THE SYNTOPY

An Information-Based Model of Space

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Abstract. The paper argues that Modernism has produced a manifoldness of theories about spaces or spatial configurations which resemble valuable facets. Yet, they all shed a light on single aspects of spatiality. This raises the question if not in the age of information, there could be a common ground for theories of space that might serve as a model to purport a more general view. Speaking with French philosopher Michel Serres, when the old model of time collapsed at the end of Modernity, it has left the underlying concepts as scattered elements to the beginning of Modernism. The most promising approach to reconcile these elements in spatiotemporality appears to be Category Theory in mathematics. It defines four categorically differentiated domains which exactly resemble the scattered elements. In search for a common ground to build up a new model, the Syntopy is being developed for thinking space, based on the way information is encoded within these four domains.

Keywords. Space; Information and Data; Lambda Calculus; Topography and Topology; Synthesis.

1. Introduction

From the early arrangements of CIAM to the structural approaches such as Archigram, rather topological conceptions such as Space Syntax, or the more complex approaches based on social considerations by Henri Lefebvre, Edward Soja, et. al., Modernism has developed many concepts about space or spatial organization. Yet, as Lefebvre himself criticizes, each one of these is focused on a single aspect towards the question, what would be the cause for a certain type of spatial organization (Lefebvre 1991). It is not the point of this paper to deny the achievements of the mentioned Modernist approaches, but to think about them as conceptual species which resemble facets of how to extract information from the world. This whole issue recently gains a new relevance as computational approaches seek the optimization of functionality in the smart cities. At the same time spatial theory apparently finds it hard to position itself towards recent developments, such as augmented or mixed realities, increasingly penetrating the physical world. So, the question may be asked if the point of departure for a
reading of spaces in Architecture can still be based on the Kantian a priori (Kant 1781), while the concept of space in Mathematics and Physics shows an inversion where information is put at the basis and space is a mere result. The concept proposed by this paper was named the “Syntopy”. In Biology, the term describes a habitat, shared by several species (Sick, 1993). But literally, it simply means “a place assembled from parts”. Taking up this inversion from mathematics, the Modernist approaches could be interpreted as informational species making up the space they inhabit.

2. The Old Model

But how to deal with this manifoldness of sometimes overlapping, sometimes contradictory concepts? To speak once more with Lefebvre (Lefebvre 1991), there has been a consistent model of space in European Renaissance. And as Michel Serres puts it, Modernism has expelled the consistency of an older model and left its concepts as scattered elements (Serres 2002). So maybe it is worth taking a step back and to revisit this old model and to term the major paradigms, leading to a contemporary notion of space.

So, instead of the ceaseless pursue to collect all of the concepts about space since the beginning of Modernism, and to find a common denominator, it might rather be helpful to name the different ways of extracting information from the world. It appears that Renaissance has probably not been the only cultural turn, when an older model has collapsed and was reconstituted on a higher level of abstraction, correlated with a new key-technology in notation (Carpo 2011). The assumption is that this has also happened in ancient Greece with the phonetic alphabet (Harris 2009). The characters of an alphabet act like mythical elements: they do not make any sense of their own, sense lies encrypted in between their arrangements. In Greek philosophy elements were geometrical parts. Albeit, not parts in the strict kind of sense but pro-portionate portions (Asmuth 2003).

According to Mario Carpo Renaissance was also a cultural turn correlated with a new key-technology in notation (Carpo 2011). This key-technology was to encode space in drawings. When Alberti wrote about the “lineamenta”, the meaningful elements, he defined a first paradigm of geometrical arrangements. (Alberti 1755).

If Renaissance constituted space as a result in between the proportions of elements, René Descartes was thinking space as a self-referential framework in Baroque. For this second paradigm, he neutralized the elements to pure geometry (Descartes 1925), while he transposed meaning to the level of logics. To do so, the coordinate axes were used as a hub to translate between individual geometrical objects and their identical algebraic description in analytical geometry.

The third paradigm to recall was introducing the Grammar and the Algorithm. Affirming that it is rational to deal with irrationality, must have been a big deal for the European contemporaries at the dawn of Enlightenment. The grammar holds rules, but the validity of the grammar is governed by law (Leibniz 1714). Newton and Leibniz invented the Differential Calculus and Leibniz transferred the idea of the Infinitesimal to his concept of the Monad. The Infinitesimal subsequently
contains any possible combination of digits. The Infinitesimal is not actually a number, but rather the intermediate in between any two numbers and by this it fills the real line.

In the same way, the Monads fill space in between any two objects. The Monads are boundaries, bounding nothing but themselves. Like the infinitesimal contains any combination of numbers, each Monad is containing the whole world. Leibniz discovered the paradox that Monads are same, while not being equal (Leibniz 1686). Based on the idea that every point in space is same, while not being equal, Kant was able to postulate the a priori of space and time, being the source of knowledge (Kant, 1781). The implication was that space could be constructed topologically, connecting places as nodes and preserving structure beyond geometrical layout, as Leonhard Euler proved in his solution to the problem of the seven bridges of Konigsberg (Euler 1736).

The fourth paradigm is based on resonance. Sadi Carnot opened Pandora’s Box of energy conversion (Carnot 1824). And although Carnot called the way sub-systems of an apparatus regulate each other through feedback the “Circular Process”, he seems to be the first to have conceived energy as a directed flow. The price to pay for the increase in complexity was a loss, occurring at the interfaces where one form of energy is being converted to another one, entailing the idea of everything tending towards Entropy (Clausius, 1865).

The Architect Semper fused this thinking with the notion of algebraic group structures by Evariste Galois (Galois 1828/29) and the co-evolution of species (Cuvier 1817) in his programmatic concept of “Style”. For him Architecture is the central element of cultural cohesion, defining the function between coefficients like social necessities, building techniques, materials, traditional forms, and so on. By positivizing elements, Semper completed the circle (Semper 1884) that Alberti once started. Apart from this, Semper’s buildings, such as the Polytechnikum in Zurich have proven to be resilient towards alteration, since Semper was organizing spaces through defining interfaces between building parts. Yet, Semper’s whole ontology of Style pre-assumed an immediacy in between topographical form and topological content, based on the Euclidean postulates which were just about to break down.
To sum up the older model, the four paradigms take the shape of four profoundly distinguishable domains:

- the geometrical arrangement is positivizing indexes for assembly
- the logical pattern is positivizing rules for order
- the topological system is positivizing law for structure
- and the harmonic program positivizes interactions for organization

Figure 2. The four paradigms as given through history. Renaissance sets indexes, Baroque achieves order by logic, Enlightenment builds structure, and Classicism resonates between topographical layout and topological structure.

3. Scattered Elements

The first indicator for the collapse of the older model was probably when the German mathematician Bernhard Riemann stated that the three-dimensional flat space is merely a special case of a manifold. According to him, a manifold can be divided into something he called “Quanta”, patches of space sharing the same properties of curvature (Riemann 1854). By this, Riemann inverted the Kantian a priori because in this understanding, space is a result and not the source of knowledge.
Yet, it took some seventy years until Relativity and Quantum Science proved his ideas to be more than a mind game. The only problem now was that these two approaches scattered the existing theories into continuous and discrete conceptions, incommensurable to each other, and the four paradigms became fundamentally distinguished domains of thinking space. And this now sheds a different light on the incommensurable “theories of space”, Modernism has brought forth. They do resemble attempts to constitute new models, each within one of the domains. To bring them together again, the proposition would be to find a common ground where the Kantian “source of knowledge” and the Riemannian “property” mean the same. This “same” could be encapsulated in the concept of information: within the registers of information the four domains of thinking are nothing but cases. They depict four different ways of conceptualizing space, while none of those can ever be complete. Yet, they all have got information as a common ground.

Figure 4. Modernist spatial concepts ordered to the four domains.
4. Three Pillars

4.1. THE INVENTION OF CODE

If there was a cultural turn from Classicism to Modernism comparable to the one from the Middle Ages towards Renaissance, then this should go together with a new key technology in communication that opened up a new level of abstraction. The hypothesis is that this new technology was the ability to transmit signals at the speed of light and the respective form of communication was the contemporary understanding of code (Virilio, 1977, et. al.). The beauty of the computational code is that it fuses the argumentability of alphabetical articulation with the calculability of numerical reasoning (Turing, 1936). The digital code does not just establish the sign-functions between information as content and data as form, but by being calculable it also provides operationality. The computational program runs and subsequently produces answers to the coded questions.

4.2. DISTINCTION OF INFORMATION AND DATA

This implies that there is also a clear distinction between information and data. Information can only be symbolized. For example “π” is an irrational number and therefore it can never fully be grasped. Yet, can it be rendered into certain appearances according to the four paradigms: As proportion, finite but imprecise and discrete; as in-between, finite but imprecise and continuous; as an algorithm, infinite and continuous; or as a mapping, infinite and discrete. For each of these formations, a code is needed to establish a functionality between information and its operationalization as data. Information behaves like an obstruction in the mathematical sense: it is real, but this reality is out of reach, no matter how realistic the rendering of data will be.

![Figure 5. Four ways of encoding π.](image)

4.3. DEVIANT PATTERNS

The assumption that code rather delivers an operationality to ask questions than being a tool to note down answers, leads to the conclusion that any survey is conducted from the viewpoint of one of the domains, out of which a specific
reading of data will occur as a pattern that is prior to interpretation. If something new is expected to be found, it can only be a deviation from that which is already known. Charles Sanders Pierce termed this kind of deviation “Firstness”: something which has a meaning, but it makes not yet sense. The idea the Syntopy is based on, is that a spatial environment and the life unfolding within influence each other which leads to new patterns occurring deviant to that which is already known. To identify such deviations, data has to be neutralized: pattern recognition is prior to interpretation. On the level of data it is nothing but a sequence of 0 and 1 and yet these sequences can be compared, related, and clustered.

5. A New Model

5.1. HOIST THE ANCHOR AND SET SAIL

By making this clear distinction between the terms of data, code and information, it should be possible to create a kind of common ground and to pay respect to the conjecture that life permanently creates new patterns. Further on, it might be a delusion that any given algorithm will ever be able to capture this abundance. The sensorial availability of information about a spatiotemporal environment might as well be called a white noise that depicts an unstructured presence where everything is potentially connected to everything else, upon which consistent patterns can be foregrounded. In this sense the white noise is not the absence of information but the potentiality of any information. It appears as a superposition of patterns that turns into entropy if the keys to decryption fail on its complexity. Every communicative technique creates a framework of a certain capability. Therefore a new form of notation, a new technology in communication always provides a new key to the world, increasing the capabilities to decipher apparent white noise. Therefore, the gain of knowledge that can be achieved by computational codes lies in their capability to filter the abundance of available information into data regarding a specific question.

5.2. ASHORE THE FOUR DOMAINS

This means, from the unstructured presence where everything is potentially connected to everything else, the computational approach may help to break futile connections. For example: if Modernism tried to optimize functionality, every considered aspect had to be flattened down within a single system to define absolute measures for creating a space which is equally good for everyone. But the question may be asked to which extent absolute measures are appropriate, since one individual likes to cave in, while the next would rather chose a glazed penthouse.

But on the level of coding information by categorizing aspects to their respective domain, the polarity of transparency and opaqueness is a characteristics of an environment, and so it relates to the positions and properties of objects in space belonging to the domain of geometry. In the second domain, issues may be found that can be addressed as sequencing. All matters of the functionality in between the patches of space and how they topographically relate to one another could belong here. The third is entanglement. It is a topological view on how
places show similar patterns, beyond metrical or topographical proximity. The fourth domain of resonance deals with the temporal recurrences of identity-groups. This may also involve the use of time-critical media or mixed realities and extend on spaces which are either limited in time and / or “personalized”

5.3. NAVIGATING IN THE OPEN

The idea that it might be helpful to acknowledge that there are different kinds of spaces existing simultaneously according to different aspects of reading data, instead of trying to flatten them down into one unified system, frames a comprehensive common ground to include as much of the potential information about the spatiotemporal environment as possible. Within this framework the focus can be shifted towards the non-identifiable patterns that will present themselves as discontinuities of an increased heterotopic degree. To figure those out could help to talk and to ask new questions to find definitions for spatial patterns which are not yet coded. Some patterns may appear as impenetrable obstructions on a specific domain, but can be deciphered on a different one. The crucial part then becomes a matter of connecting the domains. As aforementioned, different ways of coding may filter patterns from the noise like a tuner finds channels in a spectrum (Shannon 1949).

The mathematical framework to connect the domains is called Category Theory (Zafiris, Epperson 2013). It appears to be exactly what takes the paradigms of Modernity as scattered elements, collapses the old model of time to re-arrange them by shaping the four domains. And since the domains can be ordered across two axes, there are always two ways of encoding discrete objects and two which are based on continuity, while one of each can deal with paradoxes, but fails in infinity, and the second two are complete in achieving infinity, but fail to paradox. To connect the domains, something Category Theory has termed “bridge” is needed to figure out symmetries in between them. One of such bridges has already been mentioned above: In the old model, the coordinate axes connect the domain of geometry to that of logics and algebra. To transfer the concept of a bridge to the digital age becomes a challenge. One way to think about such bridges was introduced by Alonzo Church, and is termed the Lambda Calculus which offers the opportunity to encapsulate (neutralize) the meaning of elements (patterns) and to compare their structures (Church 1932). In Category Theory “bridging” becomes a paradigm in itself on a higher level of abstraction: arranging symmetries in between the domains to find the invisible logics of order (Zafiris 2015).

5.4. THE COMPASS

One last item is missing in this conception. What is the device to collect information? If the two-by-two-matrix to order the four domains is folded in to a topological structure, the six connections to link all of the domains can be reduced to two irresolvable obstructions. Two obstructions are needed to establish the interplay between the appearance of a spatiotemporal environment and the life which unfolds within.
Figure 6. Folding of the fourfold matrix to a topos of two obstructions.

This interplay relates to the most recent change in paradigm which goes from the programmed solution to differential programming. For example, the geometrical movements of people or the properties of objects can be tracked and traced and be fed into an emulator as neutralized pure numerical values. And instead of a simulation where the rules of how objects behave are scripted, the behavior of observed elements can be mapped to find out about apparent rules. The Syntopy is a theory of space for the digital age because the Quanta, the locally consistent patches of the Syntopy cannot be pre-defined, they need to be learned. It is a cycle of observation, evaluation and modification. And it can be done in terms of all of the four domains:

- Geometrically: properties of objects and spatial voids in relation to the tracked traces
- Logically: how do the derived voids relate to each other
- Topologically: where are identical objects appearing in seemingly non-related places
- Harmonically: what are the rhythms of recurrent patterns

The hypothesis is that over time and within the available data-streams, ordered patterns will occur in each of the domains and either show boundaries between topographical patches of space or invariances in topological terms. Such boundaries and invariances are exactly the discontinuities as mentioned above, where a computational approach will not only help to find non-identified patterns but also find the ones transgressing from one domain to another so that the domains can be bridged. The bridges themselves are logical and singular to avoid the conflicts arising from paradoxes.

6. The Undiscovered Land (Conclusion)

The proposed concept is not an endpoint, it is a point of departure. It provides a framework upon which further investigations on the question “what means space in the digital age” can be conducted. For the Syntopy, data is taken from the real world, decoded to neutrality, ordered into patterns according to the different domains.

To conclude, interpretations of data patterns do rely on a certain paradigm that works as a spectral filter, while the bridges establish a space of comparability between them. The bridges can be used to find changes in the pattern behavior to
partition an informational manifold and to figure out boundaries and invariances between patches of space. The Syntopies constitute a kind of Architecture of space under the definition that Architecture is about joining elements. They do not claim to be natural representations of the real world but are constitutive parts of Synthezising the information that the available data provides. The arising patches are topographical as well as topological. The Synty is a place where different informational species coexist together, sharing the same space on many levels of abstraction.

References