Analogous Models and Architecture

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Abstract. *Among the many possible ways of classifying the concept of "modelling", Maldonado refers to "homologies" when structure but not shape and function are similar; "analogies" when structure and function are similar, but not shape; and "isomorphisms" when structure and shape are similar, but function may or may not be similar.*
Traditional artistic representation would basically fall into the category of isomorphisms, whilst analogous models are to be found mainly in activities such as magic, play or industry. Other ways of representing reality, such as architectural models or drawings, are also traditionally regarded as isomorphisms.
In the course of the last century, this panorama has been altered somewhat by the post-industrial or second industrial revolution in computing and communications. Using mathematical algorithms, the computing tool has an enormous capacity to describe things of extremely diverse nature: from the shape of everyday objects to relatively complex human behaviours, these can all be described using the common language of bits.
Alongside developments in computing, the world of communications has been providing us with increasingly advanced means of transmitting information, including sophisticated systems capable of emulating our own perceptions.
This paper is intended as a contribution to the theoretical debate conducted over recent years on the considerable shift that has occurred in architectural representation techniques. The analysis that follows highlights a two-fold change in traditional representation techniques: on the one hand, a change in the nature of the model (as is discussed in this paper); and on the other, a modification of the interfaces or communication and perception mechanisms of the model. The conjunction of these two factors has led to the emergence of representation modes that can no longer be regarded simply as isomorphisms of reality. Insofar as virtual spaces have the capacity for us to move, to interact, in short to inhabit them, they should be regarded as "analogous models" of architectural space. In other words, there has been a shift away from representation modes based on illusion in favour of those based on simulation.

Keywords. *Representation, Models, Virtual Space, Virtual Reality.*

Introduction

Reality simulation has its roots in the most primitive forms of representation, but in recent times has reached an extraordinary degree of complexity, to such an extent that it even replaces reality itself in many instances.

This has been made possible by the degree to which new technologies have broken down the boundaries traditionally dividing illusion and reality into separate concepts and watertight compartments - something artists had been striving to do for centuries.

This paper offers a brief overview of the subject and examines the suggested shift in the concept of representation (from the classical concept of illusion to the modern concept of simulacrum), the characteristics of this shift, and its significance for the field of architectural representation.

Reality and Representation

When studying the concept of representation, some authors differentiate between "isomorphisms", which assume a formal relationship with the referent, and "analogies", where the relationship is functional.

Thus, Maldonado (1992) considers two realities to be homologous when their structure but not shape and function are similar; analogous when their structure and function are similar, but not their shape; and isomorphic when their structure and shape are similar, but their function may or may not be similar.

The mythical double

From Stevenson to Freud, many authors have dealt with the subject of the alter ego through which human beings become aware of their own identity (Gubern, 1988).

Throughout history, humankind has repeatedly sought to represent itself. Imitation is a way of learning about reality, and self-imitation a way of learning about oneself within that reality.

It has been said that God comes to know and be aware of Himself through the Creation. In the search for answers to the eternal questions, in the search, ultimately, for their own identity, human beings replicate this creative act over and over again. Just as God did in Genesis, human beings represent themselves in their own image and likeness.

Human beings reproduce this divine act through two basic modelling techniques: they develop isomorphisms to imitate the form (i.e. the image) of what they represent, and they use analogies to reproduce the functional behaviour of reality (the likeness of Genesis).

Formal Representation

Two-dimensional representation

The history of the illusionist tradition is well known. It is a history punctuated by a series of milestones marking specific achievements in the field of iconicity. Thus, a key moment was the Renaissance, when the linear perspective was developed, a discovery that produced close collaboration between artists and mathematicians. The linear perspective represented an important milestone in achieving the representation of space.

Another moment of particular importance was the discovery of photography. Ever since its invention, photography has presented itself as a paradigm of reality, insofar as it constitutes a reflection of a specific situation. It bears witness to a specific event, providing irrefutable evidence of what was real. (In a similar way, the synthetic image is an imprint of the computer-generated model from which it comes.)

The emergence of photography is one of the determining factors in the new directions taken by painting in the late nineteenth century. Ingres declared in 1862 that the birth of photography meant the death of painting.

Painting did indeed lose its primary function,

and illusionist perfection changed from being an artistic problem to a technical one. As we know today, this led to the impassioned periplus in painting throughout the twentieth century, in which artists sought new paths, turning their attention to the conceptual field or simply abandoning any idea of representing external reality.

A third moment of particular significance when analysing the history of illusionist representation was the discovery of the moving image: cinema.

Cinema represents the transition from the static to the dynamic, the ability to capture movement - something artists had been striving to do throughout history. Once again, the artists themselves were harsh in their self-analysis: "It seems as if everything we call art is becoming paralysed" said Tristan Tzara.

Three-dimensional representation

Alongside two-dimensional representation, of which painting is the most notable example, there have always been representations of reality developing within the same three-dimensional space. These representations include sculpture and modelling. Within the latter category, we find the particular case where the scale of the model and its representation are the same. This has often been used to obtain doubles or simulations of reality, or even new realities cloned from preceding ones.

There are many fine examples of this, from the museistic reproduction of Palaeolithic caves, to the shikinen sengu, the sacred reconstruction of Shinto temples (see Baudrillard for all of these). Examples range from purely formal clones to representations, such as prototypes, which functionally emulate reality to such a degree as to become indistinguishable from it.

There comes a point where this change of scale leads to a conceptual shift. The possibilities offered by a life-size model are not the same as those of a miniature and in many cases we are actually dealing with analogous models in the sense described below. Works that explore the point where this conceptual change happens are very disturbing. Examples of such works include those of Venturi in Western Square in Washington (1977) (a model it is possible to walk around in but which is not life-size) and Franklin Court, Philadelphia (1972) (a life-size wire model).

Analogous Models

As already suggested, analogous representation consists in reproducing the functional qualities of reality.

It is possible to find examples of analogous models in very early stages of human development, since one of the most common strategies for resolving problems is in fact imitation, the reproduction by other means of an external referent, often taken from nature.

Industrial development brought with it many devices that replaced more primitive ways of relating to reality. In a similar way, the computer and communications revolution of the second half of the twentieth century saw the replacement of numerous tasks of an intellectual nature.

Computer software is based on observing human mental processes and reproducing them by means of elaborate algorithms. Consequently, computers would seem to be an ideal instrument in the field of analogy. This notion is implicit in Leibniz' early works aimed at establishing a universal code or language for the description of ideas.

This behaviour modelling has important precedents in two activities that are closely involved in the acquisition of knowledge: play and magic, neither of which is at all alien to computer activity.

The virtual model and architecture

Architecture comes from an initial idea, from a mental design.

However, in order to conceive objects of a certain complexity, as well as to subsequently transmit them, the designer has to resort to the use of models, symbolic representations that simplify

comprehension of the design.

The architectural object is constructed on the basis of a model. It is not so much a replica of the idea as a transposition of the model. The latter thus seems to be an intermediate stage between design and product. It is as much a representation of one as the other.

Apart from the occasional use of scale models, the model most often used in architecture has always been drawing. A linear drawing can be related to a three-dimensional reality by means of the various transformations developed in the representation systems of descriptive geometry.

An application is established between worlds with dimensions which are sometimes different or which use different elements. In the case of drawing, three-dimensional volumes of the real world correspond to lines or surfaces on paper. In this process, certain entities, qualities and relationships are lost, as they have no equivalent in the different system.

The greater the number of elements and relationships that can be represented, the greater the iconic capacity of the representation.

The computer model has the capacity to represent a large number of elements and relationships of the real world, more than any previous system. It can, in fact, have the same number of geometric dimensions as reality. Unlike drawings, the computer-generated model has the capacity to represent the complexity of an architectural work in a single model, creating authentic prototypes of real or imaginary worlds. Moreover, whereas a drawing is an isomorphism or formal model, the computer model is analogous, incorporating temporal or interactive phenomena, as will be seen below (Burcu (1996) makes particular reference to the 4D aspect of the virtual model).

In fact, the computer model is not of a visual nature, but a mathematical one, and it has a microscopic physical medium within the inner workings of the computer. For this reason, intermediate representations are also used to allow comprehension of the model. These intermediate representations are generally drawings. Sometimes these are very conventional, as is the case with drawings on screen; others rely on great skill in the representation of the model, allowing a certain interactive relationship with it, as is the case with virtual reality technologies. Finally, there are some occasions when these intermediate representations simply disappear, as is the case with numeric control machines.

Thus, virtual models allow the representation of the architectural "function", i.e. the execution or simulation of a function. This is in contrast to traditional systems of representation in architecture, which lacked this capacity, as Vidaurre (1979) pointed out in his analysis of semiotics in architectural design. In other words, virtual models are in effect analogous representations - as opposed to the isomorphic models traditionally used in architectural representation or to certain homologous models (specifically diagrams) used to show the functional layout of a building - since they can replicate a building's functional structure, its constituent parts and relationships.

An exception would have to be made, however, for some 1:1 scale prototypes, notably in the field of industrialisation, which also allow functional representation. Although, effectively, these are representations, they cannot really be referred to as "scale models" (which would belong somewhere between the second and third of the categories used by Moles (1972) to classify objects according to their size). In any case, they are too unwieldy to be suitable for everyday use in the architectural studio.

Function is a broad concept in architecture and can be approached from four or five different levels.

Firstly, we may refer to the functional suitability of a given architectural element; such as whether a staircase is comfortable to use, wide, meets particular structural and technical standards, is suitable for evacuation in case of fire, etc. Although

some of these issues are directly related to the execution of the work itself and cannot be predicted using a virtual model, there are others, such as the acoustic capacity of an enclosure or the suitability of a lighting plan, which can be simulated in a virtual environment. It is necessary to establish the modelling capacity of a particular "microworld" in the sense used by Mitchell (1990); the extent to which the elements comprising it are capable of describing, in this case, the real architectural elements. The entities and objects comprising virtual models are, in this sense, extremely potent, since they incorporate alphanumeric information that enables them to replicate many properties of the real objects. However, it should be pointed out that although the entities in cyberspace have great mimetic capacity, their true nature and the laws governing the relationships between elements and spaces tend to be different from the real ones (see, for example, the principles proposed by Benedikt (1991)).

A second level concerns the reproduction of certain functional aspects of particular spaces, with the unquestionable advantage and economic saving this could imply for an architectural project. Such would be the case in the study of the acoustics in an auditorium or the lighting of an exhibition hall. Such studies would be possible on the basis of a three-dimensional model.

A third and fourth level of approach to the concept of function would refer to complex architectural objects formed from various spaces (relating to studies of architectural typologies) and to the study of the city and its infrastructures.

In some of these cases, the model of reality goes beyond mere imitation, offering alternative uses or even replacing the real spaces. The representation (the virtual microworld) acquires substance and is capable of replacing the real space, as is the case with distance learning courses, commercial webpages and virtual libraries.

Finally, mention should also be made of functions of a more generic nature, intrinsic to any architecture or even to any spatial area. This refers, specifically, to the use of architecture as an aid to human communication. This requires at least three aspects of computerised representation that are not found in traditional representation: the interactive nature of this type of representation; the symbolic clones that allow us to "inhabit" the virtual space; and the representation of the space itself.

Interactivity

Interactivity is a very broad term, ranging from artistic to industrial activity.

In the artistic field, it breaks the traditional rules governing the relationship between the artist and spectator. Moles & Rohmer (1972) refer to it as the death of traditional art, the end of work that is closed and an end in itself, as we enter into more complex operations in which the spectator participates. As Gaviria observes, in the introduction to these authors' "Psychology of Space", abandoning traditional art transforms the artist into a creator of circumstances and events and turns the art critic into a phenomenologist of sensitivity. This means that the artist becomes more and more a "programmer of emotions".

The idea of the artist as programmer leads us to the concept of "field of possibilities" and "open work", as discussed by Umberto Eco (1962).

Conventional representation is replaced by a new conception of representation wherein it is no longer a question of recreating the appearance of reality but of creating experiences that recreate real life.

The world of art here takes an important step from mere formal representation to analogous representation.

Analogous models simulate the functioning, the temporal evolution, of a particular event. Time thus seems like the "playground", the space in which both the functional analogy and the interactivity develop.

The analogous model is structured around an "operating program". These are not closed or

conclusive models, rather they predict a range of activities depending on the decisions of the spectator or user.

This planned interactivity is what Manzini (1990) terms a "program of interactivity" with the user. To give a particular physical form to an object is, according to Manzini, to establish a certain program of use (which the users can then follow, interpret or even ignore). The physical form is, as this author points out, an "interactive program" expressed in an analogous way. If anything interactive must have a program, Manzini observes that what we nowadays term interactive is based on a program no longer inscribed in the macroscopic physical form of the object, but recorded by electronic means.

Interactivity is thus closely linked to the existence of a program. In this sense, it should be noted that a computer program, unlike that of a washing machine, is very versatile and even interactive in its own way. It can change according to circumstances and even improve over time, as is the case in artificial intelligence programs.

In any case, we are now at a point where it is more important to establish laws of behaviour than to find precise definitions of a particular space or object.

Interactivity, virtual space and symbolic subjects

One of the numerous meanings of the term interactivity relates to certain types of theatre where the concept of diegetic theatrical space is broken down and the actors and spectators coexist in a shared space and theatrical work. This is an immediate forerunner of another type of space, namely the central theme of this article: virtual space.

Virtual space, the representation of a real or imagined space and perhaps a space in its own right, can be travelled through by the spectator/user. This is what is known as "navigation". To be able to navigate a path that is not pre-set, but determined by decisions taken by the user as he/she goes along, is now a minimum form of interaction with a virtual space.

A second common meaning of the term "interactivity" relates to objects. Thus, for example, a folding chair or an automatic washing machine can be regarded as interactive objects insofar as they contain a particular operating program.

The virtual objects that inhabit virtual space cover a broad spectrum, ranging from those known as "subjects" or "symbolic clones" - in reality objects with a close interactive relationship with other users - to those which have, to a greater or lesser degree, a life of their own in response to external stimuli.

The representation of architectural space

Finally, it should be pointed out that the greatest achievement of computer representation, compared with traditional systems of drawings and scale models, lies in its capacity to represent that truly architectural concept: space. Traditional systems have been unable to reflect the essence of the architectural experience.

As Zevi (1948) observed, drawing is a technique that is totally incapable of representing complex architectural organisms. He comments that cinematography will represent one, two, three possible paths for the observer in space, but space is captured by infinite paths. For Zevi, it is essential to follow the right path in the creation and assimilation of the fourth dimension. We have to go there ourselves, we have to be included and we have to become and feel ourselves to be part of the architectural organism.

The convincing representation of spatial experience in the virtual model rests on two fundamental pillars: the development of increasingly sophisticated "interface" mechanisms involving more and more senses in the perception of the model, and the development of symbolic clones capable of moving and interacting with the model.

Three-dimensional space can never be understood by means of two-dimensional representa-

tions unless it has been experienced previously. The fundamental requirement for understanding space is to have experience of its scope. The ability to move, or shifting viewpoint, is thus the essential skill in spatial awareness; and function-movement is only possible by means of analogous models. Many researchers are currently engaged in comparative studies of this aspect between real and virtual models (Martens & Voigt (2001) offer a summary of some of these studies). Finally, it should be noted that another factor that contributes significantly to the sense of immersion in a virtual space is the vision of oneself in the said space. To observe oneself within the virtual world - the dynamic self-representation - is, as Bricken (1991) points out, "convincing proof that you are there".

In a certain way, this seems to be a repetition of the primigenial experience of the reflection in the lake, whereby man became aware of himself in the world, but in this case, it is awareness of oneself in virtual space.

Representation and reality

In the discussion above, we arrived at the concept of virtual space from the idea of modelling an external reality.

As we have seen, the virtual model constitutes an increasingly sophisticated system of representation, so much so that the question arises as to whether, in this process of improvement, there does not come a time when the very nature of the concept changes.

In effect, virtual models have ceased to be mere representations, since they no longer exist solely as reflections of an external reality or of a mental plan. Virtual models have certain qualities - beyond mere similarity of form – which make them almost indistinguishable from reality. It is possible to explore and interact with them, they serve as a means of human communication and are the most sophisticated extension of our own corporal nature that we have yet created.

The virtual world interacts with the real one, just like the parallel worlds created by Asimov (1972) in "The Gods Themselves", the form of the real world accurately reflecting the vicissitudes of the unpredictable virtual world.

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