

# The Internet, grids and brain waves

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**Abstract—** The project described in this article is the result of an experimentation conducted as final thesis in the Faculty of Architecture of Rome, University of Rome “La Sapienza” under the supervision of Professors Benedetto Todaro and Stefano Catucci.

The article highlights the achieving potentiality and the contribution offered by using a combination of metaphors, brain waves and parametric software in the architectural design. In particular the described project wants to point out two theories, showing how they can be used as metaphor and transformed in architectural elements through the use of a generative parametric software. These two theories are combined and translated in design rules for the project through the use of Grasshopper, a generative parametric software. Three main aspects emerges from this experiment. First, the importance of using metaphors as evocative and operative tools in the architectural design. Second, brain waves which describe us as human and express our perception of places can play the role of kick start to define an entire project. Third, the project highlights how the above described features can be concretely transformed in architectural elements thanks to the use of generative software which allows architects to reach accurate and precise results not only during the design phase of architectural projects, but also to plan any conceptual stage.

All these aspects are combined flowing one into each other in order to open to new possibilities in architecture.

**Keywords-** brain waves; the Internet; metaphors; grids; membrane

## I. INTRODUCTION

Derrick de Kerkhove in his book *the Architecture of intelligence*[1], explains a theory which puts in relation the introduction of vocals in the ancient Greek alphabet and the consequent discovery of proportions and symmetry in their architecture. The improvement in their communication system had influenced not only their perception of space but also their way to conceive it. Indeed, due to vocals, any word acquired a single, unique meaning. Words, put together formed a phrase, from left to right, up to down, according to

a grid. This new, linear, unequivocal way to communicate influenced their architecture, their way to use new proportions and symmetry. The grid became a tool used to measure and organise the space, it was rational and democratic. Indeed, for instance, the grid was used by Hippodamus of Miletus to design his cities in Greece. As described by Aristotle in *Politic*, Hippodamus “invented the art of planning cities, and who also laid out the Piraeus”[2]. This theory explained by Derrick de Kerkhove is not only important because it focuses the attention on how a communication system or writing as a direct influence on architecture, but even more because it opens and calls into question one important aspect which the project described in this article has tried to seek. In light of the fact that an improvement in a communication system influenced the perception of places and consequently also the way to build architecture, what would happen to contemporary architecture if we tried to move from the linear writing communication system to a hyper-textual system which is also our contemporary communication system alias the Internet?

The Internet then implies a second important feature. Indeed, according to Marshal McLuhan there is a parallel between the human brain and the Internet. They function in the same way, both are “pulses’ converter being constituted by electricity”[3]. This parallel is not only important in terms of how these two systems work but also because the human brain is directly involved in our perceptions of what surrounds us. It expresses our perceptions, our feelings of places in form of brain waves. The use of brain waves, according to the 2012 article *Engaging the brain: Implications of mobile EEG for spatial representation* [4] by Prof. Richard Coyne, Mavros Panagiotis, Jennifer Roe and Peter Aspinall, Edinburgh College of Art, University of Edinburgh, becomes really important, especially if we move it in an architectural framework.

The above mentioned article shows an interesting experiment that took place in Edinburgh in 2012. In the specific it consisted in a survey conducted on a pedestrian group and their perception of the city. A sort of contemporary version of Kevin Lynch's survey[5] or the Situationists' Psychogeography[6]. People were asked to walk through Edinburgh wearing an Emotive EPOC, a

helmet for electroencephalography (EEG) reading, in order to map their brain activity, expressed in brain waves. Meanwhile they were asked to note and to describe their experience during the route. The experiment showed how our perception of places changes according to the surrounding environment and how these changes can be measured. The importance of this survey stands in these words directly taken from the article: “The use of mobile EEG opens the possibility of exploring these questions, providing alternative models for mapping cities and environments, new approaches to interaction design, and new ways of understanding social activity and human behaviour in context.”<sup>i</sup>

In this way, the final thesis’ project, described in this article, doesn’t only seek a possible new way of interpreting our contemporary communication system, the Internet and its implication in the architectural design but, it is also a contribution to important studies about brain waves. It shows how these waves can be used as metaphor and translated in formal elements for the architectural design.

## II. THE PROJECT

The thesis’ project consisted in a Fun Place. The aim was to design something which was able to host “multiplicities”<sup>ii</sup> [7], in form of different functions and activities for the whole society.

Due to this social aspect, the major issue during the design phase was to conceive a spatiality which, on the one hand avoided any possible perception of hierarchy between the different elements which compose the project while on the other one, the spatiality had to be perceived as a unique space. A sort of Deleuzian description of event [8] where a pure Many flows into One. To sort these two issues out, a hyper-textual spatiality was experimented. It involved and implied several aspects to maintain under control. It required the use of a ‘rational and controlled but irregular grid disposition’. This is to say that, a normal abstract grid, (i.e. referred to the ancient Greek communication system’s improvement [1]) would have produced a feeling of hierarchy and sense of repetition in users. In order to evoke and realise a new perception of space in them, the project needed to go beyond a regular grid, or better, it needed to evolve this disposition arisen from an ancient and past improvement in the writing system. Indeed, in this project a new way of “writing” was experimented, according to our contemporary communication system, the Internet which is hyper-textual. Writing and Hyper-text have intrinsic in themselves an evocative and architectural meaning, furthermore these two words are linked one each other. From the dictionary writing means “system of human intercommunication by means of conventional visible marks”[9], while Ted Nelson in 1965 defined the word hyper

as “extended, generalized and multidimensional”[10]. These two definitions implied a reconsideration of the use of abstract grids following a new hyper-textual way to write.

In order to translate this hyper-textual idea of writing, three main metaphors were used in the project. It is useful, before proceeding with the description of the experiment, to describe the main metaphorical passages.

The approach to the theme consisted in using a design methodology based on the application of metaphors. They are meant to be evocative tools not only in order to enrich the projects with meanings but also to become concrete examples. They are thought as tools from which is possible to obtain designing rules to be moved into the project.

The three used metaphors were the following:

### A. Metaphoric:

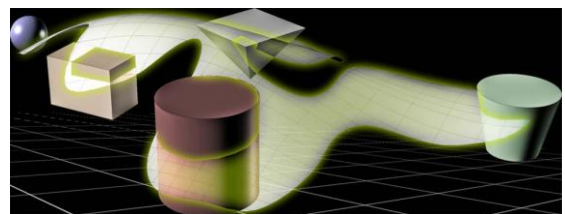


Figure 1. Conceptual Interpretation of Hymnen by K. Stockhausen

In 1966-67 Karlheinz Stockhausen composed a song named *Hymnen* (fig.1)<sup>iii</sup> in which he used different elements such as national anthems, words, distorted sounds. He mixed, merged, conflated and inter-modulated all these ingredients. As result, he played a melody where each component didn't stand as a single one but rather as a musical instrument, resulting in a perception of an unique sound [11].

### B. Strategic:

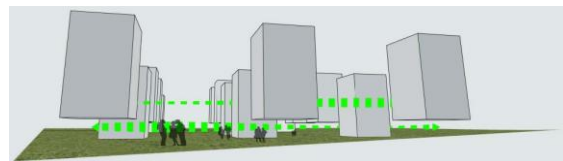


Figure 2. Conceptual interpretation of an abstract grid

The use of an abstract grid to mitigate the hierarchy between elements (fig. 2). For instance, in order to pursue this purpose, Bernard Tschumi, in his project for the *Parc de la Villette* [12], displaced the *folies*, the elements which constitute the project and host the different functions in this park, on an abstract grid. Furthermore, as said in the introduction it plays a key role, being arisen from an interesting theory by Derrick de Kerkhove [1], which describes a connection between the introduction of vocals in

<sup>i</sup> Mavros Panagiotis, Richard Coyne, Jennifer Roe, and Peter Aspinall, op.cit. page 8

<sup>ii</sup> Deleuze Gilles and Guattari Felix, op.cit. see the rhizome chapter, pp. 1-25

<sup>iii</sup> In the composer's catalog of works, it is "Nr. 22"



This last statement describes the fundamental role that the Theta wave has played in the project. In fact it means that the relationships between user/project, project/metaphor and user/metaphor are connected through and thanks the use of this wave.

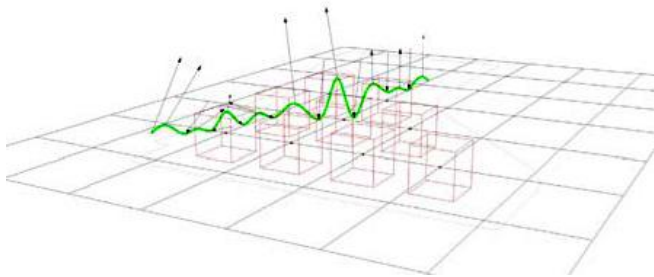


Figure 6. The pulse transformed in attractor

According to what above said, the wave being constituted by points is treated and transformed in an attractor (Fig.6) thanks to Grasshopper [15], a generative parametric software. In fact every point on the curve occupies a position in the space described by a vector with its own magnitude derived from the value of the wave's frequency. The transformation of the wave in an attractor has produced two important effects.

3) *One pulse, two effects:*

Two effects are resulting from the conversion of the wave in an attractor:

a) *scaling effect:*

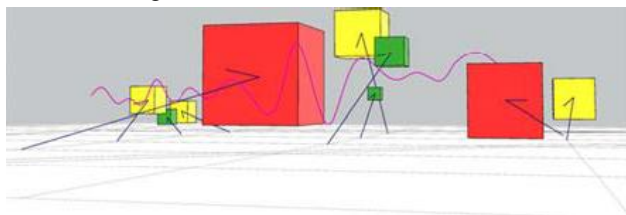


Figure 7. The scaling effect

Cores, initially disposed on the abstract grid, get scaled in three size, Small, Medium and Large (Fig.7). This scaling effect is linked to a parallel investigation about the attractiveness of entertainment fields or macro-functions<sup>viii</sup> in relation to a group of social spheres (under 12, under 20, over 20, over 60, conservative, explorers, single, couples, families)<sup>ix</sup>. This survey has been useful in order to define the final disposition of every function on the site. In particular,

<sup>viii</sup> Macro-functions are: generic sport, extreme sport, culture, nature, commerce, game, accommodation, media, music.

<sup>ix</sup> These categories are normally used in marketing surveys

functions with a major appeal are placed in Large cores while functions with minor appeal in the Smallest ones.

b) *moving effect:*

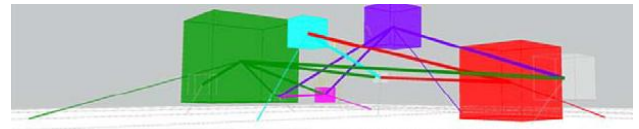


Figure 8. The moving effect

Cores are moved from the ground of the initial grid (Fig.8). This movement is described by a vector (see Fig.7). Using the magnitude of each movement vector, it has been possible to define how many and between which cores there were connections. In particular, according to the magnitude of each vector, Grasshopper identified five different groups of links (if a connection is established between two or more cores, then the Internet takes place as a membrane between them).

4) *Phase 3: Genesis of the membrane*

This final movement effect has not only defined 5 groups of connections between cores but has also produced a deformation of the initial grid. These two effects, deformation and connection are put in relation one to each other. In fact, treating each connection as an Internet dataflow, and according to the fact that the Internet can be metaphorically described as a membrane between two or more nodes connected one each other, we have obtained five deformed grids which have been used to generate five different membranes (Fig. 9).

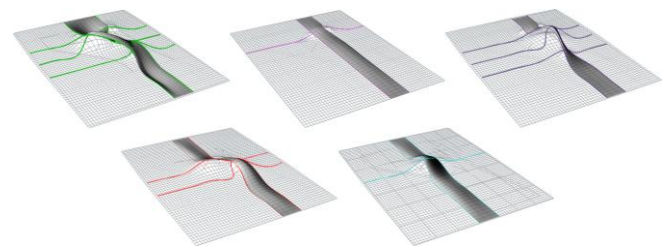


Figure 9. The five generated membranes

The five membranes are subsequently overlapped (Fig.10) and merged into one, unique membrane (Fig.11). In order to merge these surfaces, a process of inter-modulation has been used. This process can be explained as "the amplitude modulation of signals containing two or more different frequencies in a system with nonlinearities... which creates spurious emission [16]". In substance, after the five membranes are overlapped, their describing curves are extracted and merged individuating the average points between them.

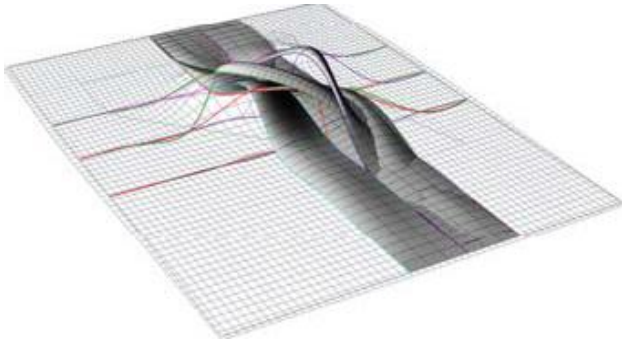


Figure 10. Surfaces overlapped

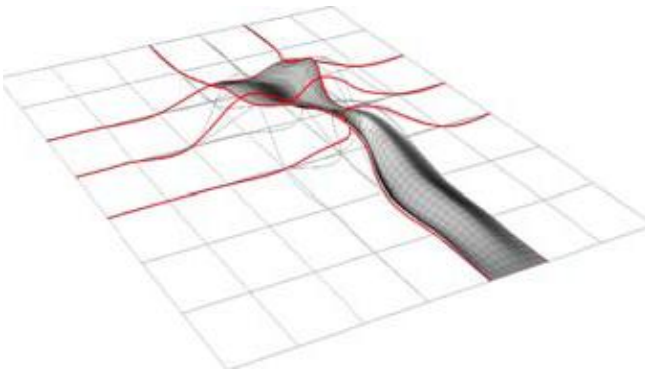


Figure 11. Membrane resulted after the inter-modulation process

#### IV. CONCLUSION

What is described in this article is the initial part of my final thesis' project that, I have to admit, is a work still in progress. As I have written in the introduction, this was an experimentation, a possible way to show how to combine generative software and metaphors in order to verify two important theories [1,3]. Furthermore, it wanted to be an occasion to experiment in an effective way human brain waves trying to transform a simple pulse in an entire project.

Three main aspects have emerged here. First, it possible to achieve and to experiment new languages in architecture arisen from a different way to write architecture. This implies a new hyper-textual way to conceive architectural spatiality which can set us free to realise a condition well explained by Bernard Tschumi in *Architecture and Disjunction*: “surely you agree, Mr. Architect, that buildings should have a base, a middle and a top? Yes, but not necessarily in that order”<sup>x</sup>[12]. Second, the use of metaphors in the architectural design, are not only meant as an enrichment in terms of meanings but rather as a “machinic” feature. Felix Guattari in 1995 explained this word as “a machine that develops universes of references...The complexity of the machinic object realises itself and becomes

<sup>x</sup> Tschumi Bernard, op.cit. page 13

embodied in the different machinic systems referred to earlier”[17]. In other words, what the philosopher was stating here is an intrinsic capacity to be developable. An architectural project, according to this definition, acquires a capacity to be transformable, flexible and this feature is not only related to the conceptual phase but also once the project is realised. Third and last point, the importance of having combined metaphors, human brain waves and parametric software, not only can offer new contributions to the architectural design but can also configure a real conflation of two systems, man and machine. This to say that, when we use our perceptions, our feelings arisen from what is surrounding us in terms of physical and measurable data, treating them with computer software in order to define an architectural project, in doing so, we are not only transforming metaphors in concrete elements but, even more, we are affecting a hybridization between man and architecture. We are merging two systems. We are using a piece of our humanity, instilling it in a machine, a software, in order to give back a result which will constitute the entire project. It is like we are combining our DNA with an artificial one in order to obtain a crossbreeding.

This last feature, maybe, is the most important contribution that this article wants to leave still unaccomplished, a work in progress which is waiting to be developed.

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