BRIEF CV - MEMORANDUM OF SELECTED RESEARCH WORKS AND AUDIOVISUAL PROJECTS

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BRIEF BIOGRAPHICAL NOTE:

Dimitrios Traperas is an Associate Professor at the Department of Fine Arts and Sciences of Art, School of Fine Arts, University of Ioannina. He holds degrees from the Department of Physics at the School of Sciences, University of Ioannina, and from the Department of Audio and Visual Arts, Ionian University. He completed his doctoral dissertation and postdoctoral research at the Department of Audio and Visual Arts at the Ionian University, focusing on the study of visual and auditory perception of higher spatial dimensions, also known as "hyperspaces".

His artistic work has been presented in solo and group exhibitions of painting, photography, video art, and interactive audiovisual installations. He is the author of the painting album *6 Seasons in Folegandros* and the book *Notes on Modern Science for Artists*. His research interests center on sensory perception of higher spatial dimensions and interdisciplinary approaches developed at the intersection of Art, Science, and Technology.

ANALYTICAL MEMORANDUM OF MAIN RESEARCH WORKS (R), PUBLISHED ARTICLES IN SCIENTIFIC JOURNALS (A), PRESENTATIONS AT SCIENTIFIC CONFERENCES (C) EXHIBITIONS OF AUDIOVISUAL WORKS – VIDEO ART (AV), AND BOOK AUTHORSHIP (B).

MAIN RESEARCH

Development of Interactive Audiovisual Applications and Installations, Using Informatics, for the Perception of Higher Spatial Dimensions

1. Doctoral Dissertation: "Visual and Auditory Perception of Hyperspaces" (2019) (R)

Description:

This research explores higher dimensions, known as "hyperspaces," and how they can be approached through human senses, within the contexts of Art, Technology, and Science. It specifically examines how humans perceive three-dimensional space based on sensory input and brain processing. The concept of dimension is analyzed both in its familiar form and in scientific fields such as Mathematics and Physics, with emphasis on theories about real and imaginary worlds.

The geometric understanding of the fourth spatial dimension is examined through mathematical logic and by exploring the properties of simple higher-dimensional geometric solids. The historical pursuit of higher dimensions is also studied, including the dissemination of the fourth-dimension theory to the general public through Art and Literature. The connection between hyperspaces and Contemporary Art is briefly discussed, tracing back to the early 20th century.

The core of the dissertation involves developing Interactive Audiovisual Applications and Installations using Informatics as tools to approach hyperspatial perception. Specifically, the following were developed:

a) An interactive artistic installation exploring hyperspatial sound as described by Varèse and Helmholtz, in relation to gravitational waves.

b) A scientific approach to Johan Van Manen's intuitive "hypersphere," linking it to the Quantum Geometry of String Theory, and offering a new cosmological model through an artistic lens.

c) An interactive application visualizing the hypersphere, based on the evolution of Hinton's colored cubes method.

Link to doctoral dissertation:

https://www.dropbox.com/s/fjqas0dw1v69l50/Didaktoriki_diatribi.pdf?dl=0

Published in:

LGA database of Leonardo® – International Society of Art-Science-Technology

https://leonardo.info/leonardo-abstracts-service?subject&labs_id_112&display_name=Traperas&degree_97&year_99&display_name_1&department_104&keywords_111&fbclid=IwY2xjawJpugVleHRuA2FlbQIxMQABHlWZzDw2mzBZArGfebvOnsGRqhGQ02Ew_vXThHTHwxT_6vPfffav7ZlAPQpF_aem_ptLbQRGAhmJva4oUxGmQpg

2. Postdoctoral research: "Visual and Acoustic Perception of Hyperspaces" (2019 to 2023) (R)

The postdoctoral research presented belongs to the interdisciplinary field of Art, Science, and Technology, with a particular focus on the concept of higher spatial dimensions—dimensions for which there is, yet, no scientific proof of existence. To date, both scientists and artists have approached the perception of hyperspaces primarily through mathematical and topological descriptions, as well as through imaginative exploration.

With the advancement of technology, artificial intelligence, and the global dissemination of knowledge via the internet, it is now possible to create applications that enhance the brain's ability to perceive hyperspaces. There are compelling indications that the human brain is capable of processing such complex concepts. The scientific community is increasingly open to the possibility of hyperspaces, as evidenced by its efforts to validate predictions of theoretical models such as String Theory, which posits the existence of 11 dimensions. Verifying these theories—through astronomical observations and high-energy particle accelerator experiments (e.g., the LHC at CERN)—may serve as a catalyst for making hyperspaces a prominent subject of study among both scientists and artists.

The postdoctoral research builds upon the findings of the corresponding doctoral dissertation, which examined the contributions of 20th-century artists, scientists, and

philosophers to this topic. It also proposes new directions for exploration. The interactive artistic applications and installations developed during the research, grounded in scientific methodology, immerse users in novel visual and auditory dimensions. Despite the inherent challenges in devising new perceptual methods and artistic expressions of hyperspaces, the research succeeded in advancing the field and suggesting pathways toward greater understanding and engagement.

The research is structured around three main axes:

A. An exploration of the fourth spatial dimension that integrates recent advances in Neuroscience with philosophical re-evaluations of how the brain processes sensory stimuli and constructs the perception of three-dimensional space.
B. The creation of original artistic expressions through interactive audiovisual applications that employ Information Technology to facilitate the perception of hyperspaces.

C. The development of educational materials and the authorship of a book aimed at disseminating the theory of the fourth spatial dimension and attracting new artists to this field through the lens of the intersection between Modern Science and Art.

ARTICLES IN SCIENTIFIC JOURNALS, PRESENTATIONS AT CONFERENCES, EXHIBITIONS AT AUDIOVISUAL ARTS FESTIVALS AND BOOK AUTHORSHIP

1.   Peer-reviewed journal article presenting the conclusions of the doctoral dissertation titled 'The Aesthetic Approach to Hyperspaces'. (2018) (A)

Traperas, D. and Kanellopoulos, N. (2018) "**The Aesthetic Approach of Hyperspaces"** *Technoetic Arts: A Journal of Speculative Research*, 16:3, pp. 363–375; DOI:10.1386/tear.16.3.363_1

Article website address:

https://www.dropbox.com/s/ac5w1ex5x6li5u0/TA16.3_art_Traperas_Kannellopoulos.pdf?dl=0

This article has been reviewed for publication by at least two reviewers.

Description:

This work focuses on the diverse ways in which scientists and artists have approached hyperspatial cognitive perception, proposing new aesthetic frameworks through the exploration of the capabilities of human senses, biosensors, and the brain. Specifically:

a) it introduces a cosmological model emerging from the synthesis of Johan Van Manen's projection of the "Hypersphere" with the Quantum Geometry of String Theory.

b) it presents an interactive artistic installation that explores hyperspatial sound, and

c) it describes an interactive audiovisual installation designed for the visualization of the hypersphere.

These topics are examined in greater detail in the following three articles.

The overall content of this article, along with the conclusions of the doctoral dissertation, was presented at an international peer-reviewed conference.

Traperas, D and Kanellopoulos, N (2018) "The Aesthetic Approach of Hyperspaces" *International Conference on Taboo - Transgression - Transcendence in Art & Science*, UNAM and CCD, Mexico, 11-13 November 2018. (C)

Conference website address:https://avarts.ionio.gr/ttt/2018/

2. Article in scientific conference proceedings: "An Interactive Art Application of a Proposed Fourth Spatial Dimension Cosmological Model" (2021) (A)

Traperas, D. and Kanellopoulos, N. (2021) "An Interactive Art Application of a Proposed Fourth Spatial Dimension Cosmological Model." In Panagopoulos, M., Papadopoulou, A. and Giannakoulopoulos A. (eds), *Digital Culture & AudioVisual Challenges 2018 - Interdisciplinary Creativity in Arts and Technology International Conference Proceedings* (pp. 33-40), Ionian University | Department of Audio and Visual Arts, Corfu, Greece. ISSN: 2732-9038 ISBN: 978-960-7260-68-0. (A)

Address of the website of the proceedings:

https://avarts.ionio.gr/dcac/2018/en/proceedings/

Description:

Johan Van Manen, in his attempt to visualize the shape of the hypercube, provides a vivid and conceptually rich description of a form he interprets as the projection of the "hypersphere" in his book *Some Occult Experiences*:

"The four-dimensional sphere can be best described. It was an ordinary three-dimensional sphere, on each side of which, starting from its vertical circumference, projected bent converging horns, which, by a circular bending, joined their vertices above the sphere from which they started. The result is best described if we surround the number 8 with a circle. Thus three circles are formed, the lower one representing the original sphere, the upper one representing empty space, and the larger circle surrounding the whole."

Fig. 1: Van Manen's "hypersphere" design.

The cosmological model we propose in this figure is based on the following considerations:

One of the prevailing models in Cosmology is that of a closed Universe, according to which we exist on the three-dimensional hypersurface of a four-dimensional hypersphere. Moreover, the quantum geometry derived from String Theory introduces the principle of T-duality, which asserts that the physical properties of a universe— emerging from the behavior of its fundamental constituents—remain invariant whether the universe has a radius R or 1/R (with the Planck length as the unit of measurement).

The proposed model envisions a "double" closed Universe, hypothesized to take the form of the four-dimensional hyper-solid structure described by Van Manen. This structure reflects a topological fusion of dual spatial curvatures, embodying the interplay between macrocosmic expansion and microcosmic contraction suggested by T-duality.
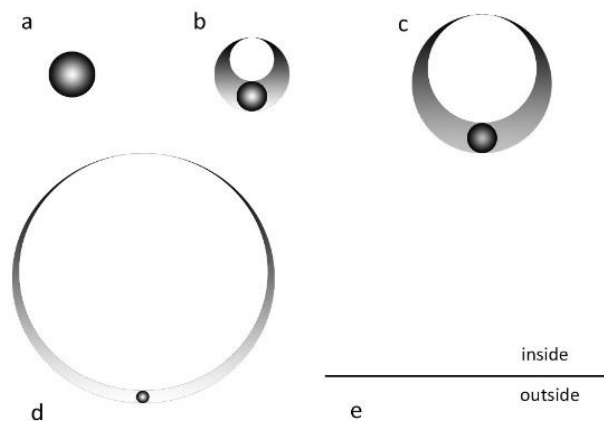

Fig.2: Evolution of the proposed cosmological model.

Website address of the Van Manen "hypersphere" simulation:

https://www.dropbox.com/s/8g1cpjicya7a39r/9.mp4?dl=0

and the cosmological model:

https://www.dropbox.com/s/x8gag4uy4v11rpy/10.mp4?dl=0

using the open-source programming language Processing.

The article was presented at an international peer-reviewed conference:

Traperas, D. and Kanellopoulos, N. (2018) "An Interactive Art Application of a Proposed Fourth Spatial Dimension Cosmological Model". *International Conference on Digital Culture & AudioVisual Challenges*, Ionian University, Corfu, 1-2 June. (C)

Conference website address:https://avarts.ionio.gr/dcac/2018/

3. Article in a scientific journal: "Visualizing the Hypersphere Using Hinton's Method" (2018) (A)

Traperas, D. and Kanellopoulos, N. (2018) "Visualizing the hypersphere using Hinton's method". *Technoetic Arts: A Journal of Speculative Research*, 16:2, pp. 163–78; DOI:10.1386/tear.16.2.165_1

This article has been reviewed for publication by at least two reviewers.

Article website address:

https://www.dropbox.com/s/70c5gkhjze5ms3b/TA16.2_art_Traperas_Kannellopoulos .pdf?dl=0

Description:

A method for perceiving the hypersphere is proposed as an evolution of Charles Hinton's approach to understanding the hypercube. Hinton's method for visualizing four-dimensional space was based on extrapolating the geometric properties of lower-dimensional shapes to higher dimensions, as well as associating dimensions with specific colors. Using the tools available in the early 20th century, Hinton devised a system involving colored cubes to facilitate the mental visualization of the hypercube.

The proposed method for perceiving the hypersphere builds upon this framework. It achieves the perception of the fourth spatial dimension through two main elements: (1) the changing radius of a spherical "trace" that represents the hypersphere passing through three-dimensional space, and (2) the gradual change in color, incorporating a hue corresponding to the axis extending into the fourth dimension.

Based on this method, an interactive application was developed using the open-source programming language Processing. In this application, the user is first introduced to the concept of a three-dimensional sphere through the circular trace it leaves when intersecting a plane. Subsequently, the user experiences the perception of a four-

dimensional hypersphere through the spherical trace it leaves as it intersects three-dimensional space.

The user is thus able to simulate entering and exiting the hypersphere from within three-dimensional space—analogous to a hypothetical two-dimensional being living in a flatland who interacts with a three-dimensional sphere entering and exiting its plane. This immersive experience encourages intuitive engagement with higher-dimensional geometry.
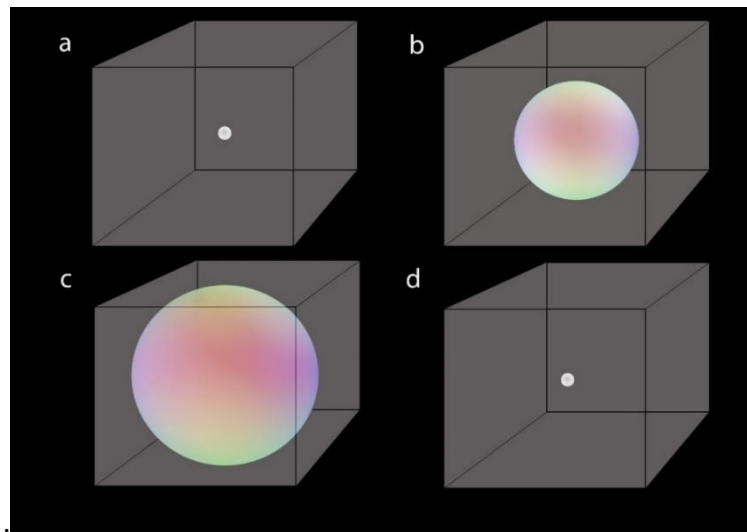

Fig.3: The intersection of a four-dimensional hypersphere with 3D space (4 snapshots from the interactive application).

Method simulation website address:

https://hypersphere-perception.vercel.app/

The development of the research, including the presentation of a hologram of the hypersphere, was presented at an international conference with peer reviewers. (C):

Gounaropoulos, C., Traperas, D. and Kanellopoulos, N. (2021) "4D Hypersphere Perception via a Holographic Art Installation". *International Conference on Digital Culture & AudioVisual Challenges*, Ionian University, Corfu, 28-29 May.
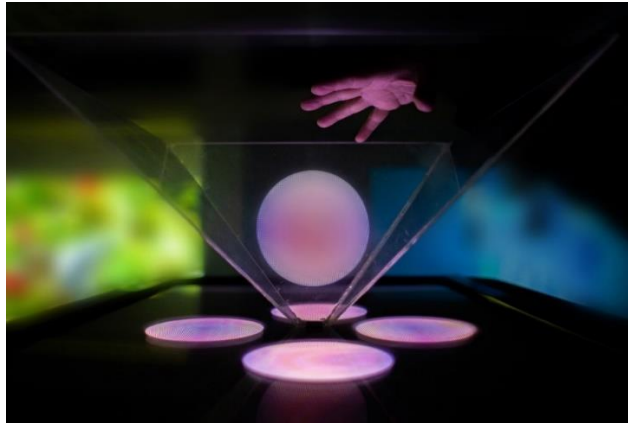
Conference website address: https://avarts.ionio.gr/dcac/2021/

Fig.4: Holographic installation presenting the hypersphere perception method.

4.   Article in a scientific journal: "Sonic representations in hyper-spaces: A creative approach" (2017) (A)

Traperas, D., Floros, A. and Kanellopoulos, N. (2017), "Sonic representations in hyper-spaces: A creative approach". *Technoetic Arts: A Journal of Speculative Research*, 15:2, pp. 221–28;DOI:10.1386/tear.15.2.221_1

Article website address:

https://www.dropbox.com/s/ka9529qy9lmv1tb/TA15.2_art_Traperas_Floros_Kannellopoulos.pdf?dl=0

This article has been reviewed for publication by at least two reviewers.

Description:

Although numerous attempts have been made to perceive hyperspaces through visual representations, sound may offer a more effective approach due to its similarity to gravitational waves, which scientists claim are the only waves capable of escaping into higher dimensions.

Using the open-source programming language Processing, an interactive simulation application of a hypothetical hyperspatial acoustic instrument has been developed. This method of perceiving hyperspatial sound is based on three main considerations:

I. The comparison between the one-dimensional linearity of sound and the two-dimensional nature of writing leads to the logical assumption that if sound acquires the characteristics of writing, it can be considered hyperspatial. In other words, we treat

sound as a spatial phenomenon that can be mapped onto points in space, effectively removing its temporal dimension.

II. Sound, as a spatial phenomenon, shares many similarities with the "sound masses" described by both artists, such as Varèse, and scientists, such as Helmholtz, in their attempts to conceptualize hyperspatial sound.

III. The design of the hyperspatial auditory instrument can be achieved by applying the inductive method to the structure and function of the human ear. The two-dimensional nature of the eardrum, which allows us to perceive three-dimensional sound, leads us to the conclusion that hyperspatial sound can be detected by a three-dimensional auditory instrument, where sound is trapped within its internal three-dimensional space and transmitted through the auditory nerve in all directions, at varying speeds, including retrograde transmission.

Based on these assumptions, an interactive installation for hyperspatial sound is proposed, and the corresponding simulation is carried out in accordance with the principles of Physics, such as wave distortion and the proportional decrease in intensity with distance.

The simulation of the developed interactive installation provides a tangible experience and introduces the user to an acoustic space that aligns with theoretical descriptions of hyperspatial sound. Our proposal for hyperspatial sound addresses a phenomenon that has not yet been scientifically validated; however, it represents an unprecedented experience and offers a novel approach to the concept of acoustic space.
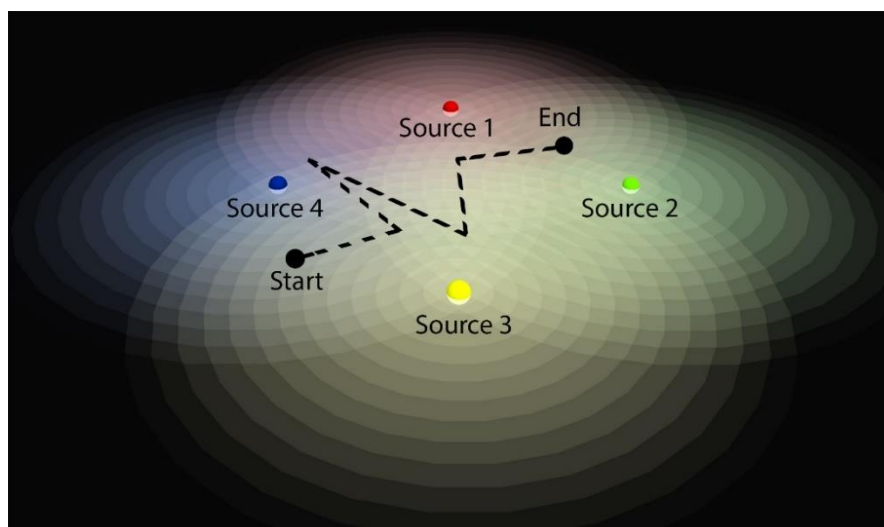

Fig. 5: Navigation in the perceptual space of hyperspatial sound.

Hyperspatial sound simulation link address:

https://www.dropbox.com/s/5ubg8ayuhp2to1g/8.mp4?dl=0

A. The content of the above article was presented at an international peer-reviewed conference:

Traperas, D., Floros, A. and Kanellopoulos, N. (2017) "Sonic representations in hyper-spaces: A creative approach". *International Conference on Taboo - Transgression - Transcendence in Art & Science,* Ionian University, Corfu, 26-28 May. (C)

Conference website link:https://avarts.ionio.gr/ttt/2017/en/

B. The work was also showcased as an interactive audiovisual installation at festivals with referees:

" Retrospective at the Megaron", *11th Audiovisual Arts Festival of the Department of Audio and Visual Arts*, Athens Concert Hall, May 20-212017. (AV)

Event website link:

http://www.megaron.gr/default.asp?la=1&pid=5&evID=3682

Festival website link:

https://avarts.ionio.gr/festival/2017/gr/

5.   Article in a scientific journal: "Plato's Allegory of the 'Cave' and Hyperspaces: Sonic Representation of the 'Cave' as a Four-Dimensional Acoustic Space via an Interactive Art Application" (2024) (A)

Traperas, D., Floros, A. and Kanellopoulos, N. (2024) "Plato's Allegory of the 'Cave' and Hyperspaces: Sonic Representation of the 'Cave' as a Four-Dimensional Acoustic Space via an Interactive Art Application". *AppliedMath,* 4:3, pp. 975-985;https://doi.org/10.3390/appliedmath4030052

Article website address:

https://www.mdpi.com/2673-9909/4/3/52

This article has been reviewed for publication by at least two reviewers.

Description:

Charles Howard Hinton, a mathematician and philosopher of hyperspaces, argued in Chapter IV of his book *The Fourth Dimension* (1904) that the Ionian philosophers, particularly Parmenides, were the first to envision a connection between hyperspaces and the world we observe. Hinton further suggested a possible link between Plato's allegory of the "Cave," as described in Book VII of *Republic*, and the concept of the fourth spatial dimension.

Specifically, in sections 514a–515c, Socrates, in a dialogue with Glaucon, envisions people trapped in a dark, underground cave, shackled by their legs and necks. Due to their inability to turn their heads, they can only see the wall directly in front of them. Behind them, at a distance and at a higher point, there is a fire. Other human figures, statues, and animal figures are positioned behind the chained individuals, and the light from the fire casts their shadows on the cave wall. These shadows become the only images the prisoners can perceive and thus come to regard as their "real" world.

Hinton used the inductive method to propose that, just as the shadow of a three-dimensional object is a two-dimensional shape, so the "shadow" of a four-dimensional hyper-object is one dimension lower, i.e., a three-dimensional object. According to Hinton, Plato, in essence, argues in his dialogue with Glaucon that our "real" world is hyperspatial, and we can only perceive its shadows.

Taking this line of reasoning further, the authors suggest that the reflection of sound on the walls of the "Cave," which the chained individuals perceive as their acoustic space, bears striking similarities to the characteristics of four-dimensional acoustic space, as demonstrated through mathematical equations.

When a wave propagates in our familiar three-dimensional space, we observe that, for instance, if a light bulb is turned on for exactly one second, an observer standing some distance away will perceive the light from the bulb for precisely one second. The same principle applies to other types of waves, such as sound waves. As mathematically proven, this wave behavior only occurs in one- or three-dimensional spaces. A wave in these dimensions propagates at a constant speed and produces the aforementioned effect. This is not true, however, in other dimensions. For example, in two-dimensional space, if a wave is created by a pebble being thrown onto the surface of a calm lake, one would expect the circular wave to move outward from the source (the point where the pebble fell) without any deformation of the surface before or after the wave.

However, our experience shows that the water surface is not calm within the circular wave. Specifically, the surface of the lake enclosed by the circular wave is distorted by smaller amplitude waves that follow the main wave and gradually weaken over time. Consequently, in relation to hyperspaces, we expect that an initial excitation causing deformation will lead to the propagation of a main wave, followed by secondary waves of lower intensity.

Therefore, we can argue that the acoustic reverberation space of a cave, such as the one described by Plato, mirrors a hyperspatial acoustic space.
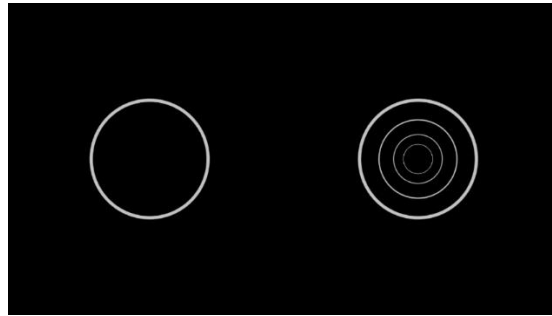

Fig.8: Wave propagation on the water surface a) only the main wave b) the main and secondary waves.

To facilitate a deeper understanding of the hyperspatial acoustic space of the "Cave," an interactive artistic application was developed. This application allows the user to experience the sound emitted by sources within the "Cave" space, either as if they were chained, or while navigating through it.
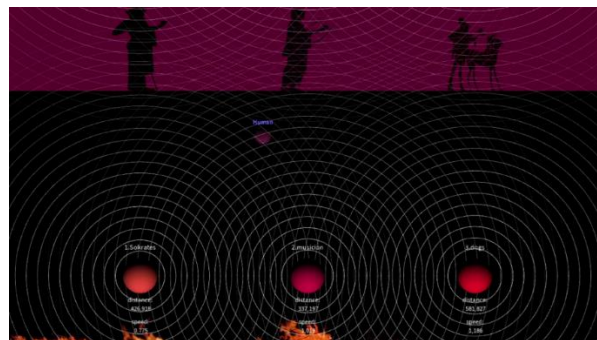

Fig.9: Interactive application describing Plato's "Cave" (snapshot).

Application video link:

https://www.dropbox.com/scl/fi/7zdemmw2xru44w08f0hma/Plato-s-Cave-video.mp4?rlkey=l45jkypphvn457djcmwwduuyt&st=vplgx63m&dl=0

The content of the above article was presented at an international conference with referees:

Traperas, D., Floros, A. and Kanellopoulos, N. (2023) "Plato's Allegory of the 'Cave' and Hyperspaces: Sonic Representation of the 'Cave' as a Four-Dimensional Acoustic Space via an Interactive Art Application". *International Conference on Digital Culture & AudioVisual Challenges,* Ionian University, Corfu, 12-13 May.

Conference website link: https://avarts.ionio.gr/dcac/2023/

6.   Presentation at a conference with referees: "It is difficult to catch a hyperspatial butterfly" (2024) (C)

Traperas, D., Georgiou, A. and Kanellopoulos, N. (2024) "It is difficult to catch a hyperspatial butterfly". *International Conference on Digital Culture & AudioVisual Challenges*, Ionian University, Corfu, 24-25 May.

Conference website link:https://avarts.ionio.gr/dcac/2024/

Description:

In the context of the original artistic expression on the theme of hyperspaces, the interactive holographic installation entitled "It Is Difficult to Catch a Hyperspatial Butterfly" was presented. This work draws elements from both the Theory of the Fourth Spatial Dimension and Chaos Theory. Specifically, the rotation of the hypercube in the fourth spatial dimension, as projected into three-dimensional space, and the shape of the Lorentz attractor from Chaos Theory combine to form a visual representation of the four-dimensional butterfly. The title of the work encapsulates the inherent challenge of approaching, perceiving, and artistically depicting hyperspaces.
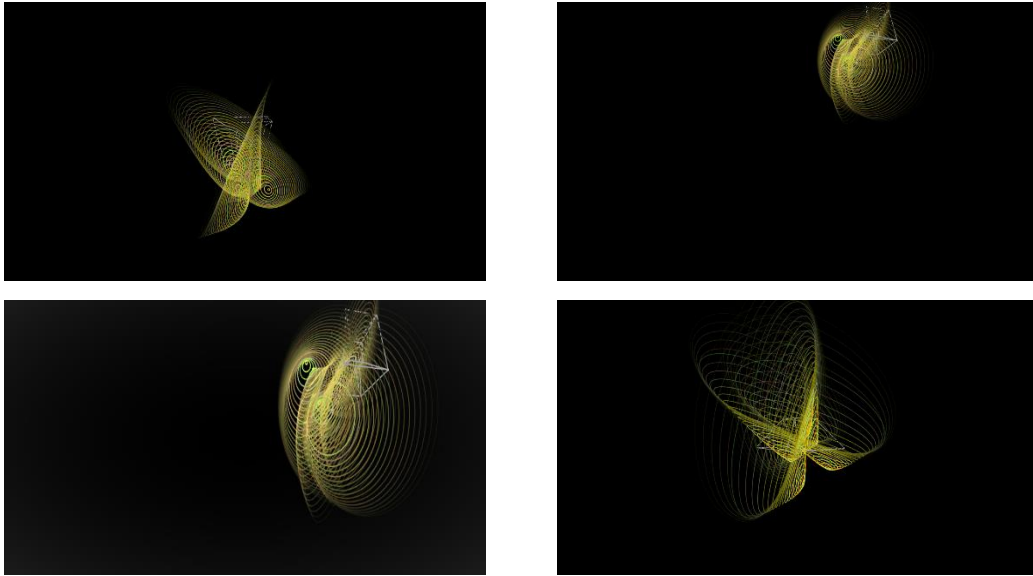
Fig. 6: Snapshots of the hyperspace butterfly's movement.

The four-dimensional butterfly is projected as a hologram onto a rectangular piece of polycarbonate glass using the "Pepper's Ghost" method, as long as the motion detector does not detect the visitor near the glass. When the visitor approaches the hyperspatial butterfly, the holographic projection stops, and the butterfly is projected onto a projection screen as a two-dimensional video at a certain distance from the visitor. The butterfly then moves in erratic patterns, mirroring the unpredictable movements of a live butterfly when we attempt to approach it.

This work captures movement across spaces of different dimensions. Specifically, it illustrates the rotation of the hypercube in the fourth spatial dimension, which we perceive in the third dimension as the movement of its projection; the movement of the butterfly as a three-dimensional hologram; and its random motion as a two-dimensional projection on the video screen. These different types of movement coexist within the piece.

The coexistence of the second, third, and fourth spatial dimensions is also present in Salvador Dalí's painting *Corpus Hypercubus* (1954). This work depicts a version of the Crucifixion on a hypercube unfolded in such a way that it forms the shape of a cross in eight cubes. The development of the hypercube appears to float above a chessboard, thus simultaneously suggesting the presence of two-dimensional, three-dimensional, and four-dimensional spaces. The intensity of this spatial experience is further emphasized by the shadows of Christ's hands, cast by a distant light.

Fig. 7: Corpus Hypercubus (1954) by Salvador Dali

Furthermore, the movement of the hyperspatial butterfly from the three-dimensional hologram to the two-dimensional video projection signifies a transition from the third to the second spatial dimension, navigating through an intermediate space of fractional dimensions. The existence of such a space is suggested by Chaos Theory.

This particular holographic interactive installation was presented at the 16th Festival of Audiovisual Arts, Department of Audio and Visual Arts, Corfu, from May 11–29, 2023. (AV)

Installation video link:

https://www.dropbox.com/scl/fi/s3ovkanmsbeqco3goq9mo/hyperspatial-buttefly.mp4?rlkey=blktaeb2kg30gq9h5np4ylnzb&st=0cxjntu3&dl=0

7.   Peer-reviewed conference presentation: "Visual Representations of Four, Five, and Six Dimensional Hyperspheres: An Artistic Approach Based on Descriptions in Peter Ouspensky's 'Tertium Organum'" (2023) (C)

Traperas, D. and Kanellopoulos, N. (2023) "Visual Representations of Four, Five, and Six Dimensional Hyperspheres: An Artistic Approach Based on Descriptions in Peter Ouspensky's 'Tertium Organum'". *International Conference on Digital Culture & AudioVisual Challenges*, Ionian University, Corfu, 12-13 May.

Conference website link:https://avarts.ionio.gr/ttt/2020/en/

Description:

In exploring global literature for suggestions from scientists, philosophers, and artists regarding the visualization of hyperspatial shapes, we were led to *Tertium Organum: The Third Canon of Thought, a Key to the Enigmas of the World* (1911) by Peter Ouspensky.

Published in 1911, Ouspensky's important work, originally written in Russian, opposed Aristotle's *Organon* and Francis Bacon's *Novum Organum*. Ouspensky argued that a new mode of thinking was needed in Western civilization—one that would integrate Eastern and Western mysticism with modern science. Such a synthesis, he believed, would elevate human consciousness and deepen our understanding of the universe's principles. In this work, Ouspensky addresses space, time, motion, causality, free will, and determinism, all examined through the lens of mathematical methodology.

The book also includes and comments on descriptions by the occultist Johan Van Manen, who explores hyper-solids in four, five, and six dimensions. While Van Manen uses the term "hypersphere" to describe these higher-dimensional objects, it becomes clear that they do not correspond to the geometric hyperspheres typically understood in higher-dimensional geometry. Given that descriptions of hyperspatial shapes beyond the fourth dimension (such as the hypercube) are rare in both international scientific and mystical literature, it became important to attempt a visual and interactive representation, aided by computer applications (such as Processing), to facilitate a better understanding of these forms.

In the eleventh chapter of his book, Van Manen describes the "fourth-dimensional globe" as he envisioned it and provides a drawing of its visual representation. His illustration features a complex of three spheres: two inner spheres, one "full" and one "empty," that together form the number 8, and an outer "full" sphere surrounding this arrangement. This "hypersphere" concept by Van Manen was already referenced in the second article and Figure 1.

Ouspensky comments on Van Manen's design as follows:

"[…] In my opinion, there is a lot of movement in the shape. The whole figure seems to me to be moving, constantly being created, as if it starts from the point of contact of the sharp edges and returns back again."

In essence, Ouspensky suggests a dynamic solid, a complex of spheres that emerge and disappear from a fixed point. Based on this description, an interactive visual

representation of this dynamic complex was created. The Van Manen "hypersphere" appears at the top of the screen, allowing the user to expand it to its maximum size or gradually shrink it back to its initial point.
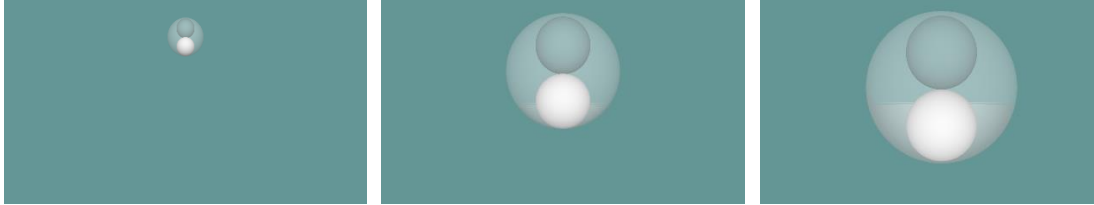

Fig. 10: Interactive visualization application of the "four-dimensional hypersphere" by Van Manen – Ouspensky (snapshots).

Application video link:

https://www.dropbox.com/scl/fi/62jhhuytr7fcd97q36ew6/4Dsphere.mp4?rlkey=c1o8g d0zgqqv7yx82e3m1vua9&st=le7yx5oc&dl=0

In the same chapter, Van Manen describes, albeit without much clarity and without any supplementary illustrations, the five-dimensional and six-dimensional "hypersphere."
"*The fifth vision is best described, or rather understood, by saying that it resembled a relief map of the Alps, with the peculiarity that all the mountain peaks and the entire landscape depicted on the map were one mountain, or in other words, as if all the mountains had a single base*."
Using this description, an interactive artistic simulation of the five-dimensional "hypersphere" was developed.
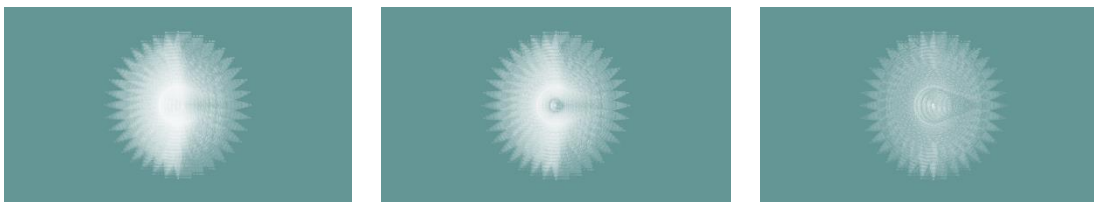

Fig.11: Interactive visualization application of the "five-dimensional hypersphere" by Van Manen (snapshots).

Application video link:

https://www.dropbox.com/scl/fi/eis6eycunpacdvmongm01/5Dsphere.mp4?rlkey=646
q1rr0293b6q21segricfqh&st=nd5ecr9d&dl=0

Regarding the six-dimensional "hypersphere," Van Manen states:

"*The shape of the sixth dimension I cannot describe. All I remember is that it gave me an impression at the time in the form of what we might call diversity in unity or synthesis in differentiation.*"

He then explains the difference between the five-dimensional and six-dimensional "hypersphere":

"*This was the difference between the fifth and sixth [dimensions], that in the fifth the spheres were in a sense externalized and yet rooted in the same unit, but in the sixth they were differentiated but not externalized: they were in a way identical with the same base, which constituted their whole.*"

Although Van Manen's description is vague, it suggests that in the sixth dimension, he refers to a system of spheres enclosed by a common outer sphere, within which the radii of the inner spheres decrease to zero at the center of the outer sphere. This contrasts with the structure of the five-dimensional "hypersphere," which starts with a central sphere of maximum radius that decreases to zero as it moves away from its center.

Based on this description, an artistic interactive application was developed to simulate the six-dimensional "hypersphere." Through this application, the user can manipulate the "hypersphere" by entering its internal structure and rotating it to better understand its complex architecture.

Fig.12: Interactive visualization application of the "six-dimensional hypersphere" by Van Manen (snapshots).

Application video link:

https://www.dropbox.com/scl/fi/g5n67ln3eeulru11qi036/6Dsphere.mp4?rlkey=34b9ch93okqnnnas1l
kra7g5f&st=f48opgmj&dl=0

8. Peer-reviewed conference presentation: "Investigating the Connection Between Plato's 'Theory of Ideas' and Hyperspaces" (2020)(C)

Traperas, D., Gounaropoulos, C. and Kanellopoulos, N. (2020) "Investigating the Connection Between Plato's 'Theory of Ideas' and Hyperspaces." *International Conference on Taboo - Transgression - Transcendence in Art & Science,* University of Applied Arts, Vienna, 26-28 November.

Conference website link:https://avarts.ionio.gr/ttt/2020/en/

Description:

In Plato's overall work, other correlations of the "real" world with higher spatial dimensions are proposed. This article examines the connection between Plato's Theory of "Ideas" and the existence of hyperspatial topological patterns that emerge during the processing of thought, particularly in the grouping of synapses in neurons in the brain.

At the Institute of Technology in Lausanne, a group of neuroscientists known as the Blue Brain Project, in collaboration with mathematicians, is processing data on the relationship between brain structure and emergent information. Their goal is to understand the structure and activity of brain neurons. They discovered that when the neocortex of the human brain processes thoughts, as well as the two-dimensional information provided by our sensory organs (such as the retina, touch surface, eardrum, etc.), it forms synaptic connectivity that corresponds to hyperspatial topological structures extending up to 11 dimensions.
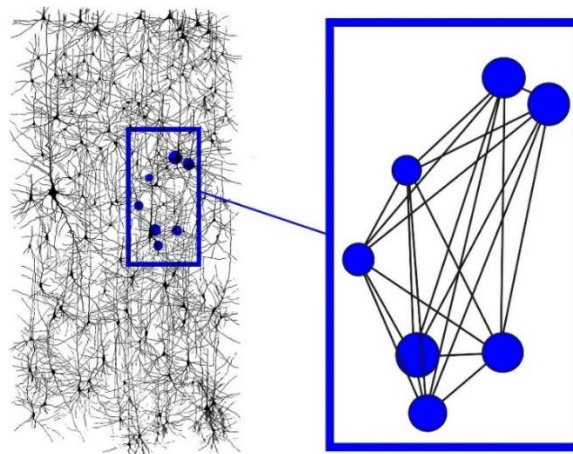

Fig.13: A group (clique) of 7 neurons corresponds to a 6-dimensional hyperspatial shape (6-simplex), as a possible projection of the six-dimensional shape into three-dimensional space.

Plato, according to his Theory of "Ideas", proposed that there is an opposition between the world of "experience", which consists of "appearances" that are often contradictory to each other, and the world of "science", which is a system of "Ideas" that are absolute and connected to each other by a bond of logical necessity. Plato's "Ideas", such as the sphere, the circle, the point, the straight line, beauty, etc., can be recognized in all advanced cultures, not as mental constructions but as eternal geometric entities and virtues. The relationship between these different worlds is that empirical objects are incomplete entities of their corresponding conceptual entities, i.e., the "Ideas". For example, a visible dot or a line drawn with chalk may represent a point or a line segment, but they do not have the properties of a point, which has zero dimension, or a line segment, which has zero width, and are therefore characterized as concepts – "Ideas".

It is proposed that the neocortex of the human brain, as an evolving "sensory" organ, has the ability to map specific information of physical entities and "Ideas" to brain cells by forming hyperspatial structures of synaptic connectivity, directly connecting us to the world of "Ideas". For example, the surface of the geometric sphere can be applied to the shape of the Full Moon, but if we observe its surface through a telescope, we will notice the irregularities of its surface. Through the process of sensory stimuli, the brain perceives the shape of the Moon and captures the geometric sphere by forming specific hyperspatial structures of synaptic connectivity. After training and development, the brain is able to form these hyperspatial structures and capture "Ideas" without the need for the physical world.
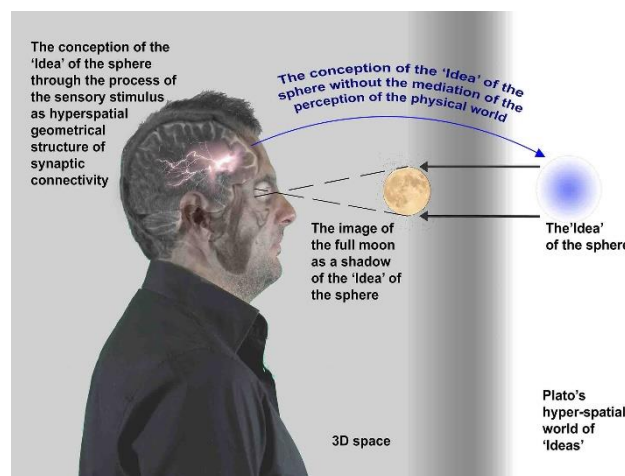

Fig.14: The process of perceiving the "Idea" of the sphere with the mediation of the physical world (Moon shape) and without the mediation of the physical world.

9.   Interactive Video Installation: "Xenophobia" (2017) (AV)

Description:

The title of the interactive video installation "Xenophobia" was chosen based on its selection as the "Word of the Year" for 2016 by the official British website dictionary.com. This choice was made due to the significant increase in user searches for the word, particularly after June 24, 2016, when the British press began reporting signs of xenophobia in connection with Brexit.

Using Arduino sensors and the open-source programming language Processing, the interactive video installation "Xenophobia" was developed, in which images of people are projected onto a large screen. The visitor is detected upon entering the installation space, and the projected image evolves into a video where the people, irritated by the visitor's presence, turn their backs. The people continue to keep their backs turned for as long as the visitor remains in the installation space.
The visitor thus experiences rejection as a "stranger" and as "unwanted."

Fig. 15: Interactive installation "Xenophobia".

Scientific Advisor: Nikolaos Kanellopoulos

Technical support: Alexandros Georgiou

Project presentation website address:

https://www.dropbox.com/s/8g3u2v39hto36z8/Xenophobia%20%202nd%20AST%20Festival%20%28Artecitya%20by%20Helexpo%29.mp4?dl=0

The interactive video installation "Xenophobia" was presented at the following festivals and has been judged by members of the evaluation committee of the respective festivals:

A. "Retrospective at the Megaron", 11th Audiovisual Arts Festival of the Department of Audio and Visual Arts, Athens Concert Hall, 20-21 May 2017. (AV)
Event website link:

http://www.megaron.gr/default.asp?la=1&pid=5&evID=3682

Festival website link:

https://avarts.ionio.gr/festival/2017/gr/

B. "The New – New", 2nd Art – Science – Technology Festival, Artecitya, 82nd Helexpo Thessaloniki, Thessaloniki, 9-17 September 2017. (AV)

Festival website link:
https://tif.helexpo.gr/el/2017_Artecitya

10. Audiovisual interactive installation: "The Hermit" (2015) (AV)

Description

The audiovisual interactive installation "The Hermit" draws references from Freud's psychoanalysis, the philosopher Diogenes, and Tarot card No. 9: *The Hermit*. The Hermit is the Madman who has matured, a traveler with minimal baggage, who learned to walk alone because he relies solely on himself. He has found fulfillment and inner peace, seeking the eternal spark within his soul while experiencing loneliness.
In this interactive video installation, developed using the open-source programming language Processing, the visitor is detached from reality as they enter a disorienting corridor with a traffic light. The sound in the installation replicates the sound that a fetus hears from the movement of blood in the aorta of the mother's abdomen. After passing through the corridor, the visitor enters the video projection space, which represents their inner world—the world of mental trauma.
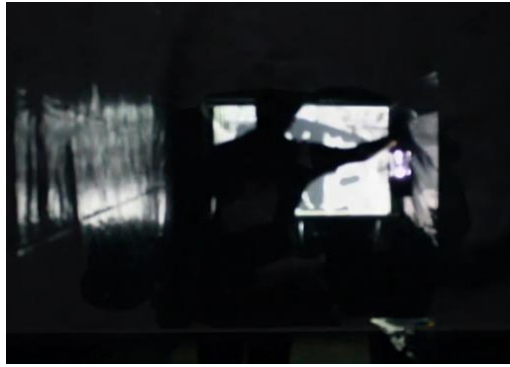
Fig.16: Interactive installation "The Hermit".

The lamp flame is detected by a camera, allowing the visitor to interact with the screen through the lamp. They can slowly fade out the video image being projected. When the visitor decides, they return to reality by following the same corridor they came from.

Sound: Aristides Katsanos

Technical support: Alexandros Georgiou

Link address to the video of the audiovisual installation:

https://www.dropbox.com/s/ryarad665ygmtyw/hermit.mp4?dl=0

The following videos are shown in the audiovisual installation:

"Agoraphobia", Video-art:

Project link address:

https://www.dropbox.com/s/fhjfi77neyxkw82/agoraphovia.avi?dl=0

"Violence", Video-art:

Project link address:

https://www.dropbox.com/s/8cd8l27x0tkw2ux/via.avi?dl=0

"Human Relations", Video-art:

Project link address:

https://www.dropbox.com/s/72mylx9735wvnrj/humanbehaviour.avi?dl=0

A. The above interactive audiovisual installation was presented before a three-member committee at the XARTS2015 international conference and has been judged by reviewers who are members of the review committee of the respective conference. Conference website link:https://summer-schools.aegean.gr/XARTS2015.

Traperas, D., Georgiou, A. and Katsanos, A. (2015) "The Hermit: An Interactive Audiovisual Art Installation". *XARTS 2015*, University of the Aegean, Syros University Unit, Syros, 9-11 July. (C)

B. It was also presented as an audiovisual interactive installation at the festival:

"Works of students at the School of Audio and Visual Arts of the Ionian University", *7th Festival of Audiovisual Installations*, Ionian University, Corfu, 20-30 June May 2013.(AV)

Festival website link:

https://avarts.ionio.gr/festival/2013/gr/

11. Video Art Projects Section: "Approaching Three-Dimensional Representations of Four-Dimensional Spaces" (2015) (AV)

Description:

The following section of video art works explores the perspective of our world from one dimension above—specifically, from the fourth spatial dimension. Just as a two-dimensional being can only see a part of an object that lies on its plane, we, as three-dimensional beings, can see a three-dimensional object (e.g., a cube) from one side, without being able to view its interior. However, as three-dimensional beings, we can fully perceive a two-dimensional object, such as a square, by observing all its sides and its interior, since we can view it from above, in the third dimension, which is external to the plane of the square. Similarly, a four-dimensional being would have the ability to simultaneously access the entire surface and interior of a three-dimensional object through visual and tactile perception.

This section consists of four video art projects created using Adobe Premiere and Adobe After Effects software:

I. "Report to Blumenfeld": A 4D self-portrait referencing a photograph by Erwin Blumenfeld, influenced by Cubism.

Fig. 17: "Report to Blumenfeld" (snapshot).

Project link address:

https://www.dropbox.com/s/1jch719s85kfjja/video1.mp4?dl=0

II. "4D – self-portrait": 4D-self-portrait with simultaneous view from multiple angles.

Fig.18: "4D – self-portrait" (snapshot).

Project link address:

https://www.dropbox.com/s/n6nmqdccknikkmc/video4.mp4?dl=0

III. "The kiss": Simultaneous external and internal 4D-view of a kiss.

Fig.19: "The kiss" (snapshot).

Project link address:

https://www.dropbox.com/s/vrnv752ojmhzdq8/video2.mp4?dl=0

IV. "Drinking a glass of milk in 4D-space": Simultaneous external and internal 4D-view of a person drinking a glass of milk.

Fig.20: "Drinking a glass of milk in 4D-space" (snapshot).

Project link address:

https://www.dropbox.com/s/4tbsn8k58p6kpr6/video3.mp4?dl=0

A. The above section of Video Art works was presented as a solo exhibition at the "Polytechno" Multi-Cultural Center, Corfu, February 4th, 2015. (AV)

B. Two of the works ("4D – self-portrait", "The kiss") participated in the international festival:
"The Project M - 3D Video Projection", *3rd Syn Festival*, Edinburgh, England, March 11-19, 2016. (AV)

Festival website address:

http://www.synfestivaledinburgh.co.uk/2016/03/07/dimitris-traperas/

12.   Video - Art: "Chaos Theory – The butterfly effect" (2014) (AV)

Description

Chaos Theory is based on the extremely sensitive dependence of a phenomenon on the initial conditions that describe it. This theory finds application in systems with a large number of interacting bodies, such as those required by Statistical Mechanics. However, what is truly remarkable is that it can even be applied to the motion of a single body, as long as the body is described by at least three variables that are interdependent with nonlinear forces, such as impact forces (for example, we know that a small impact of a ball in roulette leads to a motion that Classical Physics cannot predict). Two possible trajectories of a body subject to nonlinear forces may initially be close to each other but soon diverge sharply, leading to unpredictable results. The inability to predict the behavior of such a nonlinear system is due to our inability to measure quantities that determine the initial conditions of motion—either because of limitations in measuring instruments or because they are irrational numbers with infinite decimal places. A small difference in a digit that is beyond our ability to measure can cause the body or system in question to behave completely differently from neighboring values.

A well-known nonlinear system affected by infinitesimal differences in variables is the weather. Small changes in temperature or air pressure can affect the climate of the entire planet, as in the famous "*Butterfly Effect*," where the flap of a butterfly's wings in the Amazon can, for example, trigger a typhoon in China.

The project "*Chaos Theory – The Butterfly Effect*" (created using Adobe Premiere and Adobe After Effects software) visualizes the chaotic behavior of colors when a butterfly sits on flowering plants and then flies away, affecting weather conditions in another part of the world.

Sound: Aristides Katsanos

Fig. 21: "Chaos Theory – The butterfly effect" (snapshot).

Project website address:

https://www.dropbox.com/s/qpdetfs5g13upvc/chaos%20theory%20-%20butterfly%20effect.mp4?dl=0

The work was presented at the following festivals with judges:

A. "Zero in the Quotient", "*Miden" Festival*, Kalamata, 3-5 July 2014. (AV)

Festival website address:

http://www.festivalmiden.gr/previous-festivals/festival-miden-2014/

B. "Various aspects of COLOR", *"Art Wall" Festival*, Athens, 9-19 July 2014. (AV)

Festival website address:

https://theartwall.wordpress.com/2014/06/06/10-%CE%B7%CE%BC%CE%B5%CF%81%CE%BF-%CF%80%CF%81%CE%BF%CE%B2%CE%BF%CE%BB%CF%89%CE%BD-theartwall-an-urban-film-map-festival-%CE%BC%CE%B7%CE%B4%CE%AD%CE%BD/

C. The work was also presented at the international festival with judges:

"The Greek Element", "Videoforma" Festival, Kuryokhin Center for Modern Art, St. Petersburg, Russia, 5-6 December 2014. (AV)

Festival website address:

http://www.kuryokhin.net/videoforma_fest

Address of the festival program website:

https://studylib.ru/doc/3899738/programma---komitet-po-kul._ture-spb

and

http://www.festivalmiden.gr/wp-content/uploads/docs/Festival_Miden_Videoforma_2014.pdf

D. The work was presented in the following group exhibition:

(iv) "The Greek Element", Video Project Space [.BOX], Milan, Italy, 12-22 February 2015. (AV)

Website address of the exhibition announcement:

http://www.festivalmiden.gr/festival-miden-presents-greek-videoart-in-milan/

13. Solo Exhibition of Video Art Works, Interactive Video Installations and the Four-Dimensional Hypersphere Hologram (2021) (AV)

In the exhibition held at the Painting Laboratory of the Department of Visual Arts and Art Sciences of the University of Ioannina in February 2021, most of the works described above were presented, as shown in the following video:

https://www.dropbox.com/s/hftuaypbxrsfkts/traperas%20dimitris%20ehxibition.mp4?dl=0

14. Writing a book: "Notes on Modern Science for Artists" (2022) (B)

Traperas, D. (2022), Notes of Modern Science for Artists. Thessaloniki: Rotonda. ISBN: 9786185288624

During the postdoctoral research, and for three spring semesters, I taught the course "*Arts and Natural Sciences: Audiovisual Forms of Expression of Contemporary Scientific Theories*" to students of the Department of Audiovisual Arts. The course introduced students to the Theory of Hyperspaces, along with the fundamental principles of 20th and 21st-century scientific theories in the field of Natural Sciences. It also explored trends in art influenced by scientific discoveries, famous artists inspired by science, and initiatives by organizations, museums, and universities concerning the coexistence of art and science. Students were invited to express themselves artistically and document the scientific basis of their work, citing reputable scientific books and articles.

For the course, and with the aim of further disseminating the Theory of the Fourth Spatial Dimension to young artists, I wrote the book *Notes on Modern Science for Artists* (2022). The book presents the main scientific theories of the 20th and 21st centuries in an accessible manner, without requiring specialized knowledge, hoping to serve as a source of inspiration for artists who, while fascinated by science, are often discouraged by the terminology and "hard" language of mathematics. Neuroscience, Einstein's Theories of Relativity, Chaos Theory, String Theories, and Quantum Theory, combined with contemporary art, are explained in simple terms. The final chapter of the book is dedicated to the Theory of Hyperspaces and presents the results of the doctoral research, describing how information technology in audiovisual media was utilized to achieve these goals, with suggestions for further development.
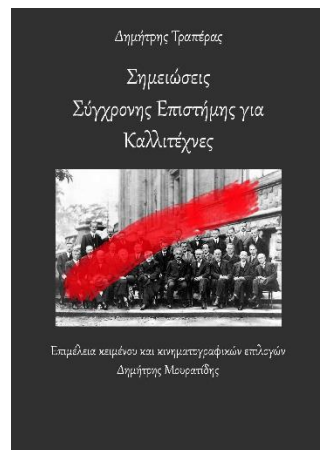

Fig.22: Cover of the book: *Notes on Modern Science for Artists*.