its architectural surrounding. In Jean Nouvel' s model of the *Galleries Lafayette*, a huge video-board functions as façade. For Nouvel, the image takes the place of traditional architectural canons and symbols as materials of façade design.

Just as steel constructions were used around 1750, the arrival of digital media can be seen as part of the future working material for architects. This is at the same time the challenge for them. The architects Diller & Scofidio, for instance, create mobile architectural space through the use of screens and multi-media applications. In their recent project for the Moscone Convention Centre *Facsimile* in San Francisco (2004), a live video camera is mounted at the back of a screen. The screen, about five meters high and eight meters wide, is mounted outside on the building surface whereas the camera points inside. Slowly, the screen travels along the outside of the building. The screen shows life images from the inside of the building. A program with pre-recorded images pretends that the images on the screen are the actual building occupants [15].

The future cities will be more and more equipped with urban screens. Declining costs for mega-screens, billboards and digital technology bring about that media architecture will play a great role in the near future of urban planning. New projection methods make it possible to see projected images in bright sunlight. Last year, a company developed a foil to glue on the shop windows. Since then, many individual shops in the cities of Europe have used this method to project moving messages on the shop windows.

2.2.1.1 Screening the Past

In Charlie Chaplin's film *Modern Times* (1936) a huge screen is integrated into the wall of the office of the president of the "Electronics" company, a modernist factory producing things looking like (of course stereotype) machine parts. Interestingly, the screen in the president's office is fully integrated into the architecture of the room (like a TV-screen or like a mirror) and the president is able to switch it on and off with the help of a box mounted on his table. The president uses the screen to control his employees in the factory hall. This example shows the use of a screen outside its Modernist concept that defined the screen as a projection-ground for mass-audience cinema. Today, in the 21st Century, this notion of a classical screen is no longer valid.

The fast growing digital calculating power resulting out of the increasing efficiency of microchips and lower costs in hardware technology makes it possible to integrate huge screens not only in the urban landscape of our cities, but also small ones in mobile phones, laptops, PDA's or I-Pods. These devices are all able to play moving image content for a long time. This circumstance involves that watching a screen has become an individualized activity in contrast to the cinematic mass-audience of the 20th Century. This also means that we are watching films in the streets, the tube, while walking, while staring out of the window of the Café during lunch break. The consequence from this shift in the use of screen technology is that we are watching while moving our own body. The classical concept of cinema forces the viewer to sit quiet, passive and motionless in a dark chamber. This also means that our perception of time-based media changes. If we have tiny screens in our hands and huge screens in the streets, the focus in regard to the content will have to shift as well.

Modernity brought with it notions on futurism, speed, cars, cities, metro transport systems and cinema. But the conductor, the viewer or traveler remained motionless. Today, in contrast, our bodies move while watching. In interactive media installations, interactive art and interactive architecture, the body will also play a greater role in the future.

2.2.2 Interactive Architecture

Few Architects, some of them belonging to the movement of Deconstructivism, developed an individual approach of interactive architecture. The deconstructivist Peter Eisenman stated in the early 1990s that a paradigm shift has taken place from the mechanical paradigm to the electronic one ([16] p207). Now, we are in the digital era. In Rem Koolhaas´s *Maison à Bordeaux* (1998) ([17] p100), pistons drive a platform supporting a desk and a chair through different floors of the house. The owner, or rather the user of the house has the option to choose on which floor he wants to work and what books he wants to use there.

In Christian Moeller' s building called *Kinethic Light Sculpture* from 1992 ([18] p158), for example, he and the architect Peter Kramm developed a coloured light façade controlled and changed by the weather. Parameters such as temperature, wind speed, wind direction, humidity and the intensity of daylight are able to influence the colour spectrum from yellow to blue. Additionally, a LED display was the

platform to visualize the ambient sound of the street as visual data.

In another, more recent project called *ADA – The Intelligent Room*, the room itself serves as a huge physical space for social interaction not only with other people but also with the room itself. The installation consists of an immersive, interactive space that has been developed for the Swiss Expo.02 in 2003 taking place in Neuchâtel, Switzerland [19]. This space functions on the basis of an interaction with the visitor within a one hundred and seventy-five square meter area. Three hundred and sixty floor tiles equipped with pressure sensors are able to track their visitors. *ADA* interacts with the visitors and expresses their emotions to them by changing the colour of a ring of ambient lights. This concept of an "intelligent room" is a pure communication space where the people move around and react to the ambience. The principle of interactivity has been transported to three-dimensional, built space and thus creates a new form of post-modern reception. Anne-Marie Duquet puts it like this:

> "That is the new situation: what we used to call aesthetic experience has to be rethought now that it has to deal with manipulation, with operation and with the viewer as performer" ([20] p15).

In the world of art, the concepts of interactivity and participation are not a novel thing. In a way, the beginnings of interactively networked devices, where objects, persons and the physical space are interconnected, can already be observed in the video-installation art of the early 1960s, where artists such as Nam June Paik, amongst many others, encouraged the viewer to take part in his artworks, by "stepping a foot pedal (1963), moving and turning a magnet across a monitor (1969), producing acoustic signals (1969)" ([21] p179).

3. THE FUTURE: FROM EYE-RELATED TO BODY-BASED SPACE

We can observe that the expansion of images into *virtual space,* on the one hand, and into *physical space,* on the other hand, is the result of the digitalization of technology. But new technologies alone do not solely define our notions about space. They might also be influenced by the idea that we gained about the world through our whole cultural heritage. Physicist theories, for instance, do have an influence on artistic concepts concerning the construction and representation of space. It is not surprising that Cubism and the theory of special relativity both emerged in the first ten years of the last century – a shift of notion in the new understanding of space, time and motion. Cubism broke with the traditional construction of the painted surface and introduced a fragmented, multiple-viewpoint representation of objects in the style of fragmented, geometrical shapes. At that time, a range of avant-garde artists, designers, architects and filmmakers (for instance, Theo van Doesburg, Frederick Kiesler and Hans Richter) were concerned with ideas about the new space-time and formulated theories based on mathemetical models, for example, the model of the fourth dimension[4] [22]. However, contemporary architects like Peter Eisenman or Markos Novak also work on these same ideas today. Eisenman used the Hypercube as well, amongst other approaches ([15] p209). In the case of Marcos Novak´s Hypercube *Paracube*, the skin surrounding the hypercube is dynamic and interactive: when one changes one surface, the other surfaces and the hypercube react to this.

Contemporary construction and representation of space has to do with interactivity, connectivity and communication. According to Paul Virilio, the perspective of the twenty-first century is the invention of a perspective of real time,

> "…replacing the spatial perspective, the perspective based on real space, discovered by Italian artists of the Quattro cento" [24].

Today, we live in a real-time perspective. Through digital technologies, everything can be connected and be made interactive.

3.1 The Outlook for the Future

The architect Frederick Kiesler had visionary concepts for the future of architectural space. He formulated ideas about "organic results" for buildings, but he saw that these ideas could not be achieved with the technical possibilities of that time. The idea of an organic house also incorporated a different image of the body, its anatomy and the relationship between body space and architectural space. In his poem *Flowers Sleep Aufrecht* ("Flowers Sleep Upright") ([25] p45), he writes that

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[4] Today, the dominating physicist concept may be the *String Theory*, comprising at least eleven dimensions that constitute the fabrics of our cosmos. String-Theory is sometimes described as the T.O.E.-Theory (The Theory Of Everything) or the ultimate or final theory because among different physicists it is considered a theory unifying all other physicist theories ([23] p16). But this is surely not a standpoint every physicist will share because the traceability of this theory is essentially based on theoretical mathematics. The *Multiverse Theory*, recently formulated by David Deutsch, even suggests a model of the universe where an endless number of universes exist parallel to each other, where one and the same person lives different outcomes of every possible path that life could possibly take.

> "For us as designers of body-environment, bio technicians, such investigations are of prime importance. Where does anatomy begin? Biology start? Physics and Chemistry of the human? And where does the object end?? (…) Is not the study of Biology the true foundation of an architect? Is not the growth and transfiguration of bodies of every kind the very essence of the architect's foundations – rather than the immobile Styles of past and present?"

This poem can be seen as a turning point from the Modern to the Post-modern project. Kiesler subscribed to the ideas of De Stijl in the early years of his work but soon became, after Theo Van Doesburg died in 1931, one of the biggest critics of functionalism and especially, of functionalistic buildings. His ideas are still valid. With contemporary and future concepts of space, issues of the body and biology will be getting increasingly important. In my opinion, future space concepts will deal with genetics, neuroscience and direct impacts on the human body. The visual representation of images and space will be replaced by bodily experiences.

3.2 The End of Post-Modern Digital Space

> "...the technofuturist imagination seems to have abandoned computing for biology. This is the century of the gene" ([2] pxiii).

How will images, architecture and the construction and representation of space develop in the future? What will most of the images look like in a hundred years from now? These are of course questions that cannot be answered yet, but there exist a few speculations about the future form of images. Some concepts are totally detached from previous concepts of perception of space. I have seen a documentation of the following work at the *Neuroaesthetics* Symposium in London in 2005. In the first room of the project *Melatonin Room* (2001), by the Swiss architects Jean-Gilles Decosterd and Philippe Rahm, the actual experience of space is altered through

> "…electromagnetic radiation at 509 nm, at an intensity of 2000 lux, which eliminates the production of melatonin by the pineal gland" [26].

Through the lack of melatonin, the user of the room becomes mentally stimulated and physically motivated. In the second room, the release of melatonin is deliberately provoked by the dissemination of ultraviolet rays. On their website, the two architects write that Melatonin Room is a

> "…space without representation, which reduces to a maximum the medium between the emitter and the receptor, and acts on the chemical mechanisms of things between each other" [26].

This is a new form of space that doesn't work on the base of visual representation. By artificially provoked chemical changes to the body, the viewer has a different sort of experience in the room and thus he perceives the space differently. Decosterd's and Rahm's work is surely an exception and it demonstrates a new approach of generating different spaces by new means. Their interest is interdisciplinary and this new form of reception is one example of a new interest in types of space that are based on the experience of the body rather than of the visual field:

> "It works on the new forms of communication created by the biotechnologies and by genetics, together with the analogical, the poetic, the aesthetic and the rhetorical" [26].

This example shows that the experience of space can be generated in an entirely different way compared to previous concepts. It shows a radical rethinking of the construction and representation of space.

3.3 Beyond the Screen: Neurocinema[5], Neuroaesthetics[6] and Neuro-Science[7]

For about a hundred years we have known that the brain works on the basis of chemical and electrical processes. By the turn of the 20th Century, in 1902, Hans Berger, a German neurologist and psychiatrist, began his research on the cortex. In 1924 he could prove after several years of research that the human brain emitted electrical activity. In 1929 Berger published his discovery and a few years later the Englishman Edgar Douglas Adrian, an anatomist and physiologist, pursued the notion of electrical activity [28]. Since 1947, the Electroencepalograph, (EEG) has been commercially available. About one decade later, in the sixties, it was possible to render " complex computer-based analyses of the EEG" ([29] p61). Soon after that it was possible to connect the output of an EEG to a computer in such a manner that persons could influence the events on the screen.

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[5] Term 'Neurocinema': Peter Weibel held a lecture called "Neurocinema" 1999 at the Museum of Modern Art. Footnote from ([27] p586).

[6] See *Neuroaesthetics* conference held at the Goldsmith College in London in May 2005, Chairman was Warren Neidich, author of *Blow-up, Photography, Cinema and the Brain* [5].

[7] neuro- Gk. *neuro-,* comb. form of *neuron* "nerve," originally "sinew, tendon, cord, bowstring," also "strength, vigor," from PIE **sneurom* (cf. L. *nervus;* see *nerve*) [28].

An example of an artistic use of the EEG comes from the 90s, in an installation called *Brainscore*: this work by Darij Kreuh and Davide Grassi connects the brain wave frequencies to a screen. Two players are able to move 3D objects on the screen based on the control of their brain and their eye movements ([30] p590). In another example called *BIOS – Bidirectional Output System* – the approach towards an interaction between the brain and the body is not so much directly related to the ability of interaction. It is also less related to game concepts. This project of the BIOS team (Jaanis Garancs, Sven Hahne, Norman Muller and Thomas Tirel) is an explicitly labeled work that does not aim towards scientific accuracy of reproduction or interpretation of neurological images. In their text *BIOS – Bidirectional Output System*, they firstly want to protest against animal experiments and secondly explore some "philosophical problems of reality, or more precisely, of distinguishing between what is "real" and what is "hallucination". This is a kind of closed-circuit system, where the viewer experiences, in a Head Mounted Display (HMD), his own celebral reaction to previously seen images. Those reactions are taken from an EEG-machine where the voltage curves of the EEG are translated into binary data. The images the viewer sees on the HMD look like abstract, wafting colored images. Unfortunately, I have not yet been able to use the BIOS-System, because when I visited the exhibition, it was not working.

3.31 Neurologically Stimulated Images and Spaces

The last example in this section deals with a method of seeing without eyes. The American Thomas Patrick Dawson has just filed a patent called 'Scanning Method for Applying Ultrasonic Acoustic Data to the Human Neural Cortex'. With this it is possible to generate sensory experiences by using an acoustic signal that is "directed to a human neural cortex" [6]. The technique is new because it overcomes conventional techniques, such as surgical implants. The sensory data that is produced through the new ultrasonic technique includes visual, audio, taste, smell or touch. This means that this kind of sensory data cannot only be stimulated but can also be 'broadcast' from other media. On page five of his patent, Dawson describes how imagery captured by a video camera is converted into the ultrasonic signal and fired towards the human cortex. This would enable for instance a blind person to

> "…view live and/or recorded images or hear sounds" [6].

This kind of stimulation is surely still far ahead of its time since it involves a high amount of sophisticated technologies to generate those kinds of images. Yet, we can still ask ourselves the question of what such impressions would look or, even better, feel like? It is interesting to see that in many recent films where the protagonists experience different worlds and dimensions their physical body plays an important role within it. As I have already mentioned earlier on, films such as *eXistenZ*, *The Matrix*, *Vanilla Sky*, and *Minority Report* all deal with the subject of interchanging spaces or places or space-times and even personalities. The protagonists experience a diversity of different layers of one world, and often he or she does not quite know in which time or personality they reside. Often, they have even lost control of the situation and stumble through their respective worlds. What all these stories share, though, is that the body is not involved actively in this process of experience, but is in disuse. Either it lies in a kind of artificial womb, fed by a liquid nutrient as in *The Matrix*, or it sits passively on a chair with an organic cable of an organic console in the spinal cord. Most of these recent films involve technology and biotechnology as their subject as well as issues of perception. The restless and immovable bodies are often controlled and kept alive by machines, either directed by human hand or by some kind of artificial intelligence, as in *Minority Report* and *The Matrix*. The protagonists experience their wondrous worlds only with their minds, but not with the actual movement of the body. Sometimes they even wake up and must discover that the body they assumed to be their real body was a mere illusion and that their real body resides in another world yet unseen to themselves.

The link between the body and technology in biotechnology is strongly emphasized as well as the issue of consciousness and unconsciousness. The state of the body in these films also reflects the state of the bodies of the viewer in the cinematic experience. The motionlessness of the body is the same state that we take on ourselves when watching a film. The often glorified, but at the same time problematic man-machine relationship of the 20th Century may very well have had its beginnings in the relationship between the eye and the optical lens.

The idea of cinema as a "Dream Screen" as introduced into psychoanalytic literature gains a new importance when regarding inventions such as the apparatus to stimulate images in the human neural cortex. The invention of the cine camera and projector brought on an optical revolution that has been further modified through the arrival of the computer. New perceptions of space having to do with impacts on the body could be the next generation of imagery. Biological and Neurological fields are likely to be the next step towards a new form of imagery of the future. Times are changing and with them the technologies and our notion of space.

4. CONCLUSION

The role of the viewer, overall perception, construction and representation of space have been transformed throughout the last century. Abstract art, functionalism and the rise of the

moving image were strongly present in the first decades. Ideas about dynamic, moving spaces, higher dimensions and the birth of a new physicist era dominated the ideas about space. In the late part of the 20th Century, concepts of interaction, communication, real-time and the computer as a "new" medium became dominant. Ideas about intelligent nano-technology, genetics, biotechnology, neurology and theories about multiple universes are current concepts in the field of science.

A shift has taken place not only in the construction and representation of space but also in its perception. Images have expanded into the space within their frame and at the same time they have expanded beyond the frame into physical space: in installations, urban environments, hand-held devices etc. The notion of an enframed image has been enabled by two inventions: the moving image and the computer.

Images as we knew them since their inception as enframed perspectival ideal representations of space, as in the Renaissance, for example, are challenged for the first time by neuro-scientific concepts that seek their representation through the mere stimulation of the human brain. These kinds of future scenarios are certainly not commonplace yet.

Digitalization brought a new loss of borders between previously separated fields. It has had an effect on how we construct, represent and perceive space.

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6.5 Figures

Fig. 1 Initial hypothesis: twofold expansion of images into space

Fig. 2 Dissolution of borders

Fig. 3 Shift from modern to postmodern space

Fig. 4 Relationship between 2D-pixels and 3D-fragments in the blue-c, courtesy of Computer Graphics Laboratory (Head of Computer Graphics Laboratory: Markus Gross) ETH Zürich, Switzerland.

Fig. 5 Video still in comparison to same image as 3D-fragments in the blue-c, courtesy of Computer Graphics Laboratory (Head of Computer Graphics Laboratory: Markus Gross) ETH Zürich, Switzerland.

Fig. 6 Screen at the Kurfürstendamm in Berlin, 2004

Fig. 7 Screen at Liverpool Street Station, London, 2003