

## Method based on space-time perception in interior design education

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**ABSTRACT:** In this article, the authors discuss a didactic method based on the analysis of space in the architectural interior, according to the ideas of space-time by Kopro and Strzemiński. The Unistic concept of art has been featured in the course, *Colour and Form in Interior Design*, at the studies of Interior and Landscape Design (ILD) in the Faculty of Civil Engineering and Architecture at West Pomeranian University of Technology (WPUT), Szczecin, Poland. The fourth dimension, i.e. time, in the design process, traditionally based on three-dimensional space, introduces the presence of the user in the space designed. The movement of the user, who perceives the composition of an interior, becomes a component of the interior *rhythm*. The theory of space-time helps to develop skills among students and future modern professional interior designers and architects.

### INTRODUCTION

The Unistic concept of art created by Katarzyna Kopro and Władysław Strzemiński in the first half of the 20th Century provides inspiration for an analysis of the design of human space and the surroundings. Ideological objectives of the concept have been filtered by generations of architecture and art theoreticians and practitioners. The intellectual veracity of the concept makes it possible to adapt the idea to science in the 21st Century.

Contemporary aesthetics and architectural technology have their origins in the avant-garde movement of the 20th Century. The transposition of the avant-garde to the composition of architectural forms and digital generation systems can be seen in the latest design trends. Strzemiński's engineering background influenced his perception of the world of forms and colours in the combined realm of art and science.

The perception of space in architectural interiors employing the concept of space-time by Kopro and Strzemiński is at the core of the didactic method adopted for the course, *Colour and Form in Interior Design*, for first degree studies of interior and landscape design (ILD) in the Faculty of Civil Engineering and Architecture at West Pomeranian University of Technology (WPUT), Szczecin, Poland. Issues included in the course aim to raise awareness among young interior designers. The didactic process focuses on the organisation and technical aspects of arranging an architectural interior.

The application of the fourth dimension in the design, i.e. time, introduces the perceiver or user into the designed space. The perception of the composition of an interior over time reflects the *rhythm* of an architectural interior. Architectural interior composition is based on two space factors, i.e. colour and form, both set in time.

### CONCEPT OF SPACE-TIME ACCORDING TO STRZEMIŃSKI

According to Unism, a work of art should be created for its own sake. Strzemiński perceived the world as an equilibrium of matter and each human creation changes that equilibrium by changing the matter. He created a term, *architectonism*, to reflect the ratio of organised to unorganised space over time. In Strzemiński's view, spatial objects should be examined from the *architectonistic* point of view. He related the term to an afterimage or a visual illusion caused by continuous stimulation of the retina. The trace of an image of the same shape, but a contrasting colour has become for Strzemiński a trace that can be used for organising space around a work of art or an architectural creation [1].

The idea of architecturisation of a spatial object is based on involuntary or unintended resemblance to neighbouring forms. This may result from a cautious or intuitive creation or artistic or architectural design. Such a design awareness should lead to the creation of works of enhanced harmony and beauty. Such a design process, apart from the creator and

the creation, also includes a person perceiving the work of art, a person who is involved in the process with their cognitive capacity.

The Unistic vision of architecture has been reflected in functionalism, where there is an objection to static designs filling plots with architectural objects in a stable manner. This has been reflected by an innovative approach to design based on spatial design. The movement produced architecture open to space, in which a human, according to functionalism, is an active party influencing its shape. Architecture has been opened up to external space and linked with other elements of that space (see Figure 1).

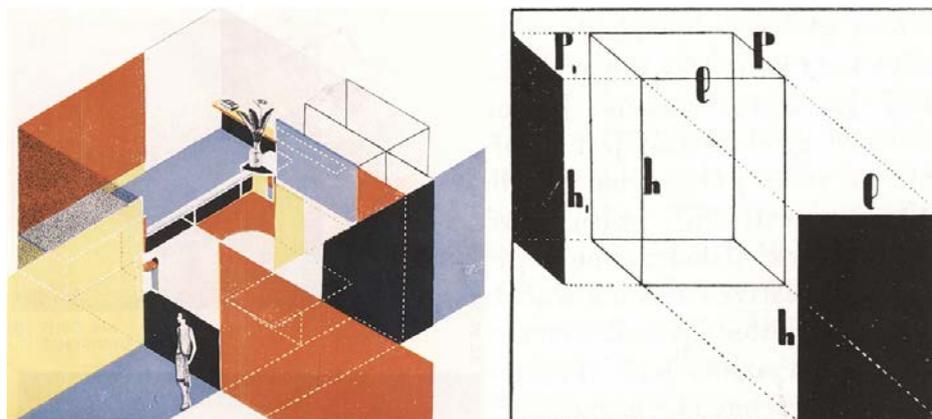


Figure 1: An interior design and the diagram, from the theoretical text by Kopro and Strzemiński [1].

#### SPACE-TIME IN A CONTEMPORARY PARAMETRIC DESIGN

Relations between architecture and space are now represented with advanced technologies. Contemporary design tools related to the parametric, generative and emergent design languages are applied in examining complex relations. Technical aspects of architectural design, based on architecture as a space-time phenomenon, are implemented with modern design tools. Parametric designs involve modelling of space using a set of parameters to generate an advanced geometry. Spatial relations between elements of space can be defined graphically or algorithmically. A form generated by software can be further developed by a designer. The method has been applied successfully by the founders of parametric design, including Zaha Hadid, architectural studios Oosterhuis - Lenard from Rotterdam and UNStudio [2].

The technology-based extension of digital space complemented with the fourth dimension of time enable a real-time representation of that space. Time has been introduced into the design process as an element of the design. The study of geometrical features in n-dimensional space combined with their dynamic transformation or the topology are reflected in contemporary architecture. Scientific achievements of this contemporary section of mathematics have been applied to ultramodern architectural structures. The continuity of space, which blurs boundaries between interior and exterior, are realised in the creations of major architects such as Max Reinhardt, Haus Eisenman, M. van Schaik's Australian Wildlife Heath and Arnhem Central Transfer Hall by UNStudio [3].

The topology in architectural design has theoretical assumptions from Unism and functionalism. Research based on relations between the form and the functional supported by mathematical definitions have some features and properties of a geometrical form that *Unists* intuitively perceived one hundred years before.

Januszkiewicz opines:

*Dynamics of movement is an attractive kind of dynamics, starting with the simplest transformations made by an architect to complex animations. In 2007, animation helped generating a trip into hyperbolic space based on the theory of vertices and complementary spaces as well as new theorems on hyperbolic structures, in which the sum total of triangle angles is always less than 180 degrees. Having the base time organized in an interactive and dynamic manner, the digital space can trigger such spatial operations as evolution, transformation, hybridization and mutation. While extending [animation] properties of a complex time sequence are used, and time can be perceived as non-linear, or time of the fourth dimension of architecture animation. This non-linear system of reading the time is the opposite of the kinematic modulation. It is increasingly often used in the formation and presentation of architecture and in the technology itself. Thus, digital tools change the previous relationship between space and time in architectural design [4].*

#### SPACE-TIME ELEMENTS

##### Space

Space is crucial to all aspects of architectural design, as well as any other design method. Real space and its forms of representation in digital media are of key importance for theoreticians and practitioners of architecture.

According to Januszkiewicz:

*According to contemporary physics, a completely empty space does not exist. Research [has] proven that even without sources of matter there is no empty space-time, since geometrical matter or a gravitation field, exists. Such a space-time deprived of sources of matter can have special properties, e.g. wrinkles, described by gravitational waves. Even the quantum space-time without matter is filled with virtual quantum processes [4].*

### Construction of Space-time Rhythms

The notion of rhythm in the architectural space should be understood as a space-time phenomenon. Perception of an interior involving a movement triggers viewers' perception of interior components as a rhythmical sequence of images. This experience links the perception of shapes with time and movement. A recipient or a participant of space, while staying in motion, experiences a dynamic series of consecutive shapes that remain in dynamic relationships. The space-time rhythm understood as a sequence of consecutive frames sets space and shapes in that space as active phenomena. This contradiction of a static perception of shapes by introducing time as a space-time factor is a key aspect of the space-time theory formulated by leading Unism artists. The combination of rhythm, movement and time in an individual perception highlights a novel concept of perception as a process spread in time. Time has been introduced at the conceptual design level [5][6].

Kobro and Strzemiński believed that:

*Sculpture and architecture should not be perceived as something static, comprising four properly developed sides, but primarily as a process of one side transforming into another, as an act of changing sides, and as a spatial rhythm taking place in time [1]. (See Figure 2.)*

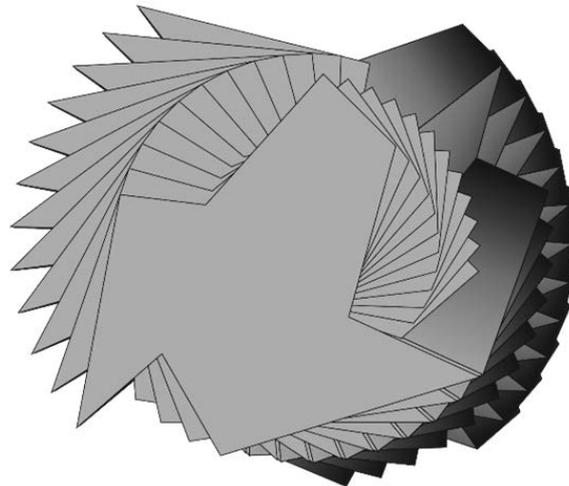


Figure 2: Shape moved out of balance by rotating it around its axis.

*The solution of the issue in suprematism is very bold and methodical: a shape moved out of balance will never restore its balance but remain in motion to use dynamic forces of its movement to merge with space, and absorb space in the direction of its movement to become a uniform and inseparable whole with it [1] (Figure 2).*

### Shape and Colour in the Spatio-temporal Rhythm

Light and colour are visual phenomena that set boundaries to make objects distinct. Boundaries of shapes are determined by light and colour. Colour and shape can be examined separately while taking heed of their relationship. They are combined in perception and *comprise* an image of perceived reality [7]. Shape is an abstract feature of an object, since shape is a concept. On the one hand, shape is abstract, far away from the object itself, and at the same time closer to that object than any other features or properties. Arnheim has introduced two terms describing properties of shape. He distinguished a physical shape defined by edges and a perceptive shape resulting from relationships between a physical object, light and the mental state of an observer [8].

The focus of this article is on the perceived shape comprising an internal network, a kind of mental structure that does not occur in reality. Additionally, there is the hypothetical possibility of perceiving a shape disregarding shape permanence. For the purpose of the study, shapes have been selected that promote such a perception, namely shapes that are not symmetrical and deprived of planar contours. According to the current status of research, as Zygmunt Pizlo describes:

*Physical objects have certain permanent geometrical and physical properties, such as size, shape, and weight. Apart from these permanent properties, objects around us have perceived properties which continuously*

change. If I look at an object, e.g. a chair, and walk around it, the image in my retina changes. It changes with the view angle. And when I change the distance to the object, its size changes in my retina as well. Sensual parameters also change continuously with conditions of our observation. We, however, see objects as the same and this is described as the perception [9].

In the shaping of a block, colour breaks the continuity of the shape, as well as the cohesion of the block. Colour is capable of covering or camouflaging the block due to its primary role in the relationship to other space factors in the perception of a block. The impression that a block is dematerialised, achieved by introducing a colour, makes the viewer perceive the block as *hidden under the coating of the colour*. It is hard to disagree with Arnheim that, during the perception of the colour, the form becomes very active and in a sense overwhelms the observer.

The reverse applies to the perception of the shape and our perception is accompanied by an active control. Then, the role of the colour seems more emotional. Arnheim believed that instead of separate reactions to the colour and shape, the observer should distinguish a receptive attitude to visual stimuli, more perceptive to colour, but also present during the perception of the shape, and the attitude which is more active when one perceives colour [8]. It is more practical to rely on shapes rather than colours.

#### Perception of a Shape in the Context of other Shapes

The boundary of a shape is not the boundary of a surface. In dynamic shapes, the boundary moves together with the dynamic influence of the shape itself - *a limiting boundary*.

The limiting boundary is the combination of protruding points of a shape. When the observer grasps the limiting boundary of a shape in motion, the dynamic boundaries of that shape are seen (Figure 3).

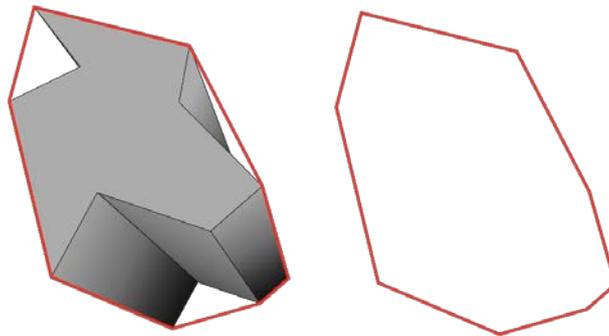


Figure 3: Block and its limiting boundary in a single perspective.

#### Applying Shape to a Part of Space

The notion of an architectural interior understood as an interior of a block that remains in spatial relations with the external space is a theoretical design issue. Determining the boundaries between the interior and exterior is a two-way process. This is actually the main idea of the studies on ILD, WPUT in Szczecin. The teaching method of the course, *Colour and Shape in Interior Design*, in first degree studies is based on theoretical assumptions of Unism. The method originates from basic creative and scientific objectives formulated by Kobro and Strzemiński, which respect the contemporary status of research and currently used design tools.

A key assumption of the method is the notion of space-time rhythm and the development of architectural forms based on the analysis of movement and the perception of space by an observer of the architectural space. The analysis of a series of observer movements, and determined variations of potential sequence of space-time occurrences in the architectural interior, enable the architect to design a composition of rhythms relevant for a given space. The method can be used both while redesigning existing interiors and designing new architectural space.

The analysis assumes that, for certain spatial values, consecutive designs will be developed, which vary in terms of colour and form. The design method requires an organised architectural interior. The design for the interior may even be already completed. However, in the case of an interior that has not yet been arranged, the design process proceeds in parallel to analyses according to the didactic method.

#### DIDACTIC METHOD BASED ON THE ANALYSIS OF SPACE-TIME

The didactic method is based on several theoretical assumptions:

- space is permanent and balanced, and it is not influenced by the movement of shapes;
- space dynamism is understood as a possibility of dynamic linking between elements of interior and exterior, while assuming that the static nature of those elements is illusory, since forces put to the form bind it with space;

- passage between interior and exterior is smooth and dynamic;
- elements comprising the spatial structure remain in a permanent though not static relationship.

The design stages are:

- architectural interior perception analyses based on a virtual walk-through by an observer (participant) in a 3D visualisation (Figure 4):
  - analysis of the interior: a path followed by the observer (participant) and distinguishing several views from a wider perspective;
  - analysis of interior perception: a path followed by the observer (participant) and distinguishing several sections in their perception hierarchy from a wider perspective;
  - analysis of interior perception: a path followed by the observer (participant) and distinguishing several constituent elements from specific sections of the perspective;
- analysis of shapes that organise space, based on consecutive interior perception frames;
- analysis of colours in the architectural interior examined based on consecutive interior perception frames;
- analysis of space-time of a selected part of the architectural interior;
- building virtual models of a selected object in interior decoration based on the analysis of the path taken by the observer (participant);
- introducing changes to the design based on the analysis.

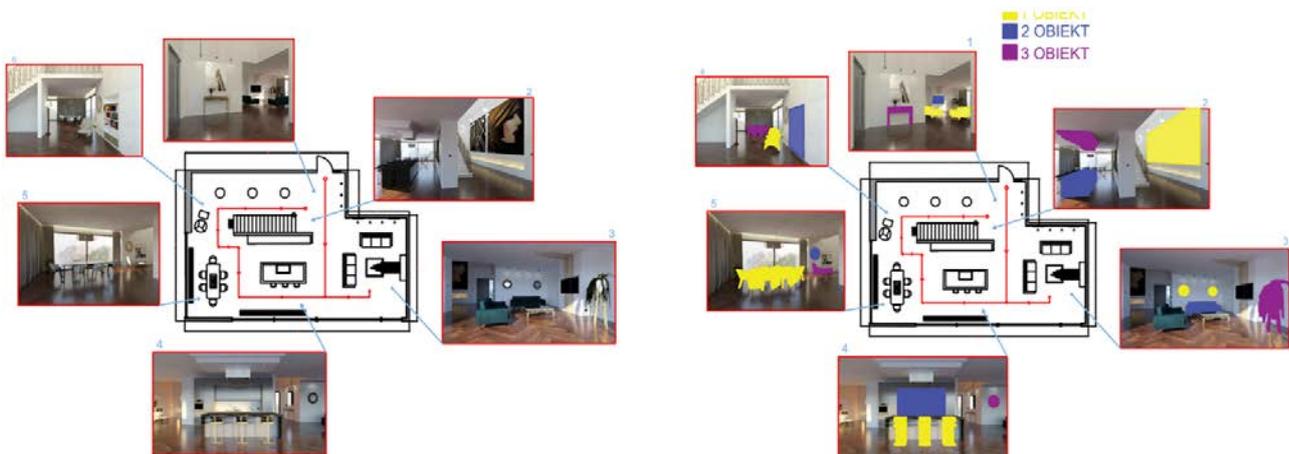


Figure 4: Analysis of interior perception by student Laura Koperska (2019).

Movement and time, included as components of a composition, open the physical and mental space of a student to aesthetic and philosophical stimuli. Space-time rhythm enables the combination of virtually any number of projection planes or single pictures and frames, in a composition set in time and space. Consecutive analyses performed by students, as a part of the method, involve a sequence of steps leading to a harmonious architectural composition. Hence, the composition of architecture, including interiors, is developed in space and time.

## CONCLUSIONS

The didactic method based on the analysis of space perception in time enables students to examine important architectural composition qualities, such as:

- composition balance of interior elements;
- space-time cohesion of the composition;
- prudent distribution of composition accents in an architectural interior.

The method facilitates the organisation of the architectural design. Students, while following the movement of a user and consecutive design scenarios of a building, can achieve aesthetic and usable results for their architectural creation.

Mathematical foundations of the method reflect an attempt to put the design process into a theoretical framework and, at the same time, reject intuitive and sensual design traits. Moreover, the didactic method, applied in the course, *Colour and Shape in Interior Design*, is in line with interdisciplinary and engineering principles of architectural education at the ILD in the WPUT. Pictures presented in the article help students to raise their design awareness,

and consequently enhance their design skills. The theoretical background will contribute to interior designs of highly aesthetic, artistic and spatial values in their future professional practice.

*The quality of education will affect the quality of surroundings and the environment; places where people live and [where] future generations will live [7].*

According to the authors, the method described in the article can also be applied to other design courses in architectural studies. The theory of designing based on space-time analysis is a universal tool that can be used in architectural and interior design, as well as in the creation of art.

## REFERENCES

1. Kobro, K. and Strzeмиński, W., *Kompozycja Przestrzeni. Obliczenia Rytmu Czasoprzestrzennego*. Łódź: Biblioteka (1931) (in Polish).
2. Nawrocka, A., Parametric planning as an innovative design method in urban design. *Środowisko Mieszkaniowe*, **12**, 15-17 (2013).
3. Helenowska-Peschke, M., On topology in designing architecture. *Archiwolta*, **3**, 56-62 (2012).
4. Januszkiewicz, K., On digital space, and more. *Archiwolta*, **2**, 48-55 (2012).
5. Wojtkiewicz, S., *Złoty Podział Przestrzeni - Unizm, a Forma Przestrzenna. Systemy Projektowania Według Katarzyny Kobro*. Białystok: *Architecturae et Artibus* - Oficyna Wydawnicza Politechniki Białostockiej (2017) (in Polish).
6. Bujnowska, T., *Idea Matematyczności Świata jako źródło Artystycznej Inspiracji*. In: Sobolewski S., Solewski R. and Stan, B. (Eds), *Studia de Arte et Educatione*. Kraków: Akademia Sztuk Pięknych im. Jana Matejki w Krakowie, Wydział Malarstwa 5-31 (2005) (in Polish).
7. Domarzewski, A., Architecture students gain experience from open-air workshops in drawing and painting. *World Trans. on Engng. and Technol. Educ.*, **17**, **3**, 373-378 (2019).
8. Arnheim, R., *Sztuka i Percepcja Wzrokowa. Psychologia Twórczego Oka*. Gdańsk: Wydawnictwo Słowo/obraz Terytoria (2004) (in Polish).
9. Pizlo, Z., *Percepcja Wzrokowa Obiektów Trójwymiarowych: Historia - Psychofizyka - Modele Symulacyjne*. Lublin: Katolicki Uniwersytet Lubelski Jana Pawła II & Towarzystwo Naukowe KUL (2010).