The True Model Concept in Computer Generated Simulations Used in Architectural Design

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Abstract

Most of the studies on the effective use of the potential of computer aid in architectural design assert that the way architects design without the computer is not “related“ to the way they design with the computer. In other words, they complain that the architectural design software does not work as the architects think and that the way designers model with computers is not similar to the way they actually construct the model in their brains. Within the above framework, this study initially discusses architectural design as a modeling process and defines computer generated simulations (walkthrough, flythrough, virtual reality) as models. Based on this discussion, the “similarity“ of architectural design and computer aided design is displayed. And then, it is asserted that in order to improve the computer aid to architectural design, it is not the issue of similarity, but of the “trueness“ of the computer generated model that needs to be discussed. Consequently, it is relevant to ask to what extent should the simulation simulate the design model. The study proposes measures as to how true a simulation model should be in order to represent the design model inherent in the designer‘s mind, best.

The Concept of Modeling

Human beings understand, create and communicate the world through models in their brains carrying knowledge [1]. Consequently, design and design communication depend on design models, initially created in the designer's mind. The design model constitutes the essence of any architectural product, i.e., from each and every drawing to ‚the building‘ itself, they are all representations of the design model. Cox describes a model as a mental representation that allows planning for the future [2].

A model is made up by the interconnection of associations and representations which have two time coordinates. The first time coordinate of a model is the actual time coordinate, indicating the time of model formation and will belong to when actually built. The other coordinate is the virtual time coordinate, indicating the potential of the model to be reorganized and revised with respect to feed-backs of the test results after being tested, thus allowing for future planning. The name of the latter coordinate reflects the fact that this coordinate is not actually but virtually, i.e. it is potentially present in every model (see figure 1). This potential is used when the designer reorganizes or changes the design model with respect to the feed-backs gained through the analysis.

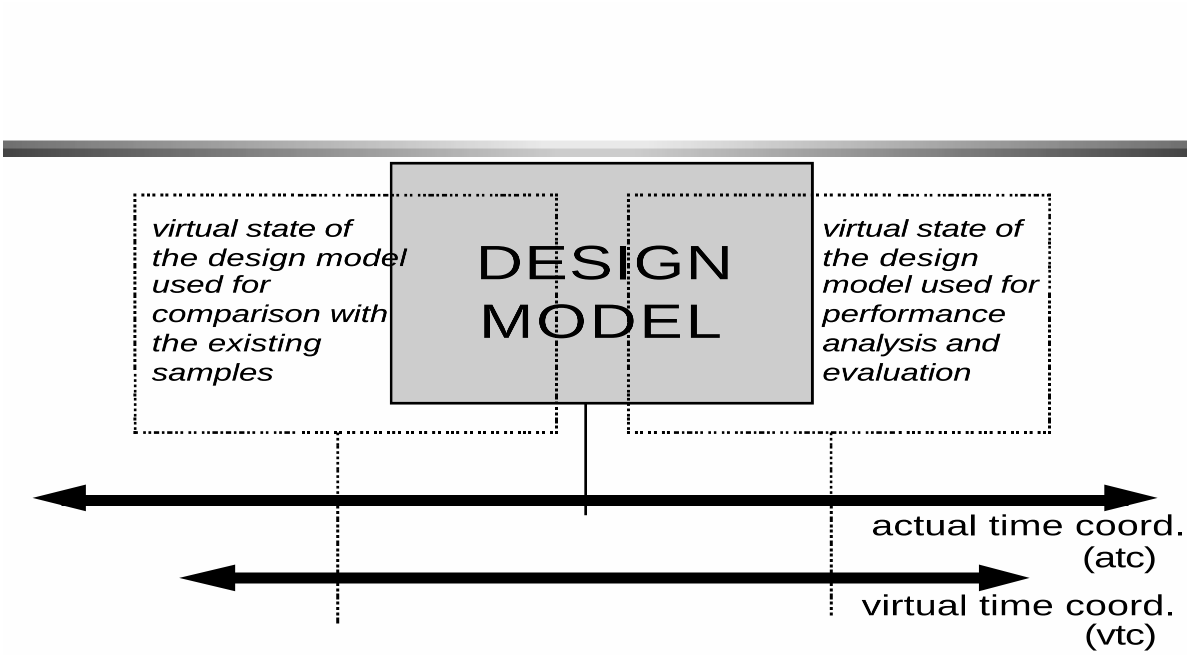

Fig. 1 Actual and virtual time coordinates of the design model.

In the age of virtual reality, the range of analysis on the virtual time coordinate spans from evaluation of different design alternatives or performance analysis of the design alternatives (e.g. thermal, structural, lighting and acoustics analysis). Mahdavi explains the operation of these analysis as "...appropriate modeling, which denotes in this context the substitution of the ‚real' experiments/ operations with carefully prepared and computationally executed ‚virtual' experiments/ operations" [3].

Parallel to the definition of the model, which is capable of being changed and reassociated, the model in the designer's mind is fed back as he thinks, talks, and consults about the design.

Baudrillard [4] suggests that modern simulations act as their own referents. This was already the case with the architectural simulations; plans, sections and elevations were already their own referents. Baudrillard's notion of the simulation of simulation, replication of the replica, untrue portrayed as true is in fact the essence of architectural representation. Naturally, this does not mean that architects are liars and that they copy, but indicates that the design process depends on the representation of the mental model. Creation and communication thus depend upon models. Here, creation is taken as design and communication as representation in architecture.

Digital Versus Traditional Media

Architecture, being a profession with a dominant historical background, is known to make use of paper-based methods for design and its communication. These methods are based on paper and pen as indicated by their name and drawings of any kind can be said to be paper-based techniques. Sketches, detail drawings, plans, elevations, sections, perspectives, diagrams, axonometric drawings depicting the architectural design are all paper-based since they are drawn on a paper. Moreover, description of architectural designs through texts and other written or verbal material are included in the paper-based techniques. Both paper-based techniques and models made out of sticks and stones, either partially or completely depicting information about the architectural design can be classified as traditional or conventional media due to their long span of use.

Traditional media lacks modeling capacity which is inherent in the design model formed in the designer‘s mind. Both paper-based drawings and mock-up models display parts of the architectural design, performance analysis of which cannot be executed upon and design changes cannot be implemented at once. However, one technique, the verbal description, stands within the boundaries of traditional techniques, but break the above definitions to a certain extent. Verbal definitions of architectural design allow changes to be implemented rapidly, being a direct extension of the model in the designer‘s brain, though lacking visual data.

Traditional media of representation (drawing, texts, constructed models i.e., sticks and stones) do not allow the design model to be totally represented, there always occurs a difference, a gap between design and representation. With the emergence of digital media however, the whole design process (from initial diagrammatic sketches to final drawings, simulations, and representations) proved to be carried out digitally, and the model became the design method itself.

The 4th Dimension in/of Architecture and Dynamic Simulations

Architecture is essentially four dimensional issue, although the fourth dimension never shows up in the traditional media of representation. The fourth dimension in architecture covers the following criteria:

i. Life cycle after architectural edifice is completed, including deterioration, maintenance, changes applied (painting of materials), and restoration;

ii. Dynamic perception of the space by people visiting or living in the architectural edifice [5].

Although being a very important part of the criteria determining the success and effects of architectural design, the 4th dimension of architecture has always been neglected due to the available techniques of representation. It is useful for an architect to be able to simulate architecture in motion since as Greenberg points out, the principal concerns of architectural design are the interior space and the external space of the building and/with its setting. We react to none of these spaces from a static position like viewing a painting, but perceive them dynamically. Consequently, Greenberg suggests that: “To obtain a deeper understanding of architectural space it is necessary to move through the space, experiencing new views and discovering the sequence of complex spatial relations“ [6].

Mark [7] defines architecture in motion as the changes of visual image of a building when observed in real time. These changes may be due to the changing of the observation point, related to the dynamic perception of the space (x, y, z, t) and variation of light, variation of use, relocation or transformation of building parts, taking place within the life cycle of the building.

Dynamic Simulations as Models

A computer generated model can be defined as an entity that represents the thoughts, the transformation of the thoughts, their implementation and results altogether. Therefore, a ‚model‘ can be ‚simulated‘ and this can result in a “feed-back” process.

A computer model then, turns out to be ‚dynamic‘ which is subject to continuous change since it is easier than throwing away paper drawings or handmade models as a result of the ‚feed-back‘ process. As Beheshti and Monroy describe: “Models are simulations of the real world. They can be static models, simulating the real world at a given point in time. An architectural plan is an example of this. Models can also be dynamic, simulating the real world seen over a period of time and allowing a study of the consequences of actions. In other words, the dynamic models give us the capability to describe changes, and unlike static models, are not rigid and can offer a great deal of flexibility. Therefore, they offer a possibility to oversee the consequences of different directions or courses of actions“ [8].

Although the fourth dimension of architecture has a crucial role for the success and efficiency of an architectural edifice, it is seldom referred to during architectural design by conventional paper-based methods. In addition, paper-based methods neither allow easy and explicit analysis of the design nor feed-back from these analyses since they operate on fixed actual and virtual time coordinates. So, they can only display static models, unlike mental design models. On the other hand, computer generated simulations offer the chance to display and observe the design in four dimensions, operating on a range of virtual time coordinates (see figure 2), thus allowing dynamic models of design similar or “familiar“ to the mental design models. The issue that remains here is to make the formation of the computer model familiar to the formation of the mental model, which largely depends on the trueness of the constructed model.

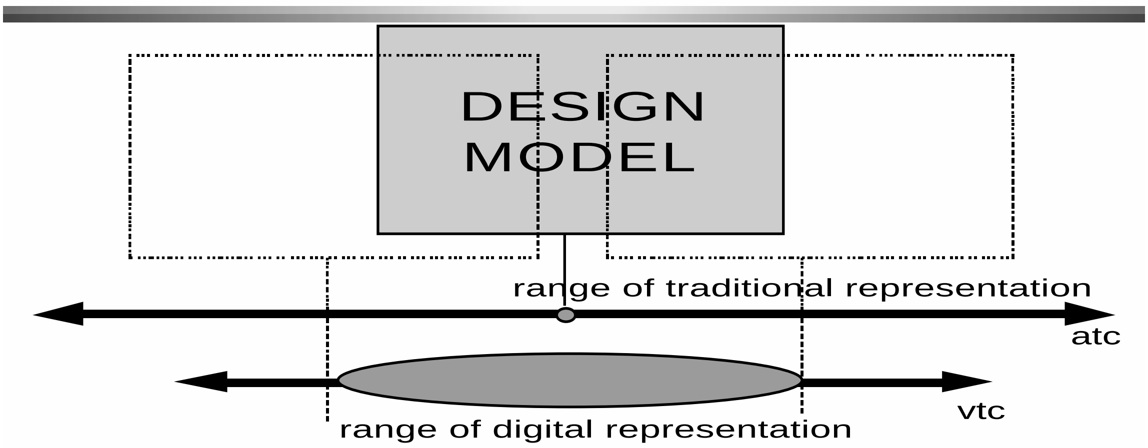

Fig. 2 Ranges of representation of traditional and digital media.

The True Model Concept in Dynamic Simulations

Based on the fact that dynamic simulations operate upon digital models, it is important to note that, however detailed a model or well-made a dynamic simulation can be, it, as of yet, can never replicate, duplicate, or simulate the real visual experience.

There are technical restrictions which prevent any dynamic simulation from giving a perspective as real as direct visual experience. Human eye has a wide perspective which cannot be obtained in a computer screen where walkthrough and flythroughs are displayed. In order to compensate for this, wide-angle lenses are employed which in return distort the view and thus give untrue information about the space. In addition, all walkthrough, flythrough, and virtual reality simulations lack the capacity of the human eye which is to see edges of the frame where the eye is directed to [9]. In the dynamic simulations it is not yet possible to feel the space as if one is inside from the perception point of view. On the other hand, whatever 3D effect is observed, it is observed from a medium which is 2D by definition [9]. Therefore, in order to give a real-looking view, dynamic simulations simulate not what is real, but what is unreal. (In other words, dynamic simulations tell lies in order to depict the truth).

At this point, it is relevant to ask to what extent it is important that the dynamic simulation simulates the reality. The aim of a dynamic simulation should be to show frames similar to the space provided the architectural design was to be constructed, rather than trying to simulate the real visual experience expected to be observed within that space. An approach as in the latter case is to result in a more unreal looking simulation due to the technical restrictions mentioned above. To put it more clearly, it is unlikely to produce a true simulation of a 3D space in 2D media. Moreover, visual experience changes depending upon the characteristics of each person within the space being subjective.

Therefore, the issue of how true a model should be in a dynamic simulation must be related to the aim as Mark puts it "... to a ‚catch a likeness‘ that might serve to put into focus a key aspect of a design proposal, rather than trying to simulate everything a person would experience when visiting a building" [7]. Consequently, it is a better approach not to expect the results of direct perception within a space, but results of the medium. Technical advances, in this sense, should deal with the provision of visual abstractions more suitable to the architects‘ cognition, rather than striving to provide almost the same perceptual experience of being inside the architectural space [10].

This gap is most critical at the educational level of the profession as Hoffman sees it: "Representation within an educational environment is at the service of the idea, not necessarily the thing. The students‘ efforts are directed toward the creation, development and presentation of the graphic tokens. These abstractions remain untested since rarely do the students construct the thing. The distance between the representation of the thing and the thing is inherent in this process. Learning to design within an academic world is, in a large measure, learning to bridge this distance" [11]. It is not only the distance between the thing and its representation but, the distance between the model and the thing since the thing is a representation as well and a much longer one between the model and the representation as well, both awaiting to be covered and it is important to figure out how these distances are to be bridged.

Conclusion

"But now, increasingly, software beats hardware" [12]

In order to supply a bridge between the model and the representation, it is useful to notice that the formation of computer generated simulation software are designed to be tools rather than the assistance method itself. It is true that, the aim of the dynamic simulations is to give an idea about the designed space, but relevant to the formation of the audience and relevant to the purpose of making such a simulation. However, one of the problems with the currently employed dynamic simulations is their being oriented the same towards different kinds of application needs, i.e. they introduce the same services for different purposes of making a simulation, for different kinds of audience.

However, designers, using digital aid, no longer build models of what they design; rather they build the whole procedure through which they reach the final design. Building of the modeling procedure digitally is not only necessary to reach the final design, but to represent the various stages of design as well. Thus, the digital aid in design will improve in direct relation to the degree of flexibility a designer has in the digital medium. The degree of freedom of the designer in determining the digital method and procedure of design when using a simulation software, determines the actual degree of digital aid [5].

In order to obtain this flexibility, it might be suggested to use the three scales of architectural representation (see figure 3) in relation to the (i) purpose of the simulation, (ii) experience level of the user and (iii) target audience.

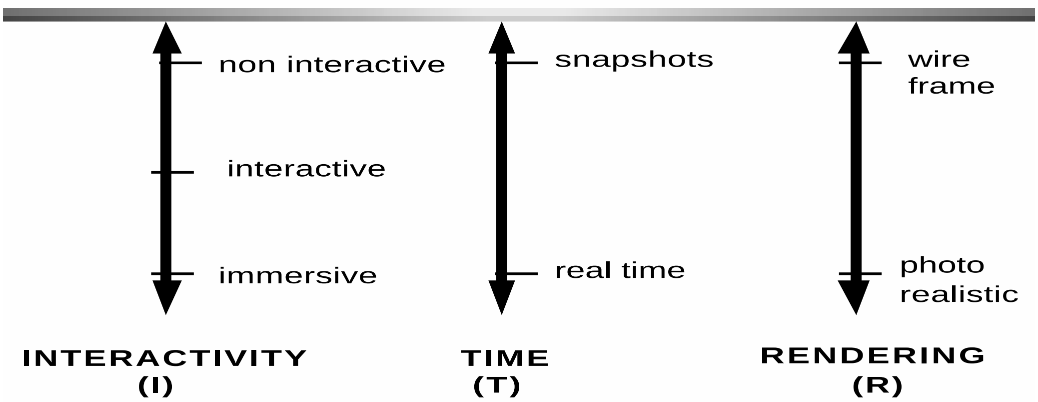

Fig. 3 The three scales of architectural representation.

An initial menu based on this relation matrix used with the simulation software is expected to supply the designers with the chance to customize the computer generated simulations according to their aims and capabilities [5].

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