The IDD System: Interactive Didactic Diagrams for Electronic Education

A Method for Teaching Digital Modeling for the Representation of Architecture

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The Interactive Didactic Diagrams allows for the structuring of useful information in the didactics of Digital Representation of Architecture courses. It is based on the possiblity of analyzing a graphic process- the construction of an architectural element with 3D CAD software, as well as the execution of a particular geometric projection- while making use of interpolated frames. The interactive diagram permits a sequential control of necessary operations until a structure of a spacial-temporal sense is obtained. This is done in such a way as to permit the user to gradually make his/her way through the sequence of steps with the possibility of reviewing them until the process is fully understood.

Keywords*: Interactive Diagram; Teaching Method; Geometric Modeling; Representation Theory; Architectural Space.*

Introduction

Well known is the legend that narrates the wager made by Lelan Stanford at the end of the 19th century, relating to the position of a horse's legs while running. To prove this theory, Eadweard Muybridge, who in that period was experimenting with a cronophotographic system made up of a series of synchronized cameras, was asked to register the running sequence in a series of images in such a way as to best analyse the situation. It is also well known that this technique is at the basis of cinematography.

Marshall McLuhan (1964) refers to this anecdote when dealing with the subject of the relationship between photography and cinema, with reference to the fragmentation of time and of space, and also cites Bergson's (1907) studies on the association between mental processes and cinematographic form. Let's take this suggestive point as a reference to speak of the method proposed here – which we have called the IDD System – whose roots are in fact in that fine line between image and movement, that fine line that has also been studied in-depth by Gilles Deleuze (1983, 1985).

It can be said that the system proposed here is directly derived from one of the mechanisms identified by Muybridge. Not so much in that which is relative to the series of photographs of race horses, as by the system used for the sequence dedicated to the human figure (Muybridge 1887). In these successions, the photographic cameras that shoot the scene are not only positioned from a frontal perspective of the figure, but are also positioned-always in an ordered and progressive series – at

other points of the scene (at 90 and at 60 degrees). This is done in such a way as to instantaneously obtain a temporal movement and a perception of the entire space of the representation. As a result there would be more film sequences of one same scene as viewed from several perspectives, in a description of a spacial-temporal type.

These images must be considered diagrams, since they describe a phenomenon by analyzing the effects and by abstracting their content from the context. It is not by chance that the author uses a numbered grid as a background for the figure which transforms the action into a cartesian layout.

The use of the Diagram in architecture

The diagram as a tool is widely used in the field of architecture today. Peter Eisenman used this diagram technique as far back his first projects; by showing the evolution of the analytical method that led to the elaboration of the project, he highlighted the process of the planning stage through the representation of the operations on form- rotation, translation, subtraction etc. His method, also used in didactics, seems very useful for the acquisition of methodologies of composition, regardless of the type of architecture realized. Even Ben van Berkel (1998) uses the diagram as a visual tool to instantly transmit complex information to cerebral memory. That is to say that the diagram's principle function is to compress informative data in such a way as to render the content explicit. Even other architects, for example Greg Lynn, use the diagram technique in the elaboration of the idea planning stage, even though, in the case of the young architect, some connotations are related above all to sequential dynamism and to morfological deformation.

The IDD System

The IDD System unites all of the aspects described thus far with regards to interactive education dealing with subjects of an architectural nature, conducted thanks to the use of digital instruments.

Interactive Didactic Diagrams allow for the transformation of the continuous progression in a discrete series, controllable in all singular successions. That is to say that it is possible to control each singular process and to repeat the sequence more than once. Such a function, which we will call basic, can be accentuated by an ulterior function that permits a spacial analysis of the model that is other than temporal, which we will call advanced. In fact, the advanced function allows for the observation of the generative process from another point of view, examining it beyond the subjective vision, and from an objective view-point. One therefore has the possibility of a horizontal and a vertical use of the process that must be analyzed, which allows prefiguration of the state of advancement of the operation in time (sequence), but also in space (virtual model).

Indeed, the transformation of a film sequence in a discrete temporal succession of singular photograms already allows for a better understanding of that which is described in one film. Therefore, the change from the linear paradigme to an interactive one, fragmented and temporal, can be a valid investigative tool. But it is not possible to have a temporal and spacial change in one same film sequence at the same time, as Muybridge would have perhaps wanted in shooting the images that we have referred to here. Indeed a film follows a linear pattern, therefore it is a question of selecting the scene that must be shown from the different shots that have already been taken, all in one same moment.

It is possible to obtain a temporal sequence within a dynamic space by structuring information in a suitable way through digital interaction. The most evident application can be that which is relative to the teaching of 3D modeling in a CAD environment.

In the construction of a 3D model, it is indeed very important to consider the sequential aspect of the operations that permit the realization of volume. However, in the design stage, it is also just as important to be able to control the object from several perspectives so as to verify the accuracy of the gener-

ative process. It is not by chance that for some time now new verification tools, which immediately show a scene with an interactive movement around itself, have been included in CAD software. In actual fact it deals with a direct application of the rigorous method of double orthogonal projection that Monge had already coded at the end of the 18th century.

An application

The example that will be referred to here deals with the generative procedure of a helicoidal stairway of elliptical directrix taken from Andrea Palladio's Quattro Libri di Architettura, which is used in the course led by myself at the Istituto Universitario di Architettura di Venezia. The complex make-up of volume has been fragmented into a series of photograms which are then recomposed in various ways within the Interactive Diagrams' mechanism.

It has been decided to use an orthogonal isometric axonometry which constitutes the foundation of the first series of photograms (Basic Frames) as the principle projection of the first sequence. In this series – which shall be identified with alphanumeric values A_00, A_01, A_02, etc. – the constructed elements of the 3D model will alternate with the lines of construction, in such a way as to explicitly define the constructive mechanism. The geometric matrixes that were most likely created by Palladio for the determination of generative geometries will thus be highlighted, and methodologies that allow for the construction of a 3D CAD model will be given.

A second series of frames consider the same operation bound to the first mongean projection, with an orthogonal projection that is parallel to the plan. The layouts are therefore highlighted with the same colours and symbols that were used in the foundation sequence. One can thus associate the following progression, B_00, B_01, B_02, etc., to each frame. After this first projection will follow the second mongean projection, with the projection on the quadrant parallel to the elevation of the work that we intend to analyse. The relative sequence will therefore be C_00, C_01, C_02, etc.

Positioning the sequence in three horizontal lines in the following order (from the top) C – A – B using interactive visualization software, one will obtain the integration between the linearity of the temporal sequence and a first spacial perception, even if it will be limited to the abstraction of the mongean projection method.

From this first hypothesis it is possible to proceed all the while trying to integrate useful information for training in digital modeling. That is to say that it is possible to insert other parallel or perspective projections, or ulterior geometric constructions. Therefore the sequence can have a discontinuous course since in some cases it can be superfluous to present the entire development of the sequence. It can represent abstract concepts, practical applications, but also textual descriptions, or even operative commands of specific software. A complex IDD model relating to Palladio's stairway is shown in Figure 1.

Great freedom is therefore left to the educator who is required to structure information according to the desired results that he/she wants to obtain during the didactic experience.

Conclusion

Thanks to the integrated use of a spacial/temporal combination, beginning with the method described here with relation to CAD applications, the method proposed in this text can be used as the foundation on which to organize substantial information that relates to architecture. It can also be utilized for complex geometric constructions that call for a precise sequence of operations on the part of the operator, as for example those relative to geometric projections or restitutions. The description of each single frame, recomposed in the IDD System can permit each user to see architecture in formation in time and space.

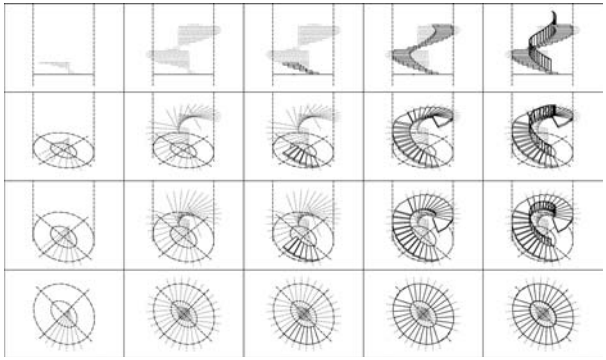

Figure 1. Didactic Diagram of Palladio's Stairway.

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References

Albarn, K. And Smith, J.: 1979, Diagram: The Instrument of Thought, Thames and Hudson, London.

Bergson, H.: 1907, L'évolution créatrice, Alcan, Paris.

Deleuze, G.: 1983, Cinéma 1. L'image-mouvement, Les Editions de Minuit, Paris.

Deleuze, G.: 1985, Cinéma 2. L'image-temps, Les Editions de Minuit, Paris.

Ervin, S. M.: 1990 Designing with Diagrams: A Role for Computing in Design Education and Exploration, in McCullough, M., Mitchell, W. J. and Purcell P. (eds), The Electronic Design Studio., The MIT Press, Cambridge, Mass., pp. 107-122.

Flemming, U.: 1990, Syntactic Structures in Architecture: Teaching Composition with Computer Assistance, in McCullough, M., Mitchell, W. J. and Purcell P. (eds), The Electronic Design Studio., The MIT Press, Cambridge, Mass., pp. 31-48.

McLuhan, M.: 1964, Understanding Media, McGraw-Hill, New York.

Minsky, M. 1975, A Framework for Representing Knowledge, in Winston, P. H. (ed.), The Psychology of Computer Vision, McGraw-Hill, New York, pp. 211-277;

Mitchell, W. J.: 1990, The Logic of Architecture. Design, Computation, and Cognition, The MIT Press, Cambridge, Mass.

Muybridge, E.: 1887, The Human Figure in Motion, Chapman & Hall, London.

Palladio, A.: 1570, I Quattro Libri di Architettura, Dominico de' Franceschi, Venetia.

Schmitt, G.: 1996, Architektur mit dem Computer, Vieweg, Wiesbaden.

Sdegno, A.: 1994, Un Archivio Interattivo di Progettazione Architettonica nel sistema ASA, CNR Report, Ancona.

Sdegno, A.: Geometry and Projection: Notes on Digital Design, Quaderni LAR, 2, pp. 27-35.

Sdegno, A.: 2001, L'architettura nell'epoca del computer, Casabella, 691, pp. 58-67.

Somol, R. E.: 1999, Dummy Text, or the Diagrammatic Basis of Contemporary Architecture, in Eisenman P., Diagram Diaries, Universe, New York, pp. 6-25.

Van Berkel, B. and Bos, C.: 1998, Diagrams – Interactive Instruments in Operation, Any, 23, pp. 19-23.

Witkin, A., Kass, M., Terzopoulos, D. and Barr A.,: 1990, Linking perception and graphics: modeling with dynamic constraints, *in* Barlow, H., Blackemore, C. and Weston-Smith, M. (eds), *Images and understanding*, Cambridge University Press, Cambridge, pp. 213-226.