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Algorithmic Topology

Unfolding Space

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New concepts of space and strategies for spatial research and practice across disciplines have been inspired by our changing understanding of reality. Essentially, information technology, Einstein's theory of relativity and quantum physics have brought radical changes in cosmology, science, art, design and philosophy, as they have altered our understanding of space and our experience of it. Such a radical turning point in contemporary thought, has attracted the interest of numerous thinkers and artists like Lev Manovich, who, as the educator and critic Monika Bakke describes, defines this change as the shift from Modernism to "informationalism" (Bakke 2006, 11, 14-15). The focal point is neither objects nor forms, but various 'information flows'. Space is now defined as a constantly and uncontrollably changing 'informational substance' in which various kinds of polymorphous relativistic spaces emerge. Such a shift necessitates new spatial research strategies for advancing contemporary site-specific art and architecture.

The boundary has been the fundamental aspect of architecture. As Steven Connor explains, architecture can be essentially conceived as a "confrontation and exchange" between the "spatiofugal" and "spatiopetal" orders of space (Connor 2004, 121-122). As space itself is neither uniform nor inert, the conventional boundaries of built architecture are radically challenged. In addition to the quantum paradigm shift in science, non-Euclidean geometry has increased contemporary artists' and architects' interest in visualising and creatively engaging with the invisible and unknown co-ordinates of reality and perception through revealing various fields of interaction between the environment, matter, technology and users, challenging thus, our conventional notions of space and built architecture as well as the functionality and morphology of the latter.

The developments that have been discussed above, necessitate a creative in-depth and inventive investigation of the relationship between digital and physical spaces for advancing digital site-specific art. In particular, new methodologies are needed for creatively revealing the paradox of the informational space of Virtual Reality due to which, the digital boundaries

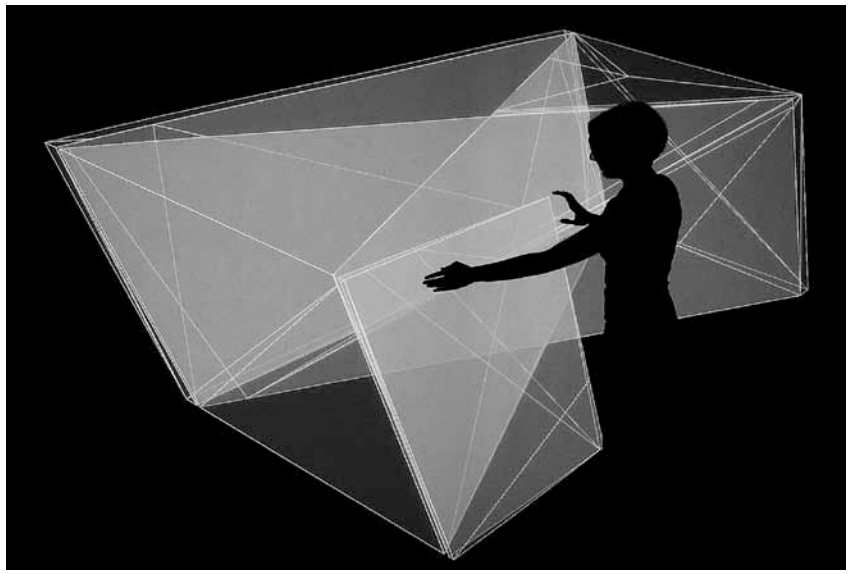

Fig. 1: Stereoscopically projected 3D digital model in the room-sized virtual environment Photo: Artwork & photograph by Eugenia Fratzeskou, all rights reserved

of architecture are not only abstract and fuzzy but also, highly flawed and unstable. This is achieved in my work through the visualisation of inter-spatiality between the physical and digital spaces of architecture, as opposed to creating interfaces and complying with the conventional modes of using digital visualisation and virtual environments in art, architecture, design and science.

Through the in-depth practical and theoretical investigation of digital visualisation systems, which has included their philosophical and mathematical foundations, it has been possible to develop new types of site-specific drawing within semi-immersive room-sized virtual environments. Although Boolean Algebra has enabled the creation of computer algorithms and volume-based digital modelling, the 'ghost' of Boolean inconsistencies remains in the algorithmic orders and its full expanse has yet to be creatively explored.The emphasis is placed on analytically visualising how the inter-passages between the actual and virtual boundaries of architectural space can be gradually revealed through the stereoscopically projected digital modelling of the built space within the virtual environment by using Boolean Set Operations [Fig. 1].

The conventional modes of digital visualisation, site-specificity, virtual and mixed realities in art, design and science are radically challenged, as the built boundaries of architecture are 'unfolded' to reveal a paradoxical hybrid space within the virtual environment. The digital boundaries of architecture are revealed to be highly inconsistent, undermining the solidity, stability, continuity of the built space and our perception of it. Such irregularity exposes not only the inherent abstraction but also, the flaws that occur in the

interchanges between the binary, numerical and graphical levels of digital visualisation systems.

A new paradoxical kind of spatiality (inter-spatiality) emerges through visualising not only the processes but also, the inconsistencies of volume definition, layering, geometry and boundary generation that characterise computer 3D modelling. Various unknown and ambiguous types of space appear as we pass through various spatial orders and geometrical paradoxes. The hidden dimensions of architectural space that remain unregulated, elusive and unbuilt are revealed. The manifestation of inter-spatiality enables a new philosophical understanding, experience, and perception of space that inspires new types of spatial research and practice in art, architecture and the related disciplines.

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Computation as Dynamic Topography:

The Coordination of Algorithms, Apparatus and Architectures in the Production of Digital Images

The tradition that assimilates computer code to text is not completely appropriate for the analysis of audiovisual works based on digital media. It forces theory to take a detour through the field of linguistics, hiding the fact that – as physical phenomena – computation has more to do with architecture than with writing. This paper proposes the spatial *dispositif* as a concurrent paradigm for the evaluation of computational processes in the production of technical images. That, computational algorithms would share fundamental qualities with the cinematographic apparatus and the installation of art in a gallery.

The similarities between computation and the organization of objects can be traced back to the pre-historic origins of calculus. Men first kept track of quantities using proxies such as their fingers (*digits*) or small stones (*calculus*). This sort of calculation had no abstract dimension and it did not produce a directly 'greadable' outcome: the herdsman separated one pebble for each head of cattle that entered the cowshed; the ensuing pile of rocks did not represent a numerical value, but it could be used as a comparative mechanism to find if any animal was missing. Thus, both to count and to understand its results depended on the same activity of *processing discrete objects in closed territories.*

The physical computer gains abstract complexity and operability. These discrete entities are arranged according to rules of occupation, which pre-process the results of calculus. The chief example of this principle is the abacus, a matrix that organizes the pebbles in a system of relative, fixed positions. This striation of computational space produces a smooth visual pattern (Deleuze & Guattari 2004), where complex values can be immediately apprehended and go through sophisticated manipulations. Similarly, one

could assume that the grid of coloured pixels in a modern computer screen is a particular surface of the machine's digital geometry, even before being any form of *representation*.

It is important to remark that the formalization of the aforementioned abstractions is visual being *conceptual*. In that sense, we'd argue that the parameters of computation are more like *rules of composition,* a strict textual grammar. One can easily perceive this operational logic in rudimentary programmable computers. For instance, Charles Babbage's mythical *analytical engine* (1837) borrowed its method of data storage and input (punch-hole cards) from the *Jacquard loom*, a device used to produce intricate visual patterns (Null & Lobur, 16). The processing method of the likewise theoretical *universal Turing machine* (1937) basically consisted of moving through the uni-dimensional space of an infinite tape and managing its binary occupation (Hayles, 176).

With electronics, the parameters of spatial arrangement become incorporated in the machine's circuit, as the once discrete entities are substituted by the constant flow of electricity. Modern-day CPUs function no differently from the first electronic computer, built 1939 using *relays* – switches that direct the electric current in one way or another (Kittler 1999, 18). Electronics take the spatial logic of computation to its last extents, as it reduces both data and its operation to the flow of energy (Kittler, 1995). In such mechanism, even the most static information depends on the system's overall motion (Kirschenbaum, 95). Hence, Bolter states that "all data in the computer world is a kind of controlled movement" (Ibid, 41) – the *trajectories* that stand as the necessary negative of the computer's dynamic topography. In other words, computation only exists while the system *runs*. It is not something the computer *does*; it is the manifested computer. Computation, all of the machine's logical and physical layers are reduced to the continuum of energy that enters through the power plug, goes through the processor and lights up the screen.

Likewise, software is never running in a computer; software is the computer running *in a particular way*, resulting in surface effects (Kittler 1999, 1). This also means that the algorithm is one of the computer's forms, impossible to tell apart from the machine's operation. Although the machine does *interpret* the code, it is not as a *reader* as much as a *performer*. Computation is not carried out in any language; even the machine's lowest ones and zeros are no more than "shorthand conveniences for voltage differentials" (Kirschenbaum, 116) – i.e. *another surface effect*. Programming languages mainly exist to bridge the gap between human use and computer operation. While low-level paradigms such as assembly still retain traces of spatial logic, high-level ones attain "superior flexibility and ease of design" by adopting natural semantics and syntax (Hayles, 58). Collaterally, they drive programming away from computation, as a "metaphor that hides the machine from its users" (Kittler, 1985).

We finish this essay by referring to modes of data input and programming through spatial arrangement, especially the *dataflow* paradigm employed in

systems such as *Pure Data* and *Max/MSP*. Based on the modular construction of electronic music synthesisers, these software call attention to the signal processing that happens on the core of the digital computer. As they become increasingly popular in the digital art scene, one hopes they inspire a critical framework more attentive to the qualities of algorithms as dispositives.

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Betaville

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The Vision of Betaville – The new urban sculpture

Our vision of the new urbanity is the smart city, a city where you wish to live in, a city of art, a city designed by its inhabitants, for their dreams and their daily life. Betaville is a tool for the next step in such a mass participatory urban design and development reality.

We have been inspired by connecting the idea of participatory design with social dynamics using the web, offering a mass player infrastructure for cultural expressions of live, architecture, city-textures, urban art, live-style, from group-design to ecological living.

Our goal is to offer a mobile-stationary AR environment for smart cities – or such where citizens would like to change it into one. The Betaville system allows the participation of citizens and local groups in the local urban development from a very early stage on. We develop different types of interactivity and access, that accumulates the engagement of users to an new sort of urban sculpture.

Alternative planning proposals will be transparently available. As a continuous test and art place – as a new function of a “sustainable” Web. In cooperation with artists, developers and researchers from Europe, North America and Asia, Betaville tries to realize this vision: a hybrid open source environment where everybody can follow – even change – the ideas concerning urban development, urban art, or a decentralized infrastructure.

A Scenario in Betaville – Participation in different environments

In Alphaville, a fictitious city, an old factory has been torn down. The vacant area is to be revived in the near future and the city hall constitutes an official planning board. In order to take into consideration its citizens' demands for a livable city as well as potential interests of authorities and technical restrictions, the public administration is interested in the active participation of other parties in the decision and development process. Therefore, Betaville could be used. It configures the real estate in the virtual system.

Bob likes to actively take part in the planning process about his vicinity. As he is interested in a mixed use of the area, he uses the functionality to incorporate 3D models of a town house as well as a small shopping mall with space for different shops. Alice gets to see Bob's proposal on Betaville and adds a kindergarten that she finds essential for a vivid quarter. After releasing her ideas in Betaville, her friend Carol also wants to participate in the redevelopment of the area. Equipped with her mobile device, Carol inspects the area and uses Betaville's mobile client for 3D on-site-visualizations of the different planning proposals on her mobile screen. With these authentic impressions in mind she realizes the long distance from the housing area to the kindergarten and changes the proposal directly on her mobile by positioning the kindergarten closer to the housing area. Back at home she realizes a lack of green space and substitutes the shopping mall in Bob's design by a small park.

Members of the community, local authorities, or even potential investors now have the chance to refine and extend the development branches created by Bob, Alice, and Carol, to rearrange the proposals or even to create new branches. Furthermore, every member of the community has the chance to participate in online discussions about the published ideas, to comment or just to vote for or against it – at home on the web or mobile at the very site. At multi-touch tables small groups can meet and collaborate in real life, discuss alternative proposals, create and manipulate new ideas and visualize.

Betaville – First in New York

The first implementation of Betaville is planned for Battery Park, the open green space at the tip of Manhattan opposite the statue of Liberty: intensively used, contested by a bewildering assortment of stakeholders.

First level: aggregation and sunshine– by providing for embedded links to various agents, documents, and proposals already in place, the online world makes it possible for anyone wishing to seriously address this oddly contested and liminal environment with a full and interactive picture of the situation. Second level: a visualization environment in which it is possible for an artist, a citizen, or in fact anyone with internet access anywhere in the world to make sense of the web of functional and qualitative constraints and possibilities for place-making in context.

Third level: playing in an environment that will really support ongoing ad-hoc local discussion of possibilities for change, from something as concrete and immediate as the siting of a new work of sculpture to more complex long-term deliberations.

Fourth level: collaborative deliberation and creation. Each proposal will be accessible through a link embedded in the master model, and will carry its own discussion threads and version history. Anyone with a idea they think is worth considering/developing can initiate this process by uploading a model, in the spirit of the open-source protocol of a "request for comment".

A real city is in perpetual "beta": unfinished, and in need of direct engagement by the broadest possible coalition of stakeholders. Betaville provides a new kind of "magic circle": the radical plasticity of any urban environment is now a creative opportunity, rather than a constant threat, to individuals and local communities – a higher form of collaborative creative play in a game with real stakes.

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Practicing the Generic (City)

Reconfiguring Life through Digital Media

> The key issue to examine with locative media and pervasive games is that many of these new, mediated experiences refer to and appropriate space while divorcing it from its meaning, history, and significance.
> (Flanagan 2007; 5)

> All Generic Cities issue from the tabula rasa; if there was nothing, now they are there; if there was something, they have replaced it. They must, otherwise they would be historic.
> (Koolhaas 1995; 1253)

Discussing locative media projects Flanagan (2007) argues that digital urban games often demonstrate a striking lack of reflection on the particular urban space they are designed for. Many claim to be psychogeographic, but hardly any of them actually are, Flanagan argues, as they neglect the historical and political aspects that were essential to the Situationists' investigations. With the Situationists and Lefebvre as analytical tool, she thus presents a critique of those games where the game 'engine' and not the context itself defines the game play. Concluding that most games understand the urban landscape simply as an advanced game board where the actual location is only superficially explored, Flanagan calls for designers to understand that locative media projects "must begin to reflect the contested nature of the lived reality of such spaces" (Flanagan 2007; 9).

Cities of 'character'?

But what kind of spaces are we talking about? We could understand these locations in light of the cities (primarily Paris) that the Situationists worked

with: large, 'traditional' European cities imbued with many layers of history. However, if we follow Dutch architect Rem Koolhaas, those cities have 'disappeared', partly through the attempts of conserving them. In his monumental book "S, M, L, XL" Koolhaas introduced the idea of the Generic City describing how every modern metropolis is essentially a slightly reconfigured clone of any other urban area. He finds the search for historic identity meaningless as the "perpetual quest for 'character,' grinds successful identities down to meaningless dust" (Koolhaas 1995; 1248). What most would bemoan, Koolhaas applauds, because out of this identity stripping rises the generic "an endless repetition of the same simple structural module." (Koolhaas 1995; 1251) Or, to return to Flanagan's vocabulary, out of this rises the city as a game board on which anything can happen.

With respect to locative media, how do we then navigate between the positions laid out by Flanagan and Koolhaas? Can digital media work with both the generic and the particular qualities of a location? Koolhaas' might offer a first step of resolving this himself as Prouty notes that the more you invest, the more particular the generic becomes, even if it is always generic on some level and even if this experience is always transient:

> the generic city describes a way of seeing as much as it describes a set of objects […] Live in one place long enough and subtle but distinct differences start to emerge […] A generic city is the humid boomtown you visit on business. It's a transient space that can't be fully inhabited. (Prouty 2009; 7)

Inhabiting and reconfiguring generic locations

Through a sketchy analysis of Dutch media artist Esther Polak's NomadicMILK (2008), let's look at how locative media can reconfigure (the experience of) a location from generic to particular and vice versa, even if only temporarily. Using GPS equipment and a robot that 'draws' with sand on the ground, NomadicMILK visualizes milk transports and herdsmen's migration routes in Nigeria as sand tracks, that show the 'shared workspace' of drivers and herdsmen.

The spatial understanding of herdsmen and truck drivers obviously differs. With Prouty we might say that while the rural landscape is generic to the truck drivers, its particularity causes herdsmen to always adapt their migration patterns. The sand robot's drawing is always scaled to its maximum range (appr. 12 m), resulting in no visual difference between a 3 km and a 3,000 km route, and this clearly plays with the generic and the particular.

Most compelling, though, is the drawing's reflection of the temporality of both the particular and the generic. As a material witness to the temporal, the sand drawing is subject to immediate erasure. Both figuratively and concretely speaking, the sand tracks can never leave a lasting impression on a particular level, although they might leave a generic impression of routes and scales as such. The sand-on-sand representation show how the generic can be reconfigured through particular acts of movement, but also how these movements have limited capacity for showing or creating lasting

(or historic to use a term from the Situationists' psychogeographic vocabulary) layers of understanding. Using this particular material, Polak's project thus shows that there is no essence, only fractals "endless repetition[s] of the same simple structural module" (Koolhaas 1995; 1251). But also fractals reveal interesting information.

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