The topology of virtuality and techno-art

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1. INTRODUCTION

Over the last decades, spatial concepts of artistic and theoretical discursivity have been moving away from the reductionist approaches that guided the artistic processes of abstraction and fragmentation in modernism. The deformed topologies, decompositions, fractured and curved spatial representations of the artistic avant-gardes at the beginning of the 20th century were often related to the new interpretations of space that emerged with the advent of the theory of relativity and the ideas of multidimensional space. Simultaneously, a similar formal paradigm of reductionism linked the diverse modernist movements, especially abstract art.[1] The integration of scientific and artistic discur-

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1   Although the pioneers of abstract painting in the first decades of the 20th century based their work on different philosophical and theoretical assumptions, they were united by a similar formal paradigm of reductionism. The painting processes characterised by rationalisation, abstraction of visible reality, and gradual formal reduction of elements composing pictorial space coincided with the prevailing scientific tendency towards quantification and the deconstruction of reality into its elementary particles or indivisible elements, which are governed by universal laws (Berlot Pompe, 2020). In a similar way as the micro-reality of the scientific world revealed the behaviour of energetically charged particles in physics and chemistry, the reality of cells and chromosomes in biology, or the indivisible sensory-perceptual elements in experimental psychology, modern art approached pure abstraction

sivity was further enabled by post-war technological and economic advances as well as by the emergence of new physical perspectives of reality, which were fostered by the integration of the theory of relativity and quantum mechanics. In the 1960s, the notion of space, no longer conceived as a constant but as a contextually defined concept dependent on the perception of the viewer, was integrated by the idea of the field as the energetic basis of reality, determined by the motion of particles; this shifted the focus of interest from the material and empirical aspects of reality towards a more fundamental, immaterial, energetic dimension, the elastic tension, which is only revealed through the effects of actions on matter. The interest in the invisible dimensions of reality and the concomitant new philosophical attempts to interpret the relationship between the subject and object, the perceiver and reality in phenomenology and psychoanalysis was also reflected in the field of art as a particular interest in the relationship between the spectator, the work of art, and space, which intensified in the postmodern period. Psychoanalytic and post-structuralist approaches describe new relations between conceptions of space and the perceiving subject, who, given the plural and polymorphous nature of reality, experiences themselves as uncertain, fragmented, and dispersed. A number of critical texts on perspective and Cartesian space were accompanied by genre differentiation in the field of art and the emergence of new forms of contemporary art (body art, performance, video art, kinetic art, optical art etc.), among which installation art established itself as the dominant art form. The multi-perspectivism of installation, which does not presuppose an ideal observation point, also subverted the ideas concerning the rational self-centredness of the perspectival view and fostered the development of new models of embodied but de-centred subjectivity. In this regard, installation art realises the post-structuralist theoretical impulses of the de-centred subject (Barthes, Foucault, Lacan, Derrida); in this framework, the individual is perceived as a dislocated, incoherent subject, internally split by unconscious desires.[2]

through painting, focusing on basic artistic concepts – pure colours, lines, and reduced geometric forms. (Kandinsky, for example, wrote about the microscopic analysis of basic painting elements, such as shape, point, line, and surface.) The dominant reductionist method and paradigm of understanding reality permeated the scientific and artistic strategies of modernism (Manovich, 2007; Vitz and Glimcher, 1984).

2   The connections between art and scientific models of reality in the 20th century are covered in more detail in the author's articles Pictorial Abstractions: *Visualizing Space in the Eras of Modernism and Information* (AR Correspondences, 2018), *Kompleksnost in tehnološki biomorfizem v sodobnem abstraktnem slikarstvu / Complexity and Technological Biomorphism in Contemporary Abstract Painting* (Zbornik za Tomaža Brejca / Proceedings for Tomaž Brejec, 2020), *Prostor in gledalec: utelešena zaznava v umetnosti instalacije* / Space and Spectator: Embodied Perception in the Art of Installation (ČKZ, 2018).

While the modern paradigm of space was based on subject–object relations, perception, abstraction, and new geometries, the development of modern information technologies and computer science established new spatial relations, which became part of theoretical reflections and were embraced by artistic practice. These spatial relations were based on the concept of virtual reality and simulation, resulting from the global abandonment of traditional spatio-temporal relations within the new immaterial sphere of the global web. Modern information and telecommunication tools enabled the emergence of new forms of disembodied subjectivity, fluid virtual connections, and altered spatio-temporal parameters of reality in relation to virtuality, highlighting the importance of body(lessness) in cyber-spatiality (A. Vidler) or the idea of temporal accelerations (P. Virilio). In the last decades, theoretical discourse on the problems related to space and contemporary artistic production have often been focused on analyses of the impact of information and digital technologies on the perception of space. Artistic research has historically been dependent on the technologies and media of its time, so the connection between art and technology is not a novelty or a peculiarity of the contemporary era. According to Oliver Grau, art has always adopted or even promoted new technological inventions in the development of media, and furthermore argues that "art's close relationship to machines in particular and technology in general, including the new media of images and their distribution, spans all epochs, from classical antiquity to the present day" (Grau, 2003, 4).

Similar continuity is reflected in the historical transformations of modes of spatial representation; despite the widespread view that the reign of perspectival space, which endured for several centuries (from the 15th century onwards), was shattered and came to an end due to the 20th century art of the modernist avant-gardes, the spatial experience of contemporary modes of spatial representation by means of digitisation, dematerialisation, and new forms of illusion testifies to the contrary.

E. Panofsky, author of one of the most important studies in the field of the culture and technique of perspective (*Die Perspektive als 'Symbolische Form'*, 1927),[3] and later especially Hubert Damisch (*L'origine*

3   A seminal publication on the subject of space was published in the 1920s, i.e. the treatise *Perspective as Symbolic Form* (Die Perspektive als 'Symbolische Form', 1927) by Erwin Panofsky, who argued that perspective transforms psychophysiological space into mathematical space. He drew a parallel between the history of spatial representation and the evolution of abstract thought, which developed starting from the ancient view of the physical universe as being a discontinuity and an "aggregate" and progressed towards the post-Renaissance understanding of space as being infinite, homogeneous, and systematic. Panofsky linked the Renaissance perspective to the emergence of a rational and self-reflexive Cartesian subject. He argued that Renaissance perspective placed the viewer at the centre of the hypothetical

de la perspective, 1987) note that despite the general belief in a fundamental modernist reversal of the (spatial) paradigm after the introduction of the theory of relativity, modernism did not in fact completely abandon the reign of perspectival culture (Vidler, 2000, 8). Damisch points out that the increasing prevalence and utility of perspective in video simulations and other digital representations of space requires a rethinking of perspective (Damisch, 1987). A. Vidler similarly observes:

> **"Despite differences, the contemporary graphic effects of digital space are in fact deeply obligated to the representational experiments of modernism, in a way that carries serious implications for the theorization of virtuality. [...] Perspective is still the rule in virtual reality environments; objects are still conceived and represented within all the three-dimensional conventions of traditional art, since there is little to distinguish Alberti's window from a computer screen (Vidler, 2000, 6).**

2. HYPERSPACE TOPOLOGY AND COMPLEXITY IN THE INFORMATION AGE

The 1970s saw the emergence of new epistemological paradigms in many scientific and technical fields, including chaos theory, the non-linearity and dynamics of complex systems, fractal geometry, self-organisation and autopoiesis, research on artificial life and intelligence, subsequently joined by theories of neural mirror networks and genetic algorithms. The change of scientific paradigm with the entry into the information age coincides with the new social and philosophical theories of postmodernism, which, in the context of technological expansion of reality through digitisation and the emergence of virtual hyperspace, focused on the concept of simulation. Gilles Deleuze, Jean Baudrillard, Guy Debord, Jacques Derrida, and François Lyotard found in the concept of simulation an emblem of a technologised society and digital culture, linked to the information flow made possible by digital communication tools and the World Wide Web. In the age of digitalization, the

world and that the perspective representation of space with its vanishing point on the horizon of the picture was connected to the eyes of the viewer who stood before it. In this way, perspective created a hierarchical relationship between the centred viewer and the space of the painting spread before them (Panofsky, 1991). In the feminist and post-structuralist theories of the 1960s, Panofsky's treatise became a key reference for critical studies on perspective as a symbolic form; the authors of these studies stressed that the perspective view was linked to the concepts of mastery, control, and self-centredness of the viewer in relation to the representation of a static "stage".

technologically manipulated image is determined by completely different principles of constitution, reproduction, distribution, transmission, and perception.[4]

The leading paradigm of postmodern science was established on the basis of complexity theory, chaos theory, and the theory of non-linear dynamical systems; already in the 1950s and 1960s fractal geometry described the reality of the phenomena of complex systems and non-linear dynamics, causing the Euclidean geometry to become useless. Chaos theory is based on the observation that even the simplest systems can generate chaotic behaviour, which cannot be understood by accumulating input information, since we are dealing with non-periodicity and complex phenomena, associated with a steep increase in errors. The study of the behaviour of chaotic systems revealed that reality is established through the relationship between order and disorder (chaos). For the study of non-linear systems, it was therefore no longer fundamental to link cause and effect, but rather to look for patterns and certain irregular repetitions (similarities, non-identical iterations). A space that is curved, deformed, twisted, broken, undulated, and dynamic was adequately described by fractal geometry (Benoit Mandelbrot), which revealed similarities (not perfect identity) in the structure of fractals recurring in different scales; the micro scale of the fractal structure reflects the macro structure, and each minimal particle of the system mirrors the order of the whole to which it belongs.

Ernest Ženko notes that postmodern sciences, such as physical theory, which deal with the structure of matter (quantum mechanics), do not contribute anything particularly new to the understanding of space (new in the sense of the break with Einstein's theory of relativity). Similarly, fractal geometry or theory of chaos and complex systems did

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4   See, for example, Jean Baudrillard, *Simulacra and Simulation* (1981); Guy Debord, *The Society of the Spectacle* (1967); Jacques Derrida, Dissemination (1972). In his critique of simulation and the hyperreal, Baudrillard expresses the belief that the reason for the loss of contact with reality in the postmodern era is conditioned by modern technological and media production. This loss has strategic consequences, affecting different systems of representation (for example, in science and art) but also the wider social condition. In reference to Plato's paradigm of reality, Deleuze (*The Logic of Sense,* 1969) and Derrida reflect on a postmodern society, saturated with images to the point that we are no longer able to distinguish the original from the copy; in this light, both philosophers conclude that we live in a world of simulacra. Deleuze and Guattari (*A Thousand Plateaus/Mille Plateaux*, 1980) see in the global culture of simulation a particular potential for the future. They argue that simulation and hyperreality have reached a transnational level throughout popular culture, and that advanced capitalism is creating a dissolution of old identities and territorialities. Brian Massumi notes that Deleuze and Guattari put Baudrillard's pessimism in opposition to a logic that is affirmative towards simulation: "The challenge is to assume this new world of simulation and take it one step farther, to the point of no return, to raise it to a positive simulation of the highest degree by marshaling all our powers of the false toward shattering the grid of representation once and for all." (Massumi, 1987). Brian Massumi believes that "[h]idden in the images is a kind of genetic code responsible for their generation.

not offer a new spatial model, but rather a new understanding of the surface. This is where Ženko sees the key to understanding postmodern space; he believes that "among all the oppositions that define the relationship between modernism and postmodernism, it is the relationship between surface and depth that is crucial" (Ženko, 2000, 126) or "the emergence of a new kind of flatness and depthlessness, a new kind of surface in the most literal sense as the ultimate formal feature of all postmodernisms" (ibid., 136). He demonstrates this on the example of pop-art. Postmodernity is characterised by strategies for simulating reality and persistent attempts to establish a new reality, which would conceal its original disappearance. Simulation theory identifies global changes in the technologically advanced world, highlighting in the context of art the virtual and interactive nature that characterises the new art forms. Through its effects on temporal and spatial accelerations, the digitisation of space in the information age has had a significant impact and changed the perception of contemporary reality. According to A. Vidler, with the advent of digitalisation, the competing ideas of space in modernism – which replaced the historical primary interest in time that dominated the 19th century – were confronted with a form of spatial timelessness, with a mutation in space itself that transformed space into non-space and time into timelessness (Vidler, 2000). Regarding the relationship between space and time, Paul Virilio argued that (the then) contemporary era did not witness spacelessness and timelessness, but the opposite: it saw the dominance of the concept of temporal space. He notes new forms of "time compression", arguing that "[h]ere no longer exists; everything is now" (Virilio, 2000ª, 125), and that time has finally overcome space as our main mode of perception or, as B. Tschumi notes in the preface to Virilio's work A Landscape of Events, Virilio's space becomes temporal, the theme is "the collapse of time, the acceleration of time, the reversal of time, the simultaneity of all times [...], all space is swallowed up by time. Space becomes temporal" (Tschumi, as cited in Virilio, 2000b, viii).

In the last decades of the information age, in the period of meta-, alter-, or hypermodernism, it is possible to observe new spatial concepts and forms emerging at the interdisciplinary intersection of different media genres, film, photography, art, architecture, and science; this fusion takes place under strong influence of digital technology. Contemporary techniques of spatial representation are structured by the logic of the digitally created environment, which A. Vidler declared to be the dominant form of contemporary hyperspace.[5] Digital virtual-

5   "Hyperspace" is a term used in science, science fiction, cultural studies, but especially in theories of (electronic) media, digital art, and postmodern architecture, where the term

ity is no longer described in terms of types, signs, structures, and cracks, but rather in terms of "grids, folds, layers, and overlappings", which establish and describe the forms of contemporary fluid, curved, and multi-layered space (Vidler, 2000). The contemporary experience of space is defined by the meaning of surface and by virtuality, dematerialisation, and the particularities of hybrid spatial topologies that emerge from the interplay of analogue and digital technological processes. W. J. Mitchell observes that "electronic spaces apparently deny any form of geometry. They are logical, mental spaces and in this sense 'antspatial'. The Net [the World Wide Web] denies geometry. While it does have a definite topology of computational nodes and radiating boulevards for bits [...] it is fundamentally and profoundly antispatial. [...] You cannot say where it is or describe its memorable shape and proportions or tell a stranger how to get there. But you can find things in it without knowing where they are. The Net is ambient – nowhere in particular but everywhere at once" (Mitchell, 1995, 8).

A particular understanding of post-structuralist, dematerialised (hyper)space, a space of folds, layers, foldings and overlappings, is described in the works of Gilles Deleuze. Deleuze' thought is distinctly spatial and often inspired by scientific – mathematical, biological, botanical, or physical – representational models, when he refers to mycelium, chaos, spatial planes, axes, tangents, or mathematical points of inflection. Deleuze compares contemporary spatial reality to the structure of the mycelium, which is a rhizomatic, decentralised, horizontal extension without a centre or relation to verticality; Deleuze's second spatial representation consists in topology and the reality of inflections. According to M. Vatovec, it is the mathematical topology that "appears as a pertinent 'way of thinking' for comparison with Deleuzian concepts, or rather, for comparison of topological functions with Deleuzian concepts" (Vatovec, 2012, 189). Topology presents specific spatial aspects as mathematical problems. It is a generalisation of geometry and classical mathematical analysis and changes the very notion of space: from Euclidean to more general topological space.[6] Its main role is to determine whether spaces are topologically equivalent to each other or

"hyperarchitecture" is becoming widespread. In a broader sense, it refers to a space of a higher dimension, described as a dimension of space that is alternative and parallel to our ordinary space. We access this space by extending our normal perceptual-conscious states (or, as depicted in science fiction, by means of an energy field or other device), and move through it at superluminal speeds, the temporal parameters of past and future being no longer existent. In architectural theory, for example, the term refers to spatial visualisations made possible by digital technology and to the aesthetics of a dematerialised and fluid space, subject to the effects of simulation, projection, and mutation (see for example Luigi Prestinenza Puglisi: HyperArchitecture: Spaces in the Electronic Age. Basel, Boston, Berlin, Birkhäuser, Publishers for Architecture, 1999).

homeomorphic. This entails determining the neighbourhoods, continuities, and other topological properties for a given space as well as attempting to find the same spaces. This identity is called homeomorphism (ibid., 187).[7]

The topological mapping of points in Deleuze's system is subject to the logic of difference, multiplication, and variability: it is neither a continuum of ordinary points nor a discontinuum of extraordinary points. According to M. Doel, there is, instead, "a dissimilatory fractal of singular point-folds, reminiscent of Cantor dust" (Doel, 2000, 128). Many of Deleuze's works (*The Fold,* 1988; *A Thousand Plateaus,* 1980; *The Logic of Sense*, 1981) include series of descriptions of a multilayered and multiplied space: a folded, bent, curved, elastic space that has no constant points, only folds that create consistency. What appear to be points or constants are in fact folds upon folds. The fold is a spatial "differentiator, differential", says Deleuze, who proposes the technique of origami, the art of folding, as the appropriate model of spatial representation (Deleuze, 2009, 16).

Deleuze developed the spatial metaphor of the fold in his work The Fold (*Le Pli*, 1988), which interweaves his diverse interests in physics, metaphysics, mathematics, and art. Through the text, he derives interesting mappings and provides illustrations of scientific and mathematical concepts, comparing and describing them by means of philosophical concepts (considerations on the subject – the monad, which is the 'fold of the world', and on the 'folds in the soul') or illustrating them with examples from art.[8] Deleuze reflects on folded, curved space and on the

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6   The distinction between topological and metric space is particularly evident in quotient topology, where gluing is used to create toruses. For example, a two-dimensional torus is obtained from a rectangle by gluing each point on the edge of the rectangle to the opposite point lying on the opposite side of the rectangle, whereas to construct a three-dimensional torus, we can start with a rectangular room in which we stand. Then, "imagine the left wall glued to the right wall, not in the sense of physically gluing one wall to the other, but in the sense that if you walked through the left wall, you would find yourself emerging from the right wall. In the same manner, the front wall is glued to the back wall and the ceiling. So, what do you see if you look through the floor or the ceiling? If you look through the wall, it seems that you see another identical room. There, you can see your own back. If you look through the floor, you see your head below you, and if you look through the ceiling, you see your soles above you …This three-torus has no edges, and its total volume is just the volume of the room you started with" (Weeks, 1998, 19).

7   The pioneers of research in the field of mathematical topology were Johann Benedict Listing, who first used the term "topology" (1836), and August Ferdinand Möbius. Möbius illustrated homeomorphism with the example of a flexible elastic surface: all possible shapes that are derived from it by the process of bending, twisting, stretching, and warping but without tearing or cutting, will be mutually homeomorphic. Homeomorphism is a topological (not geometrical) equivalence.

8   He extends the concept of fold beyond the Baroque and understands it in a broader sense: "[I]f the Baroque can be stretched beyond its precise historical limits, it appears to us that it is always by virtue of this criterion, which inspires us to recall Michaux when he writes of

operative concept of the fold, which is the "genetic element of the variable curve or fold" (Deleuze, 2009, 28). Using the example of Klee's figure and diagram of the inflection, he derives the thesis about the painter's affinity for the Baroque aesthetics of folds and curves: "Inflection is the authentic atom, the elastic point. That is what Klee extracts as the genetic element of the active, spontaneous line. It [...] opposes him to Kandinsky, a Cartesian, for whom angles are firm, for whom the point is firm, set in motion by an exterior force. For Klee, however, the point as a 'nonconceptual concept of noncontradiction' moves along an inflection. It is the point of inflection itself, where the tangent crosses the curve. This is the point-fold" (ibid.). On the basis of the example of Klee's three figures, he illustrates the relationship of the inflection, the significance of the intertwined curves, and the significance of the shadow, which marks the convex side and thus disengages concavity. He describes the inflection as an ambiguous sign that is weightless: "[I] inflection is the pure Event of the line or of the point, the Virtual, ideality par excellence. It will take place following the axes of the coordinates, but for now it is not yet in the world: it is the World itself, or rather its beginning, as Klee used to say, 'a site of cosmogenesis', 'a nondimensional point', 'between dimensions'" (ibid., 29–30). Deleuze writes about mathematical transformations (referring to works by B. Cache and R. Thom), about the inflection, which "cannot be separated from an infinite variation or an infinitely variable curve", and mentions the Koch's curve, "obtained by means or rounding angles, according to Baroque requirements, by making them proliferate according to a law or homothesis. The curve passes through an infinite number or angular points and never admits a tangent at any of these points. It envelops an infinitely cavernous or porous world, constituting more than a line and less than a surface (Mandelbrot's fractal dimension as a fractional or irrational number, a nondimension, an interdimension)". There is an infinite fluctuation and the possibility of adding a new detour "by making each interval the site of a new folding" (ibid., 31). Deleuze, who is often described as a "horizontal thinker", a thinker of difference and differentiation, also understands space as a differentiating rather than a unifying element. Space is a multilayered interconnectedness that cannot be described

La vie dans les plis (Life in the folds), or Boulez when he looks to Mallarmé and composes "Fold after Fold" or Hantaï, when he constructs a method from folding" (Deleuze, 2009, 59). He also goes back in time, writing about P. Uccello and El Greco, and describes modern painting as comprehending "the textures of matter (the great modern Baroque painters from Paul Klee to Fautrier, Dubuffet, Bettencourt etc.)", stressing, however, that Informel is not a negation of form: "[I]t posits form as folded, existing only as a 'mental landscape' in the soul or in the mind, in upper altitudes: hence it also includes immaterial folds. Material matter makes up the bottom, but folded forms are styles or manners" (ibid., 60–61).

by points, integers, and identities, but rather by multiplicity, fractality, rhizomatic interconnections, inflections, and folds that are constantly in motion. It is a dynamic, changing space where "[m]ovement takes in everything, and there is no place for a subject and an object that can only be concepts. It is the horizon itself that is in movement: the relative horizon recedes when the subject advances, but on the plane of immanence we are always and already on the absolute horizon. Infinite movement is defined by a coming and going, because it does not advance toward a destination without already turning back on itself [...]." (Deleuze and Guattari, 1999, 46). Everything takes place on the surface, on the plane of immanence and consistency. Space is always a pure virtuality: it resists actualisation and changes every time it is actualised.

3. THE VIRTUAL

The virtual constitutes one of the central spatial concepts of postmodern philosophy (Deleuze, Guattari, Derrida, Lyotard) and new media theories. Although virtuality has a long artistic tradition, it is only with the digitisation of space that it has become one of the fundamental concepts in contemporary theories of hyperspace. Here, I present two different conceptions of the virtual; first, Deleuze's understanding of the virtual in relation to the actual, and after that, a more technically-focused approach to the interpretations of the virtual within new media theories, which puts the virtual in opposition to the real.

The virtual – the actual

In Gilles Deleuze's philosophy, the concepts of the virtual and the actual appear as ontological categories which replace the pair of the intelligible (conceptual) and the sensible, also referred to as the pair of essence and existence.[9] "The actual" refers to the material and the current state of affairs, while "the virtual" describes an immaterial, past, and ideal event. The essential element of this definition is the relation of the

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9   The conceptual pair of the virtual and the actual constitutes one of the fundamental dualities of Deleuze's ontology, which was introduced in his early writings on Bergson (1956) and discussed in more detail in his seminal work *Difference and Repetition/Différence et répétition* (doctoral dissertation, 1968) as well as in number of his later works. Although he often changes the meaning of his metaphysical categories according to the problems he is addressing, the question of the virtual in relation to the actual keeps emerging as a decisive element of his metaphysical system, remaining active up to his death. Deleuze focuses on this conceptual pair in his works such as *What is Philosophy?/Qu'est-ce que la philosophie?* (1991), *Pourparlers* (1990), *The Logic of Sense / Logique du sens* (1969), and, lastly, in his posthumously published chapter (following his suicide in 1995) from the unfinished work *Le Virtuel et l'Actuel / The Virtual and the Actual*. For a more detailed treatment of this issue, see: Sasso, R., Villani, A. (eds.) (2003): *Le Vocabulaire de Gilles Deleuze*, 22–29.

virtual and the actual to the real: both concepts are linked to the real, but in different ways: the virtual is the real as an Idea, while the actual is the real as the actualisation of the virtual (Deleuze, 2011, 327). Deleuze points out that the virtual is not in opposition to the real, but only to the actual. The virtual possesses full reality by itself, but it should not be simply understood as a "reservoir" of potential possibilities.

Deleuze stresses that "the virtual must be defined as strictly a part of the real object – as though the object had one part of itself in the virtual into which it plunged as though into an objective dimension" (Deleuze, 2011, 327). For Deleuze, therefore, "every object is double without it being the case that the two halves resemble one another, one being a virtual image and the other an actual image. Virtual objects are incorporated in the real objects." (ibid.). To understand this duality, topology seems to be the appropriate tool; it explains the homeomorphism of topological spaces or objects residing in a four-dimensional space, such as the Klein bottle, which is a famous graphic representation of a non-orientable surface (a two-dimensional multiplicity).

In the perspective of Deleuze's distinction between actuality and virtuality, and the immersion of the object in the latter, it seems crucial for the reflection on the nature of the art object or art space to recognise the specific duality of the image (virtual and actual image) present in the object, i.e. the idea that the object only appears as real when it emerges as an actualization of virtuality. In The Logic of Sense (1981), Deleuze illustrates this connection in more detail, taking the field of painting as an example. Painting is supposed to represent what lies beneath representation, i.e. the virtual. But this "beneath" should not be understood as another plane, as a foundation that is under the actual (representation), but as having a more topological sense: the virtual and the actual are the other side of the same plane, like the other side of the coin: the virtual lies under the actual, but they are separated only by an infinitesimally thin edge.

In order to comprehend the regime of artistic representation or its relation to the real, it is important to understand Deleuze's emphasis that the actual opposite of the real is not the virtual, but the concept of the possible (possibility), and that the virtual should not be confused with the possible. At this point it is important to introduce another type of conceptual dichotomy, namely the relation between the possible and the real, which also differ because the first "refers to the form of identity in the concept, whereas the [second] designates a pure multiplicity in the Idea" (ibid., 331).

When Deleuze links the possible to identity, he inserts it in the regime of identity and resemblance; for Deleuze, the possible is thus a

category of Platonism – an entity is possible only if it is derived from the identical, it is therefore its copy. Here, we approach the essence of the difference between representation and simulation; the possible operates in the regime of representation and is therefore similar to the real – imitating, copying, and representing it – whereas the actualisation of the virtual is governed by the rule of difference and divergence – the actual is neither similar to nor a copy of the virtual, which it nevertheless embodies (Klepec, 1998, 146). The virtual does not exist outside bodies, on the contrary, it is inside them, even though the bodies do not bear a resemblance to it. Deleuze says:

> **"The actualisation of the virtual [...] always takes place by difference, divergence or differenciation. Actualisation breaks with resemblance as a process no less than it does with identity as a principle." (ibid.).**

Deleuze's philosophy of difference is fundamentally anti-Platonist. Plato argued that the Idea is truth, i.e. the existent. Reality crated by senses is supposed to be only a reflection of a higher reality or Idea; it is therefore a poor copy, while art is only a copy of a copy and as such degraded. This absolute Platonic idea became the model for copies and simulacra. Deleuze, on the other hand, argues that the Idea is a simulacrum, i.e. that it is essentially virtual, also referring to it as the "difference", which is the fundamental concept of the differential philosophy of difference and means that "the Idea is precisely real without being actual, differentiated without being differenciated, and complete without being entire" (Deleuze, 2011, 335).[10]

Deleuze's anti-Platonism[11] implies a denial of the existence of

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10 Deleuze's third dualism, the distinction between differentiation and differenciation, is introduced here. Whereas differentiation is the totality of the diacritical relations that occur within the Idea-structure, differenciation is the process of actualisation of such a structure. Differenciation marks the actualisation of virtuality, but it forms only the first half of the notion of difference. What is differenciated must first be distinguished from itself, and only the virtual is different from itself. For Deleuze, thus, the virtual should not be imagined as a doubly latent or preceding phantom of the real; the virtual is not related to the process of realisation but to the process of actualisation or, as Deleuze also refers to it, differenciation: the virtual being this process (Klepec, 1998, 146–147).

11 Deleuze explicates Plato's ontological philosophy of the model, the copy, and the simulacrum in *Difference and Repetition* (1968) as well as in the chapter *Plato and the Simulacrum* of the treatise *The Logic of Sense*, published the following year. Plato distinguishes between two types of images, between "good" icons, which resemble the model – the Idea, and "bad" simulacra, which simulate resemblance even though they are different. The model is endowed with an original superior identity that belongs only to the Idea, while the copy is judged by its derived internal resemblance. The concept of the model acts as a criterion for distinguishing between imitations, good images or icons and bad, simulated images or phantasms. The simulacrum or phantasm (according to Plato) is not just a simple copy of a

an identity that determines the world of representation; "the modern world is one of simulacra", and modern thought is established on the ruins of representation and its concepts of identity, homogeneity, and imitation. The difference and the simulacrum, degraded in Platonism, come to the fore in postmodern theories of simulation and hyperreality. In the theories of simulation, semblance, and hyperreality (Baudrillard, Lyotard, Jameson, Derrida), the concept of difference is no longer present in comparative relations between model and copy (Plato), but appears in serial repetitions of the same elements, and in differential oppositions between the elements of serial, simulated images without an original.

The virtuality of digital space

Today, the question of the relationship between representation and simulation is part of the theoretical discourse on new media and virtuality; these describe the contemporary effects, which are produced by the virtualisation of the real and linked to the accelerated processes of digitisation at all social condition levels. In theoretical discourses on new media, the concepts of virtuality, simulation, and representation are often discussed by focusing on technical aspects, as the Deleuzian dichotomy of the virtual and the actual is usually replaced by another pair of opposites: the relation between the virtual and the real. The studies of virtuality are based on the analyses of the screen functions and the importance of interactivity, technological innovations (software or interfaces), psychological effects of immersion, and altered experiencing of temporal and spatial categories or altered sensory and body perception in interaction with the machine and cyberspace.

Oliver Grau (*Virtual Art: From Illusion to Immersion,* 2003) notes that the idea of virtuality in new media art has a long history, as it pertains to the tradition of illusionistic and immersive artistic representations, which changed according to the possibilities offered by the media of expression and technologies of the time, from illusionistic frescoes, perspectives, and panoramas, to digitally created illusions experienced interactively by the user. In this context, Deleuze highlights the specificities concerning the virtual environment of computer art. Computer art depends on the development of interfaces and software and through the possibility of interaction enables a metamorphosis of the very concept of image and its perception on the part of the user.

copy or an infinitely slackened resemblance, a degraded icon or image. The simulacrum is a demonic image which, unlike the icon, shows only an external resemblance, as it is constructed around a difference. If it creates an external effect of resemblance, it is only an illusion and not an inner principle of the image.

"In virtual reality, a panoramic view is joined by sensorimotor exploration of an image space that gives the impression of a 'living' environment. Interactive media have changed our idea of the image into one of a multisensory interactive space of experience with a time frame. In a virtual space, the parameters of time and space can be modified at will, allowing the space to be used for modeling and experiment. The possibility of access to such spaces and communication worldwide via data networks, together with the technique of telepresence, opens up a range of new options (Grau, 2003, 7).

Lev Manovich (*The Language of New Media,* 2001) explores the forms of virtual space through the genealogy of the screen and the evolution of representational apparatuses and technologies. According to a well-known definition of virtuality, cited also by Or Ettlinger, the virtual space is "the visible world of pictorial images: paintings, films, photographs, TV programmes, video games, or any other pictorial medium, i.e. physical devices that allow us to experience through them something that is not physically there. According to this interpretation, whatever is seen through any such device is considered to be located inside of virtual space, and therefore 'virtual' (Ettlinger, 2008, 6). In these devices, the screen, or rather the rectangle of a screen, acts as a cut into reality, which is now split into the normal physical space, i.e. the reality of the body, and the virtual space of the image inside the screen. From the point of view of technicialy-focused reflection, the division between real (physical) and virtual space now becomes crucial.

Manovich explains the relations between the body, the mind, and the experience of virtual space through the genealogy of the screen as a frame that has changed forms and functions in visual culture since the Renaissance:

> **"The visual culture of the modern period, from painting to cinema, is characterized by an intriguing phenomenon – the existence of another virtual space, another three-dimensional world enclosed by a frame and situated inside our normal space. The frame separates two absolutely different spaces that somehow coexist" (Manovich, 2001, 95).**

This is the most general definition of the screen as a "classical screen" and equally well describes the Renaissance painting (e.g. Alberti's formulation of the perspectival painting) and the modern computer screen.

Manovich goes on to say that a hundred years ago a new type of screen emerged, which he calls the "dynamic screen". The dynamic screen – for example cinema, television, and video – retains all the

properties of a classical screen but can also display an image changing over time. In addition, the dynamic screen modifies the relationship between the image and the spectator, or the particular viewing regime. "This relationship is already implicit in the classical screen, but now it fully surfaces. A screen's image strives for complete illusion and visual plenitude, while the viewer is expected to suspend disbelieve and to identify with the image. Although the screen is in reality only a window of limited dimensions positioned inside the viewer's physical space, the viewer is expected to focus entirely on what she sees in this window, focusing her attention on the representation and disregarding the physical space outside" (ibid., 96).

The development of the computer screen has enabled an interactive position of the viewer and real-time image manipulation – rather than displaying a single image, the computer screen typically displays multiple co-existing windows, which can also be compared with zapping, the quick switching of television channels that allows the viewer to follow more than one programme; in both cases the viewer has the possibility of simultaneously observing several images. As a fourth type of screen, Manovich describes VR technologies. Paradoxically, with VR, the screen disappears altogether. VR typically uses a head-mounted display whose images completely fill the viewer's visual field. The viewer is no longer looking at a rectangular, flat surface located at a certain distance that acts as a window into another space but is now fully situated within this other space. More precisely, we can say that the two spaces – the real, physical space and the virtual simulated, space – coincide. The virtual space, previously confined to a painting or a cinema screen, now completely encompasses the real space. Frontality, rectangular surface, difference in scale have disappeared, and at certain level even the screen has vanished (ibid., 97). Manovich's genealogy of the modern screen is focused on the classical type of screen introduced by Renaissance paintings – conceived as a window on the world – and its subtypes: the dynamic cinema and television screens and the interactive screen introduced by digital virtuality. The author also draws attention to the different types of temporality that these "screens" establish: in the case of the perspective image, the static image freezes a moment for eternity, the dynamic recording (film) represents moving images in the past, while the computer image also enables interaction and image manipulation in real time. At this point, it is important to highlight the differences in the position of the viewer's body in relation to the screen. The Renaissance painting screen with its perspectively organised space presupposes a static position of the viewer, who is motionless and monocularly observes the virtual space expanding towards the

horizon. This immobility of the viewer, in turn, presupposes a dynamic mental projection into spatial virtuality; the more the virtual image becomes mobile, the more the viewer becomes immobile and passive in the mode of its reception. In the tradition of representation, viewer assumes a double identity: he or she exists simultaneously in the physical space of his or her body and in the represented, virtual space of the screen; the splitting of the subject is the trade-off for the new mobility of the image (ibid., 107–109).

Another important distinction when reflecting on the relationship between the viewer's body and the virtuality of space (in the context of classical or dynamic representation) is the difference between representation and simulation. In the tradition of the art of simulation, which can be exemplified by the illusionistic spaces of traditional artistic genres, such as frescoes and mosaics, it was important that these were inextricably linked with architecture, enabling the viewer to create a continuity between the virtual and the physical space. In the tradition of simulation, the viewer existed in a single coherent space – the physical space and the virtual space, which continued in the image. As the tradition of simulation sought to merge virtual and physical space, rather than separate them, it focused on finding size correspondences between them and different possibilities that would encourage the viewer to move freely in physical space. In contrast, the tradition of representation aspired to create a moving and movable image that could be moved into any space, which implied that the previous continuity could no longer be guaranteed. For this reason, the image represented a virtual space, clearly distinguished from the physical space where both the image and the viewer were located.

The interaction of viewers with new digital media stimulates the mental projection of the viewer into virtual space, neglecting physicality: mental interaction is emphasised, while physical activity is minimised or neglected. The mind, which is itself immaterial, can "survive" in digital space, unlike the body, which is rendered immobile. Digital technology separates the mind from the real body; at best, the body is mapped into virtual space in the form of an avatar. It is a new form of being, where the viewer, hypothetically, moves freely in a space without a body, and thus the subject becomes a bodiless spectator. The Internet is an infinite cyberspace, which gives rise to worlds within worlds as well as to new spatial and temporal forms. With new forms of being and interpersonal communication, digital space has the potential to transform real, physical space, which today is primarily a technologically supported and media-augmented space.

4. TECHNO-ART

The relationships between body, mind, and space in virtual space also have an inevitable impact on relationships in physical space, as physical distance and orientation are losing their traditional meaning. Digital spaces create a reality that is different from the actual reality – it is no longer conceived as a comprehensive and holistically unified reality, but as a site where different realities and spatial possibilities converge. Today we live in a technologically transformed space that has become our everyday reality; according to Strehovec, in fact, the cyberspace created by the interaction of man and machine causes the internalisation of human existence into a world of man-made machines, which in turn significantly influences our mental processes (Strehovec, 1994).

Techno-art is art that is produced in this new hybrid, analogue-digital space. Its creative process is not necessarily and exclusively limited to digital environment, but combines practices where digital processes are intrinsically intertwined in different forms and domains of artistic production. This type of art is defined by techno-aesthetics, which, according to Miško Šuvaković (2001), is "a postmodern theory that describes, explains, and interprets contemporary society, culture, and art using technological information models for representing the world and creating a new (other, artificial) techno-reality pertaining to the world of people and machines. It is a shift from the production of the object (artefact) to the production of the world itself (context, ambience, reality)" (Šuvaković, 2001, 9).

Techno-art, media art, and hybrid art practices (virtual reality or VR, interactive installation, augmented reality or AR, bioart, nanoart, genetic art, robotic art, art of artificial life, digital animation) are experimentally oriented, transcending genre and cultural limitations through transdisciplinary approaches. This does not only reflect the artistic curiosity or a desire to confront the new and the unknown, but is often also a way of dealing with ethical and socio-political themes or even with critical areas linked to overlooked, problematic, or neglected aspects of science itself and its research processes.

Technology-based art creates hypotheses of new possible worlds. Digital and analogue layers are hybridly intertwined in creative processes: "Large portions of the image resources of our natural environment are combined with artificial images to produce mixed realities, where it is frequently impossible to distinguish between simulacrum and original. [...] In the digitally produced virtual artwork, "being" now means "process"; finished and absolute are replaced by relativity, stability by dynamics" (Grau, 2018, 74). Grau also argues that within the

specific framework of the system of art, media art enters increasingly into discourse and debate on today's crucial social issues, such as the relationship between humans and machines, genetic engineering, and globalisation: "Media art is, therefore, an essential component of how contemporary societies may achieve an adequate self-description and by which means they can seek to attain a critical distance to the increasing pace of change" (ibid., 76). These changes, brought about by the increasing digitisation of everyday life and art, are often linked to a change in sensory perception; Grau observes that in the virtual world and in the framework of virtual reality, the projection and incorporation of spectators into artificial bodies, which are, nevertheless, merely images, will enable the extension of the sensory-cognitive experience and the experience of evocative phenomena that influence our consciousness. Today, audiovisual media, computers, and telecommunication technologies converge to form a polysensory and virtual hypermedium, which changes the cultural history of our sensory apparatus as well as the dynamics of virtual image spaces (ibid., 69).

5. CONCLUSION

Digitisation, information technologies, and cybernetics have established new standards of understanding and creating space also in the field of contemporary artistic production; today, space and technology no longer appear as separate (parallel) categories (as in modernism), but as intrinsically intertwined concepts, which place immateriality, virtuality, disembodiment, fluidity, and dynamism at the core of contemporary aesthetic experience, both at the level of artistic realisation and experiencing art.

Contemporary art and science are emerging in a period characterised by a paradigmatic technological shift. Techno-art, similarly as science, appropriates the technologies of its time and experimentally introduces new research processes and technological tools to address social, cultural, or aesthetic issues. The development of contemporary digital and information technology undoubtedly opens up and encourages new possibilities for artistic research, but the dilemma pointed out by Paul Virilio in the light of techno-science progress seems somehow justified. In *Information Bomb* (2000), Virilio observes that modern science has gradually become techno-science, which, in blurring the distinction between the technological (operational) instrument (i.e. technology) and experimental research, no longer seeks to reveal the coherent truth that will serve humanity. This slippage is treacherous, and Virilio casts it in a negative light:

"Indeed, if the 'experience of thought' does in fact lie at the origin of the experimental sciences, we cannot but notice today the decline of that analogue mental process, in favour of instrumental, digital procedures, which are capable, we are told, of boosting knowledge. Operational reality of the technical instrument, resolutory truth of scientific thought – two fundamentally distinct aspects of knowledge, which are fused here without anyone apparently becoming alerted to the situation. Science, which is not so attached to 'truth' as once it was, but more to immediate 'effectiveness', is now drifting towards its decline [...]" (Virilio, 2000, 2–3).

While Virilio refers to techno-science as a decline of the analogue mental process in favour of instrumental digital procedures in science, A. Nordmann, using the example of nano techno-science, notes that the conditions of truth or falsity, functionality of devices or usefulness of substances no longer serve as its epistemic standards; instead, nano-science is rather an exploratory attempt to claim foreign territory and to inhabit a new world or an hitherto unexplored region of the world (Nordmann, 2004). Epistemic success is therefore a kind of technical achievement, the elucidation of liminal or extreme aspects of reality, the conquest of invisible topological dimensions revealed by modern optical technologies, biotechnologies, and biogenetics.

The question that could be asked by analogy is whether contemporary technologically-oriented artistic production (techno-art) – in a similar way as contemporary technoscience – replaces the epistemological value of discovering the truth and the unknown with the banal operativity or effects of technological spectacle. At this point, we refer to the reflections by H. Bredekamp (2015), who highlights the active potential of technological images; he believes that scientific and technological imaginaries do not consists only of passive illustrations, but also include dynamic actors, which participate in the epistemological production of knowledge. Scientific illustrations in the natural sciences do not merely represent, but also transform, clarify, and communicate findings in form of images that actively participate in the formation of knowledge as culture. When techno-art is not just a technological experiment, but a cognitive-sensory invention that hypothesises new spatial, semantic, and sensory perspectives within a transdisciplinary interplay of scientific, artistic, and philosophical dimensions, it achieves a transformative potential that both mirrors and transforms the wider social reality.

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