A MODEL TO SPACE

ABSTRACT
Architects are used to work with models since the early beginnings of Renaissance. These models were designed to conceive spatial objects before they become realized. Nowadays space seems to be outdated: there are information topologies, virtuality, and globalization. Our models are logistical rather than spatial and they become increasingly complicated. They put an emphasis on energy- or cost-efficiency rather than the vividness of a localized place. But as architects we are supposed to be 'masters of creating places', and it can be shown that architectural conceptions through the course of history had been oscillating from dealing with objects in space to reasoning about spaces themselves. The hypothesis now is that at any time one of these issues was in immediacy, while the other was mediated by models, a notion to be closer looked at in the following text. For now the question remains, how models of architecture can go beyond dealing with technical parameters of objects in space and their mutual interactions. In this sense it might be necessary to reconsider our mastership upon the articulation of space.

One way to achieve this might be that computation could do more than just deliver increasingly intriguing geometries, instead it might offer us a look at spaces conceivable but not yet imaginable: computed as information topologies and then rendered back into the geometrical framework of physical space.

New media have entered our perception to a degree never imagined by future sciences of the past. So the question arises if space-time can still be considered as a single layer in actuality. As individualization takes command, being special becomes normality. In a quantized society, where many cultures coexist at the same places simultaneously, a new model to space must deal with the superposition of territories.
In the Renaissance, Alberti and others witnessed the shift from medieval space to the ‘relative space’ of mercantilism, and so they liberated Architecture from a mystical context. One result of this liberation was a broad utilization of the architectural scale-model to coordinate all issues on a geometrical basis, before doing anything irreversible. This means, instead of working with ruler and compass in the immediacy of the one-to-one template as it was common for medieval craftsmanship, Alberti established the proportionate ‘Lineamenta’, allowing for parametric operations. For the model, detached from the immediacy of the real object, Alberti stated (Alberti 1755, p. 1):

> And there you may easily and freely add, retrench, alter, renew, and in short change every Thing from one End to t’ other, till all and every one of the Parts are just as you would have them, and without Fault.

The advantage of the Lineamenta was that the relative proportions remain stable, while the absolute measure may be scaled up and down. Within these proportions Alberti was seeking to achieve beauty, which now had become a human right and not anymore a divine privilege (Alberti 1755, p. 357):

> If Beauty therefore is necessary in any Thing, it is so particularly in Building, which can never be without it, without giving Offence both to the Skillful and the Ignorant.

On the level of space, he was clearing out the field and discretizing the continuous mystical space by relating positions of objects in space towards each other. These positions could now be represented in tables, which was crucial at this time as a list of characters was unmistakable and not subjected to the failures or interpretations of the copyists (Carpo and Furlan 2007) (Note 1). His way of relating objects on equal ground towards each other, cleared out the field from unnecessary content and delivered his famous ‘Map of Rome’ that provided the ground on which the new Rome of the Renaissance could be built (Figure 1).

Renaissance led to Enlightenment, which brought about a major inversion of concepts; in 1637 Rene Descartes published “La Geometrie”, and figures in space became calculable. In 1687 Newton defined the laws of Physics and space became absolute (Newton 1846, p. 77). And finally in 1755 Kant added a history to the hitherto perennial Cosmos (Kant 1755, p. 113). By being able to calculate space, it became the model itself, and by viewing space from the outside through the perspective of mathematical models, it was stabilized in an absolute manner. The baroque void was the architectural equivalent of the Newtonian container space, while built environment was now conceived in immediacy as built society. Revolutionary Architect Ledoux, for example, was convinced that society could be engineered through Architecture to produce better humans.
And although still anchored in the old regime he preceded social emancipation and was concerned about enabling and comforting people (Ledoux 1981, p. 110):

> You will be an educated man or a barbarian just like raw or polished stone, according to the way the ground surrounding you will do its working. […] In these beautiful chambers everything becomes joy, here love comes to rest and will stay, here man is still full of innocence.

Ledoux and Alberti, they were both masters of their times. And what they had in common was their conviction for their contemporary traditional ways of building as being inappropriate for a newly emerging age. And this may be a question even today, if the digital age can still be appropriated by increasingly complicated models, yet logical and virtual but still rooted in old conceptions of unified grammars.

**ARCHITECTURAL IDENTITY**

Back in the days of Alberti it was the application of valuable materials which raised the necessity for a skilled planner. In the times of Ledoux it was the availability of algebraic calculus for spatial complexity. One of his successors, famous Pan-European Architect Gottfried Semper, delivers a great point when he complains about his fellows being backwards oriented, instead of embracing the new possibilities of industrial production for design (Semper 1834, Preface VIII):

> We want art, but we get numbers and rules. We want something new, but we get something from the remote past. We should conceive the contemporary from the point of beauty.

In the times of Semper industry additionally made available all applicative elements of all ages. So with Semper, Architecture became consecutive, extremely systemic and complicated. As an answer to this, Modernism reduced the constraints to the absolutely necessary to clear out the field for a new shift. So it can be shown that Architecture is not just about beauty. Architecture is neither Art nor Science. Architecture is not subjected to Engineering. Scientific engineering is axiomatic trying to flatten topologies within a specific system. Engineering does a great job in explaining and optimizing but it fails when it comes to a change in paradigm (Wack 1985, p. 1) (Note 2). This is when Architecture comes into play. Architecture is about the organization of complexity. Architecture is descriptive and atomistic, which means not about judging on cause and effect, but about contracting modes of operability. So Architecture is about working with systems and not within a particular system. And as Architecture is the faculty of jointing elements, so is the architectural model: an artifact of joint elements.

And to avoid the misconceptions of communist theorists like Henri Lefebvre or Guy Debord: architectural space is also not subjected to a ‘Unitarian’ dogma or unified
grammar. There are two conceptions of space, oscillating from outside perspective to inside view, from absolute and axiomatic to relative and atomistic, from explanatory to descriptive. But since the old Greeks we know that the two spheres have to be kept apart: when Zeus made Atlas to separate and block Uranus and Gaia so that they did not embrace all the time. Only after this act the world could start to develop. And so did Alberti, when he separated mystical conceptions from geometry: he enabled development in Architecture.

Nowadays we tend to worship ‘the field’ as the ultimate explication of informal content into formal expression. But we should be aware that not only the well-functioning picturesque downtown quarter appears as a continuous field, but also the Ghetto, the Slum and the shabby shacks of peasant villages. Even theorists as Habraken agree that when societies change, environmental conditions have to adapt as well (Habraken 2006, p. 2):

*In Modern times, all this changed. Traditional ways of building became obsolete as new materials and new techniques emerged. Age old building technologies could no longer serve the needs of a rapidly changing society. New ways of transportation and communication disturbed familiar processes.*

Contemporarily it is digitization that reshapes our understanding of spatial organization and as aforementioned the question arises whether it is appropriate to conceive multi-ethnic, yet multi-ethic societies in terms of a unifying grammar. Especially as in computation now there is a tool we can use to describe interlaced fields of separate systems. For this reason it appears to be necessary in architectural research to find answers to questions the field does not ask as long as we conceive it as an unconscious, self-reproductive mechanism. Taking a sly glance on Christopher Alexander, Alberti might state that we have been given the great gift of consciousness that enables us to claim mastership and to find newly appropriated solutions for the alternating life-plans of those people for which investors and developers build up realities.

**THE APPROACHES**

Not just since the Deleuzian distinction between Roman and Gothic ages, or the conflict between Constructivism and Structuralism, or the gap between the theory of relativity quantum mechanics, or the imperative versus the declarative programming paradigm, or the Cartesian versus the Riemannian spaces, has there been a notion of two sometimes opposed, sometimes complementary approaches to the way objects in space and their relations towards each other can be conceived.

The Atomistic Approach

The great achievement of Alberti was precisely to open up space, by clearing out the field. His ‘Six Elements’—regio, area, partes, partibus, tectum, apertio—and his proportionate ‘Lineamenta’ establish parametric relations in space. By reducing the continuous
field to discrete objects he exemplifies the ‘Atomistic Approach’: there are discrete elements, whatever they are, and we describe relations between them. In this thread, a shift does not mean setting up more and more rules, but to figure out which rules are essential. A shift in paradigm, which means a new level of abstraction, can only be achieved if rules are reduced to the absolutely necessary to set free the creative potential. This procedure will be called the Principle of Expulsion. In this sense the famous sketch of 1977 Sideburns Issue 1 (Note 3) can be applied to any revolutionary shift. In case of Renaissance and Architecture: six elements and a handful of adequate proportions and this is it (Figure 2).

The Axiomatic Approach

Claude-Nicolas Ledoux exemplifies the ‘Axiomatic Approach’: Relations are complicated, not complex: subjected to tree-like structures, not as a rhizome. Everything is subjected to a unifying grammar, which continuously transforms one instance into another. In the Newtonian model of space the determinant axiom was the enactment, which led to the epos of the universe where the drama of life could unfold to the tragedy of being. This stage-play was no longer taking man as an individual but centered mankind as a functional system. The beauty of it is: through grammar space is liquefied. Out of the loosely joint elements in space becomes a continuous stream of algebraic information processing in time. And with time the grammar introduces the system. A shape-grammar is encoded in the way the distinct types can be composed. But if we wish to explore the possibilities of a system transformation is being introduced. And so are the rules of transformation as shown with a sequence of instances of the toll stations, called by Ledoux “Le Propyleés de Paris” (Figure 3). A transformation-grammar determines how to translate one instance into another and by this the grammar fills the space of possibilities.

TOPOLOGIES OF TYPES

This is not anymore just a parametric repetition of morphology, as can be exemplified by the Hôtel Thelusson of Ledoux: It was the time of French Absolutism and everyone who could afford would like to have a copy of Versailles, but this could not just be scaled down to an urban site. So with undisputed genius Ledoux was folding and twisting the grammars of spatial sequences from the desired layout onto the given topography by keeping the constraints of topological relations. Opposed to the juxtaposing arrangements of spatial objects in Renaissance, grammars involve not just addition, but also subtraction, intersection, multiplication, and division of spatial voids. Apart from this, grammar involves language and Ledoux used it to try to program space as he intended to improve society through Architecture. In this he stated (Ledoux 1981, p. 115):

[... the shape of the cube is the symbol of justice, it is to be placed on a square base, from where it will punish the tort and reward the virtues.]

However, the people of Paris did not share his opinion when they burned down most of his toll stations around their city in 1789. So as a lesson from this we can take the insight...
that the relation between program and spatial layout is neither mutual nor directed determination, but programs inhabit spaces and change along with demand (Habraken 1996, p. 8). Any attempt to program spatial configuration imposes a system, which will lead to the misconception that place and space are being mistaken. In this perspective a place is an appropriated piece of space, bound by constraints to other places within a topology and by this 'placed' or located relationally and identified by a specific program. So if the spheres of content and expression are kept apart, a spatial layout will embed topological structures that can host very different processes of distinct socio-cultural systems.

And by taking a look at the Hôtel Thelusson we could see that even in grammar it seems possible to go beyond the axiomatic hierarchical notion of the Chomsky-Grammar. By referring to the Danish linguist Louis Hjelmslev who stated that form and content are in arbitrary but appropriate relation, it should not be too farfetched to say that the activities of the people who make up the inhabiting systems can take place, and yet it will be possible to avoid the conflicts that we produce if we try to impose our own reductive understanding of a particular system. Another way to put this is: if we speak of systems in space we speak of pre-specific systems, which will be specified by their particular utilization. This means: a spatial layout allows for patterns of activities, processes, without determining what these will actually be, unless a program is formulated. So the program becomes one individual within the generic (see Beetsplein by NL-Architects). And: until now we have perceived geometry to be something definite, while topologies are somewhat confusing because one and the same graph can be displayed in many different ways. But taking a look only at the ground floor of three different housing types, built for the same purpose, the Renaissance Palazzo, the Amsterdam Canal House, and the Parisian Hôtel: a family residence in urban context to demonstrate presence and to do business. Basically, they share an identical topology, while the geometry is arbitrary (Figure 4). So it becomes the task of the Architect to bring form and content into this arbitrary but appropriate relation to establish architectural space as an articulation to support the demands of those for whom we build.

ANOTHER INVERSION

We have now laid out a tool-box to do another inversion. The first of these tools was the conception of the model itself, which helps to conceptually separate an object under consideration from the surrounding immediacy to retrench and refit, until all conflicts are sufficiently solved. The second was the inversion from the physical model of objects in space of Renaissance to the mathematical models of space in Enlightenment. And the third was the concept of arbitrary but appropriate form to host a certain topology. Now, as stated in the introduction, since the advent of modernity the emphasis is again on the objects in space. To be more precise: our models are still mathematical, even computational, which when switched from arithmetic to logical calculus, may reveal benefits if objects are consecutively calibrated. Some mathematical concepts that deal
with spaces themselves and what they might bear might appear problematic, however; and the formulation “what they contain” is here being avoided on purpose because unlike the baroque conception of adding, subtracting and crosscutting units of space, we are now operating on strata of spatial organization, on superposed programmatic fields. The relations between these fields have to negotiate how these distinct strata ‘deal’ with each other. This is where a conception of active space comes into play and might rather be called an economy than a system. According to Deleuzian territories several systems of equal value have to deal with each other, instead of being ordered into grids, which would be determined by a unified common denominator. Another way to put this: we can determine a line on a surface, or a surface in space, but as soon as the space we wish to describe is not congruent to the space into which it is embedded, we are facing severe problems.

This is why Riemannian geometries become so interesting. There is not one function governing over a spatial figure by means of a flat space of higher dimension subsuming it under the smallest common denominator, but local curvatures of space itself that rule over one part of it, contracting it to all the other parts. The link between them is the Cipher, the ‘Nothing’, which contains the code of computing how the systems cope with each other. For this we need a new entity. We used to conceive our environment as a manifestation of matter and energy, and by considering its intrinsic properties, we can no longer as the question of what there is, but also how it is related. As result we get information as the third entity that makes up space, information that is precisely what becomes incorporated if code is applied. Coding, as opposed to formulation, is what makes computation different from calculation. Coding is a creative process and not an act of agency. Coding is the means of taking something out of everything to create anything. Coding is the formative matter of building logical models. Now we have to figure out what kind of Lineamenta these models might support.

As it was stated that Architecture is the mastership upon jointing elements into arbitrary but appropriate form, the question how to achieve this appropriation becomes a matter of how to improve and to maintain vividness of places. Considering society as a quantized multitude of individuals rather than a continuous field of behavior, one way should be to follow the line of superposed layers of activities. Humans—a shopper in a mall, a talker on a bench, a thinker in search for an idea—are like Qubits, which are not either on or off but show different spins according to the system into which they are embedded at the moment of measurement, and all this at the same time at the same place, depending on the question being asked, depending on the group of people with whom she/he is associated with. So it becomes clear that the territories of these groups must be interlaced and there cannot be a single-use zone. Instead of thinking positively—this is a zone for working, this is a zone for residential purposes, this is a zone for etc.—it could be possible to negatively avoid contradiction between differentiated utilizations. One approach to render connectivity and non-connectivity into space could be the following one: Stating there should not be a single function governing a spatial
figure, but rather a differential approach of local operations, space itself is used as an active element of computation. Quantized bits of space then have to cope by syntax, contracting the ways how they impact on each other.

Figure 5 shows how agents induce their properties on such spatial quants. These quants were named ‘Spaxels’, as they like Voxels have got spatial dimensions, but they can take attributes and values of the agents embedded and through this bridge the connections between them. As shown in the figure, these connections make up joints, where no object (agent) has been before. The relations they create are made up of intrinsic properties rather than extrinsic formation. Yet this context-free model seems to be twisted and distorted although it is topologically flat, as neighbors are neighbors throughout the process. Taking it a step further in the succeeding figure, it can also be shown how different fields can be promoted simultaneously. In this version (Figure 6) the embedded objects have got different properties, red, green, and blue, which proliferate simultaneously through the field of Spaxels. This refers to the behavior of quants: They remain in undecided state until being measured. The outcome of these measurements will depend on the applied quantum system and in general it should be possible to transfer this concept to the digital Lineamenta.

CONCLUSION

So this literally is this first step of an emerging computational model. This is the part where the two spheres of form and content are being separated: The architectural model describes a conception, while the engineering plan explains how to get there. In a quantized environment axioms as logical forms become elements themselves, dealing on equal ground. Objects embedded are like principles, which cannot be explained but only described. What we can explain is the consistency of the logical relations between them. Each one of these is special and that is normality. What seems to be further complication, because it is a higher level of abstraction, is a way to reduce the rules to allow for higher complexity. This is why the Spaxels introduced in this paper are considered to be a model to space: what they do is negotiate information bit by bit, not imposing an axiomatic function, but superposing fields for activities. The tool is about to be equipped with the data from an actual environment or even better with a continuous stream of data taken from the movements and gatherings of actual groups of people. Data which can easily be collected as a side effect of building automation systems and correlated with the ‘Like’ or ‘Don’t Like’ responses of the people involved. The volumetric figures represent the localizations of as yet undetermined activities, but may exemplify those occurrences already incorporated in the ‘ordinary’: the everyday life of the people we build for. (Figure 7) Yet we have to keep in mind the lesson to be learned from Ledoux that it is not the task of Architecture to judge upon cause and effect, but to create articulations of space. As Alberti would state towards Ledoux: Architecture is descriptive not explanatory. Or as Bohr supposedly once answered Einstein during their legendary dispute, “Stop telling God what to do!” (Note 4).
The next step is to find the questions to ask, unless the fields we perceive as consistent derive from necessity but not necessarily from matters of comfort. The questions to ask might be: What means type in a global village? What means normality in the age of individualization? What means program in spaces of undecided state? What means culture in global society? And what means form in a digital paradigm?

To summarize the above mentioned strategies, there are five major issues to rely on:

1) The Atomistic Approach. Through parallel processing it becomes possible to encode computational tools, which do not represent a specific hierarchy, but a generic mode of operability. They just negotiate elements of equal value and liberated from content.

2) The Axiomatic Approach: The transformations of Ledoux, the field, as N.J. Habraken defines it, or the shape grammars of George Stiny, are ruled by grammatical systems. The grammar fills the space. It is implicitly contained in any field and needs to be explicated. Digitization allows for a new conception in which a process may not just appear as formulation in a single language, but also through the rules of transformation in any other language, depending on the 'system being measured'.

3) Principle of Inversion: At times the two approaches tend to switch one into another. Alberti arranged objects to spatialities, while Ledoux sequenced spatial voids, wrapped by objects.

4) Principle of Expulsion: A model is reductive towards actuality. If space is conceived as active, a model of space has to be constituted in a group theoretical sense: In its setup it bears every possible information as everything is connected to everything. Creating structure, creating a model of something particular, means to break the symmetries of the initially flat topology by deleting unnecessary relations.

5) The Paradigm-Shift: Innovation is linked to the refinement of processes within a system. But Digitization is a new concept, which is linked to a paradigm shift. So what is needed is a creative implementation of the abovementioned issues:

Axioms are useful, unless a system gets too complicated and starts paralyzing itself. Then meaning gets lost. Like Eclecticism happened to Historism. The Principle of Expulsion then led to Modernism, which in this case went together with another inversion from topologically internalized spaces to articulations of space inhabited by topologies. In this sense Modernism compared to Historism was an atomistic approach of combined elements compared to a consecutive system of stylistic axioms.

As a constitutive model the concept of Spaxels is opposed to a consecutive systematized parametric Architecture. Into this species of quantized active space objects may
be embedded, which are distinct and unconnected but will break the symmetry of a perfectly flat empty space. By analyzing the potential drop of properties in their locale, active space can distort. Ongoing experiments with this tool could help to represent more in space than just matter and energy, but also information to render back topologies into geometrical figures. The beauty of the New is that it was contained in the Old and will contain the Old but clears the field for something, which was not there before: a Paradigm Shift.

ACKNOWLEDGEMENTS

Kind regards and many thanks to all the people at the chair CAAD of ETH Zurich for admitting me, especially to Prof. Dr. Ludger Hovestadt, for his influences, as well as Dr. Vera Bühlmann and to Mathias Bernhard for providing parts of the code for the 'Map Of Rome'.

Kind regards to my supervisor Prof. Dr. Karl Schwalbenhofer at BU Wuppertal and to Franz Heiner Verhaeg for giving me advice in programming.

NOTES

1. For this paper, the map, based on Java script and the tables of Alberti as provided in the Delineation of Rome, by Carpo and Furlan, is just of explanatory purpose. It actually copies Alberti's manual and applies a Self-Organizing-Map for the part where Alberti states that a "man of average intelligence" should be able to connect the points closest to each other.

2. Pierre Wack notes: "In times of rapid change, a crisis of perception (that is, the inability to see an emerging novel reality by being locked inside obsolete assumptions) often causes strategic failure, particularly in large, well-run companies. [...] As Peter Drucker said, "The greatest danger in times of turbulence is not the turbulence; it is to act with yesterday’s logic."

3. Sideburns magazine started off with a sketch showing three chords on guitar strings, which is often referred to as the kick-off for punk music, which blew pop music out of its lethargic self-referential overladen repetitious era towards the end of the 1970s.

REFERENCES


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