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WHEN CODE MET SPACE:

MAPPING A COMMON GROUND IN FLUX

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Abstract
In the last decades, the rapid developments of media and communication networks have made a decisive impact on the production of space. On the other way around, architecture is considered to be the foundation on which pervasive computing technologies, cyberspaces and virtual realities rest (Mc-Cullough 2004, 48). While software is mediating a great deal of our spatial practices, we find ourselves living, working, roaming, experiencing and interacting in the common ground of code and space. This essay will argue that software and networks infuse space with temporal qualities and that this may be another effect of the contemporary space-time collision. It will also attempt to map the ways in which code enhances the mediality of space by adding successive layers of meaning and vise-versa. Cedric Price famously argued that the best solution to a spatial problem is not necessarily a building, but the question is still pending — could it then be code?

Keywords
Space
Architecture
Media
Code
Software

1. INTRODUCTION

The ways in which the ongoing hybridization of code and space affects our everyday life is a topic of discussion that brings together scholars and practitioners of numerous disciplines. It is a field that seems to be reaching a certain level of maturity, as approaches to the matter range beyond the initial purely enthusiastic or oppositional viewpoints. Various schools of thought are currently unfolding around the alliance of the virtual, the physical and the qualitative gradients in-between. This diverse community uses an arsenal of critical thinking and interdisciplinary methods to address emerging issues, dangers and possibilities as they arise. In such a pluralistic frame, this essay will attempt to outline the current situation and organize it in three possible categories. It must be made clear though, that these do allow an interflow of ideas and practices, forming more a network of discernible theme clusters, rather than exhaustive or definitive groups of concern.

The ongoing hybridization of space and software may be addressed at the following three key points. First come the ways through which software left the confinement of our personal computers to inhabit the "hardware" of our physical world. Ubiquitous, pervasive or situated, computing becomes spatially active in transforming the experience and production of urban and domestic spaces. According to Kitchin and Dodge, space is produced through a process of transduction orchestrated by software.

The second category regards software as a design tool for form-finding and making. Its standpoint differs greatly from the previous one, in the sense that it is much less about communication or networks and more about a new prototype for "the architecture machine" (Negroponte 1970): In practice, it involves scripting for the emergence of non-Euclidean geo-metries and creating the protocols and the robotics to produce them. The contemporary craftsman claims back the direct relationship with the material, which was alienated during the industrial era, by developing a new ability called "digital craftsmanship" (Gourdoukis 2015).

There is also a third point about the loans of logic and structure that infuse virtual places and cyberspaces with gradients of spatiality. This tradition can be traced back to the first steps of the world wide web and interface design, when they inherited characteristics of actual physical spaces and spatial practices: websites adopted analogies to urban structures, while their user experience often resembled real-life wayfinding. However, this point is not in the scope of this essay, for the sake of exploring further in depth the relationship between code and physical space.

Before exploring the above two clusters in further depth, it may be appropriate to set the contemporary consideration of time, space and their relationship. The following brief narrative of its evolution is an attempt to draw a diagonal between time-space and the emerging hybrids of media-architecture and code-space. Nonetheless, the ways architecture and media (and thus space and code) are thought of, experienced and produced, are shaped according to the current concepts of time and space.

1.1. Time and Space: Two converging parallels

The nature of space and time is an enduring topic in the history of philosophy. The Enlightenment conceived space and time as absolute dimensions, which is

a historical product rooted in Newton's body of work. The consideration of time and space as separate, parallel entities was widely accepted for centuries, echoing the platonic division of the arts in time-bound and space-bound. Published in 1766, Lessing's *Laocoon* took this argument further, "suggesting that temporal and verbal arts, such as poetry and music, are superior to the spatial arts, such as sculpture and architecture" (Mitchell and Hansen 2010, 105). It is worth to note here that throughout modernity, the building, architecture's main product, was often regarded as a kind of "inhabited sculpture" (Brancusi) and thus, a merely spatial artifact. The notion that time and space are two absolute and independent dimensions was later undermined by Einstein's theory of relativity. Strange enough, although his time-space continuum made a tremendous scientific impact at the time, it seems like an equivalent re-conceptualization of space ontologies appeared only decades later— arguably, in our times.

1.2. A brief genealogy of space through time

The production of substantial theoretical work on the ontology of space emerged mostly after the 1950s, rendering spatial thinking roughly fifty years old. It was then, that a theory for an *absolute* ontology of space was clearly articulated. Space was understood as a given geometric system of organization, a kind of neutral plane with measurable dimensions (Kitchin and Dodge 2011). According to this rather positivist approach, phenomena could be scientifically observed, measured and analyzed in a quantitative manner, exactly because they were unfolding in such an inert, naturally given space.

No sooner than the 1970s would the credibility of an absolute ontology of space be doubted. Demands for more *relational* ontologies arose, accusing the dominant approach as reductionist, because it stripped phenomena from social and political meaning. Advocates of a relational ontology of space argued that space was in fact far from a given, passive container, in which life took place. Instead, space was conceived to be actively shaping social and economic life *and* being shaped by these relations in return (Kitchin and Dodge, 2011, 67). At this point, it was acknowledged that spaces are not made only of their physical form, but they are equally constituted and managed by immaterial situations introduced by people. Notably, both the above ontologies failed to consider the dimension of time as part of the equation. Even if the relational conception of space took immaterial parameters into consideration, space and time remained two separate, parallel entities.

Towards the end of the 20th century, some postmodern interpretations of time and space emerged and established new entry points to the discussion. Various scholars pointed out that time and space undergo a process of compression (Harvey 1989), or even implosion (McLuhan 1964). This major blurring of boundaries is triggered by various socio-economic and technological factors that infuse space with temporal properties. As satellites allow the tracking of bodies and commodities around the globe in real-time, as communication networks allow the dispersion and consumption of information in unprecedented speeds, time and space are overlapping, or to put it more gingerly in the words of Mitchell and Hansen (2010, 111), "they are being sutured together, rendering Einstein's space-time continuum an everyday life condition". The diffusion of information and communication networks on a global scale demanded for a redefinition of temporality and spatiality.

The above theories prepared the ground for a different kind of ontology that focuses not on what space is, but on *how* space comes to being. Theorists of this *ontogenetic* approach understand space as an entity which it is not fixed in time, definable or predetermined. Rather, space is perpetually being produced as an assemblage of material and social aspects. As Kitchin and Dodge (2011, 68) frame it, *space* "emerges as a process of ontogenesis". The idea of process is important, because it introduces the element of time, which was not strongly pronounced in the evolution of spatial thinking up to this point. With time as the key factor of its ongoing practice, space comprises physical aspects (its form and materials), functional aspects (uses and activities like interactions, transactions, mobilities) and meaning (as assigned by context, events and people's memories, moods, intent).

In this light though, some theorists warn of the significance of place being eroded by the large-scale 'space-time compression' caused by globalization. In reaction to this, others find that the convergence in question holds spatial potential. For instance, Massey suggests that places are produced by the complex intersection of processes that operate *across* spatial scales, forming flows and movements from the local to the global and back (Hubbard et al. 2002, 17).

In Bauman's (2000, 110) words, "a bizarre adventure happened to space on the road to globalization: it lost its importance while gaining in significance". Even if the controversial subject of globalization reaches far beyond the purpose of this essay, there's one thing worth to consider that most theorists would probably agree on: it bended the parallels of time and space until they met.

Worth to consider is another concept of contemporary physics that recently made its way into spatial theory: 'dark matter' attempts to explain the phenomenon of 'gravitational lensing'. In the theory of general relativity, the presence of matter curves spacetime, causing the path of a light ray to be deflected (Cohn, 2010). In the universe, it is the presence of dark matter that is thought to bend the travelling light of galaxies. Scientists can't actually *see* it, but its implications on the physical world are a firm proof of its existence. Many see the concept of dark matter as a fruitful metaphor for the hidden background processes that shape space, be it urban or domestic. Vanstiphout (2011) uses the term to refer to the complex underlying web of politics, power, economics and society that enacts urban space. "Dark matter is the substrate that produces" as Hill (2012) puts it, referring to policies, market mechanisms, legislation, finance models, governance structures, local culture and national identity to name but a few. In the context of this essay, communication networks and software do participate actively in that 'spatial' black matter: they are almost imperceptible, yet they shape space in a set of tangible ways.

2. SPECIES OF (CODE-)SPACES AND OTHER PIECES [1]

1
A paraphrase of *Species of Spaces* (1974) by Georges Perec.

Nowadays, architecture is understood as an interdisciplinary act more than ever before. To keep up, architects need to understand and engage with fields such as networks and system theory, interface and interaction design, computing and data structures. In this light, architects and urbanists should be working closely together, not only with engineers, sociologists, geographers, lawmakers and communities (as they hopefully already do), but also with software developers, data scientists, designers and artists. Thus, a dynamic cluster of *spatial practitioners* emerges to address pressing questions: How is space produced, lived and

occupied? How does it relate to society, nature and time? Where does code come in?

2.1. The analog origins

The story of code and space is no novelty — it roots back to the interplay of architecture and media, with communication being their binding substance. As demonstrated in the first part of this essay, space (and thus, the built environment) was once considered to be an idle, passive container of life. Nowadays, especially when examined from the standpoint of media or system theory, architecture emerges not only as a medium, but possibly as the impurest medium of all (Mitchell 2007, 398), since it embodies all arts into a total work of art, a 'Gesamstkunstwerk'. In this light, space is understood as a structure of analog media, regaining part of its missing temporality: it includes aspects of the environment (light, shadow, sound and other elements of nature), properties of the surface (texture, color, materiality) and of course boundaries (borders and architectural elements). Space is no longer considered to be idle and mute — it processes and produces meaning by the means of structures, events, signs, phenomenological properties and temporary configurations. In short, being a spatial discipline, architecture renders itself a form of media — or as the wordplay goes, 'form informs'.

If architecture is in fact such a diverse medium, why does it fail to convey it? One possible explanation could be that whatever meaning the built environment may communicate, it will end up being mistaken as noise in a super-abundant field of signals. This is above all a matter of attention, for as Benjamin (1936, 40) insightfully said, architecture is always perceived "in a state of distraction", much like a mundane backdrop to the rush of everyday life. Secondly, it may also be a matter of form. As Jacob (2012) writes, architecture, just as McLuhan's light bulb, emits information — but we fail to recognize it as such because of the *way* it presents its data. In this case, architecture's Achilles' heel is that it undoubtedly belongs to the realm of the real, whereas the rest of media reveal the content of contiguous worlds. Also, a third issue of speed arises. Because of its nature, architecture has slow reflexes to paradigm shifts and everchanging demands. A reason why "architecture is too slow to solve problems" (Price 2003, 57) might be that as a spatial practice, it cannot cope with the speed of a reality that is constantly stretching the dimension of time.

However, apart from architecture's innate mediality, its ongoing mediatization is also reaching a peak. The origins of this tendency may be traced back to the utopia of liberating actual architectural elements from their functional role to use them as means of communication — for example, the wall shed its role as load-bearing partition and instead act as "a mediatic channel of information" between the interior and the exterior (Siegert 2013, 24). The transformation was mostly fueled by the introduction of mass media in the modern household, which penetrated its private space with dashes of public life through devices such as the landline phone, the radio and television. For many visionaries, such as Price and Archigram, this intrusion kindled further explorations of the ways communication technologies enact space, as well as demands for an architecture more ambiguous and ephemeral, able to be adapted to the everchanging needs of its users. As opposed to the res-

trictions of the top-down modernist approach, the central concept of the 'non-plan movement' came to be that of *indeterminacy or calculated uncertainty* (Mathews 2007). Looking back, the founder of the Archizoom explains that "the ingredients of a new architecture had to be technology, software, irony and happiness" (Branzi 2006).

Needless to say, the transition from the analog electronics of modernity to the contemporary digital technologies and their implications on space — be it urban or domestic — is a fascinating non-linear journey. For the purposes of this essay though, only the contemporary condition will be further developed.

2.2. The smart mandate

Over the past decade, the discussion on the alliance of urbanism and computation was developed and promoted along the key term *smart city.* According to the dominant narrative, a city would become smart — mostly energy efficient and sustainable — the moment its urban processes would be monitored, optimized and automated by software. However, when these ambitious ideas were put into practice in prototype u-cities (u — for 'ubiquitous' computing), they were met with acute criticism. It seemed that somewhere along the road, their urbanism abided by globalized corporate interests and their citizens ended up being treated as mere data mines. Most of these cities were designed as centralized control networks with little regard for the locale or interventions by their communities from the bottom up. Recalling her research visit in Songdo, Halpern writes on its absence of spatial qualities:

> **What is noticeable is the pure aesthetics of computation. Sleek glass. Pure transparency. The ubiquity of nonstructures. This is the territory of nonarchitecture. The location of the city, the site, is unimportant. It is hard to know what is being marketed, except some concept of greenness and the fluidity of life as rendered by a computer (...) What is even more curious in the standard visions of these spaces is that engineers confess that they have little interest or concern with the spatial form. (Halpern 2014, 239)**

Nonetheless, the stakes are too high to allow smart cities to be thought as urban-scale commodities. If anything, early examples of smart cities such as Masdar and Songdo serve as constructive case studies to question what city-smartness should stand for. Spatial practitioners began to articulate more holistic approaches to 'city-smartness', in order to meet the diverse needs of the world's real cities. Smart cities should be *places* where "information technology is combined with infrastructure, architecture, everyday objects, and even our bodies to address social, economic, and environmental problems" (Townsend 2013, 15). In this ongoing process of re-evaluation, the concept of *indeterminacy* returns: smart cities should allow for "spontaneity, serendipity and sociability" (Townsend 2013, 15), because if all randomness is programmed out of the equation, cities will turn into sterilized, homogenous environments of automation. For instance, with reference to the decentralized and almost completely autonomous traffic-control system of Japanese trains — on which the Korean 'smart' ones are based (Halpern 2014, 276) — anthropologist Fisch explains:

> **The margin of indeterminacy is the space and time of the human and machine interface. Put differently, it is the dimension in which bodies and machines, with their incommensurable qualities (technicities), intersect with the time and space of institutionalized regularities to produce a metastable techno-social environment of everyday urban life. (Fisch 2013)**

From a certain distance, the city may appear virtually unvaried or balanced. However, a closer look would reveal that urban space is instead a contingent entity, always dynamically shaped "through the daily flux of interactions, transactions and mobilities" (Kitchin and Dodge, 68). In short, even if urban life seems to be in an apparent state of equilibrium, it is always a synthesis of smaller, unpredictable situated processes and events—and this is exactly the reason why the margin of indeterminacy would be as vital for the smart city.

The above condition underlines the importance of *scale* in the contemporary city, made evident especially through the increasing proliferation of mobile technologies. Since smartphones grant users with the ability to directly inform the system of their local needs, the new paradigm of smart cities moves away from the vision of heavily data-driven, high-tech large infrastructures of u-cities. Instead, the focus is directed toward 'soft', situated interventions in the urban fabric of existing cities. After all, 'intelligent' global structures are an assemblage of myriad of local, 'dumb' interactions (Galloway and Thacker 2007, 67).

Lastly, the dimension of *time* is undoubtedly key in redefining the smart-city. On the one hand, smart technologies could accelerate tactical urban interventions by institutions as well as non-permanent initiatives by communities. The speed of information networks in a smart city is at the service of citizens, for they can make use of real-time data to "make chronic local problems more visible, creating new pressure for long-term fixes" (Townsend 2013, 306).

While the fruitful speculation on smart futures and potential strategies continues, cities have already been sown with code. The substrate of smartness is in place—and it is set by the relationship of space and code. The next part of this essay will examine the numerous expressions of software-mediated urban realities.

2.3. Gradients of code/spaces

> **The modern city exists as a haze of software instructions. Nearly every urban practice is mediated by code. (Amin and Thrift 2002, 125)**

As information and communication technologies become the lifeblood of the smart city, software leaves the confinement of our personal computers to inhabit our cities. Moving away from the sterile scenario of u-cities enveloped in cocoons of big data, code nowadays is developed in synergy with space and vise-versa. It might run on the background of our perception, but it produces tangible effects in physical space.

The spatial results of software can be addressed according to four successive levels of coded activity, deriving from either coded objects, or infrastructures, processes and assemblages (Kitchin and Dodge, 5). *Coded objects* rely on

software to perform as intended, but their agency varies. They range from items entirely dependent on external computers to function (such as CDs or credit cards) to objects that have the built-in ability to take input from their surroundings and possibly connect themselves to networks (such as mobile devices) to pass data on. Networks comprised by coded objects are considered *coded infrastructures*, but this term also includes all material infrastructures managed by software.

As far as urban space is concerned, these could be computing networks, utility networks (like water and electricity), communication networks (like the telephone and the radio), transportation networks, financial networks and so on. Their spatiality resides in the extend of their coverage, from localized to global. For instance, a common localized urban infrastructure is the traffic regulation system: a network the coded objects of which are the city's traffic lights.

The last two levels of activity are particularly interesting because, unlike coded infrastructures and their objects, coded processes and assemblages do not manifest their presence in some direct material way, yet their impact affects urban space in a broader sense. *Coded processes* can be better understood as flows of captured data that travel through coded infrastructures (Kitchin and Dodge, 6). They are usually associated with databases of personal accounts (such as banking or healthcare) and they regulate the ways individuals access and manage them. As a result, fundamental urban activities such as commercial transactions and civic services are nowadays almost entirely carried out through coded processes.

Lastly, the folding of multiple coded processes and their infrastructures results in *coded assemblages* of higher complexity. This convergence produces the practices and experiences of particular urban environments, like a hospital, a supermarket or even the transport system of an entire city. Air travel is considered to be one of the most intensified examples of coded assemblages. The apparatus of travelling or transporting goods as affordably and fast as possible is nowadays almost entirely virtualized—from ticketing to boarding, contemporary airports are spaces produced by software (Kitchin and Dodge, 137).

Furthermore, code produces space through a process that is a negotiated and prone to human interferences. This condition echoes the contemporary *ontogenetic approach* to space mentioned earlier in this essay. Lefebvre's oft-cited quote, that "(social) space is a (social) product" (1974, 26) is very relevant today in a whole new manner. One may suggest that it is the use of brackets that makes room for all the diverse factors that participate in spatial production—code being a new addition to them. In this framework, the alliance of code and space needs "to be understood ontogenetically, that is, as something continually brought into being through specific practices that alter the conditions under which space itself is produced" (Shepard, 23).

To describe the hybridization of space and code, Kitchin and Dodge coined the term 'code/space'. They acknowledge the ontogenetic perspective and suggest that code/space, like all space, *becomes*. The difference in-between though, lies in the fact that in this case, code quite literally mediates the practices and processes of space production. In their words:

> **Code / space occurs when software and the spatiality of everyday life become mutually constituted, that is, produced through one another. Here, spatiality is the product of code, and the code exists primarily in order to produce a particular spatiality. (Kitchin and Dodge, 16)**

The spatial agency of code derives from the fact that it possesses a significant degree of productive ability, referred to as 'technicity'. The technicity of code is realized through transduction, which is a process of ontogenesis——the making a new of a domain in reiterative and transformative practices (Kitchin and Dodge, 72). Simply put, the state of space is always in transition, in a recurrent trajectory orchestrated by software.

In general, the characteristics of code / space are diverse reconfigurations of these inherited from its respective components. For instance, the degree of the mutual constitution of space and code may vary throughout the same coded assemblage (Kitchin and Dodge, 74). Also, its experience differs among individuals according to the degree of their involvement, which may insert unplanned potential for 'sabotaging' the transduction process. It is important to note that assemblages are not absolute or universal in nature, because they are comprised of many, often competing relations. Kitchin and Dodge (2011, 137) make the case that code does not determine space, as "software's ability to do work in the world is mediated by people". All in all, the nature of code / space is never determined. Instead, it is always adapting to the parameters of place, time and context. These parameters are also key for domestic hybrids of code and space. Approaching interaction technologies from an architectural standpoint, McCullough (2004, 118) regards spatial context to be vital for a meaningful interaction, as it "reminds people how to behave" in a similar way protocols do for devices. Contemplating on the ways computing can ameliorate the domestic environment, he believes that situated interactions should adopt a modus operandi founded on enduring typologies of inhabited space.

There are numerous spatial situations which could form a fertile 'digital ground' for situated computing. McCullough (2014, 119) nests thirty of them under four general clusters of typical activities: work, home, leisure and commuting. Zooming in the home, *sheltering* is identified as its most fundamental condition and a means to ensure a comfortable indoor climate. He suggests that smart climate-management applications should allow for variations of engagement with it. The home is also a place for *recharging*, an activity largely dependent on domestic infrastructure that keeps getting smarter.McCullough (2014, 129) foresees the tendency of wearables and how they might enable the elderly to live more comfortable and independent lives. He goes on to identify that *idling*, the non-activity of just taking a moment, has changed dramatically with the proliferation of electronic communications in the home. On the one hand, they do provide a gateway to the world, but on the other, when misused they disperse the attention of the subject and alienate homely idleness. Furthermore, be it reasons of unlawful behavior or declining health, there has always been some specialized residential types that can be listed under *confining*. Could information technologies make a positive impact towards more open and versatile ways of transducing such places? *Servicing* refers to the wider network of services dispersed in the neighborhood of the home. The smart interactions of the future could focus on how to reinforce

the home's interconnections within this spatial network (McCullough 131). Finally, as long as *metering* is concerned, a more efficient management of domestic resources is needed.

McCullough is an advocate of situated computing as opposed to the way technology firms have been marketing ubiquitous computing. He finds needs for universality and total mobility to be irrelevant when it comes to meaningful situated interactions (McCullough 142). Instead, he welcomes local protocols as means to cultivate embodied experiences. A space well-made would be the richest foundation for the design of context-aware technologies.

3. CODE AS A DESIGN TOOL

A lot has changed since Negroponte's vision of the architecture machine. The exponential introduction of CAD systems in architecture transformed the profession in various ways. It allowed for an unprecedented precision in design and construction, new speeds of workflow and fluent interdisciplinary collaboration. The first steps of CAD systems followed the everyday professional routine of architects and engineers. They were designed to optimize the design process of the most complex of projects—and they managed to do so quite well. Up to a certain extend though, they were regarded simply as an enhanced, digitized equivalent of traditional draft tools like the pencil, the ruler and the drawing surface.

3.1. Paradigm shift

Right before the turn of the century, architects attempted to harvest the computational power of CAD systems to achieve geometries that would deviate from the established Cartesian norms. In practice, it was an attempt to negotiate the ways in which architecture dealt with complex and heterogeneous contexts. In one of the most influential essays of the time, Lynn (1993) underlines the need to 'smoothly' reconcile oppositions by means of an "intensive integration of differences within a continuous, yet heterogeneous system". This approach was later to be known as *parametricism* and it was indeed quite influential, especially among the younger generations of the profession. However, as an architectural approach, it wore off as quickly as it caught on for various reasons. The initial experimental intentions were soon reduced to a mere infatuation for dandified form—the prompt for 'smoothness' was misinterpreted as a literal goal, while social, economic and environmental relations were more often than not overlooked during the design process. Also, parametricism was heavily criticized for the fact that although it used new design tools, it was still maintaining the top-down design mentality of the past. The design process remained still strictly linear and new technologies were simply used to serve the initial intention of the architect as such.

While parametricism faded, another, more mature approach emerges in response to it. In the past decade, a growing number of designers began to explore the potential of software in relation to spatial conditions. As design software became more transparent, it allowed creators to engage with it and conduct the design process from the bottom up and in a non-linear fashion. Simply put, this new direction in architectural computation places emphasis

on the design process instead of the execution of a preconceived formal result. The influence of an *ontogenetic* spatial thinking is apparent, as architects set out to map potentialities and forge variations of types. Possible spatial configurations emerge as an assemblage of the various parameters and of their dependencies.

3.2. Digital craftsmanship

Nonetheless, a holistic approach like the above requires a deep understanding of properties of space, software and materials. In this light, the contemporary craftsman ought to develop the respective skillset to be able to design the design process. Apart from the use of graphical algorithm editors, that require no programming background, many designers nowadays learn how to script. This new skill provides insight on the way design software works, and allows architects to manipulate it and adapt it to their specific needs or develop their own.

Apart from that, code restores the direct relationship between architects and the material output of their labor, which degraded during the industrial era. For a long period of time, digital tools were also thought to be yet another manifestation of the nature-technology opposition. They were accused of isolating the designer in a virtual environment poor in references to the actual world. The new paradigm in architecture moves away from such concerns, as it regards digital tools as means of expressively manipulating *real* matter. Inspired by a time where the form-generating process derived form the innate characteristics of the material, DeLanda writes:

> **Craftsmen did not impose a shape but rather teased out a form from the material, acting more as triggers for spontaneous behavior and as facilitators of spontaneous processes than as commanders imposing their desires from above. In all this, there was a respect for matter's own form-generating capabilities and an ability to deal with heterogeneity. (DeLanda 2002, 135)**

In this light, digital tools seem to reintroduce pre-modern concepts like craftsmanship and respect to matter into architecture's expanded field. To use them intuitively, to take advantage of their full potential—just as craftsmen once knew their tools - seems to be a matter of protocols (Gourdoukis 2015). On the one hand, protocols are undoubtedly a crucial part of the design process but, on the other hand, they are out of reach of the architect, always built-in to the machine, always developed by specific manufacturing firms. For example, in the case of digital fabrication tools, protocols mediate the way 3D models are translated into machine gestures—be it trajectories of a 3D-printer head, a CNC miller or a robotic arm. However, this is a standardized operation, designed to offer a finite set of options to the designer. This paradox comes as no surprise, since this contradiction is an innate characteristic of the protocol, which "has to standardize in order to liberate" (Galloway 2004, p.95).

The above condition poses a challenge for architects and designers that wish to explore new ways of working with digital tools. Suggesting a workaround to this issue, Gourdoukis (2015, 52) writes that architecture "should

try to harness those protocols and, instead of following the preset standards, to try and invent new ways of operating the machines". This new direction in computational design is also supported by the ongoing democratization of digital fabrication tools, as they are constantly becoming more affordable, portable and open-sourced. In the first page of the 'Architecture Machine', Negroponte dedicates his influential book "to the first machine that would appreciate the gesture". It might have taken more than fifty years, but architects that appreciate machine gestures are finally here, ready to offer a handshake.

4. CONCLUSION

In recent years, the need for other ways of enacting spatial change challenged architects to operate beyond their traditional responsibilities. The game of space is nowadays more interdisciplinary than ever, witt an emergent cluster of *spatial practitioners* shaping its futures and posing pressing questions that are yet to be answered. The interest of this essay is to study the ongoing hybridization of code and space and draw diagonals to its possible origins, its context and implications.

The introduction of this essay offers a timeline of the ways that the conversation on space took an ontogenetic turn, placing emphasis on its background processes and immaterial properties. Subsequently, with the consideration of architecture as a medium, a diagonal is drawn from the inherent mediality of space to its mediatization, which arguably prepared the ground for the hybrid of code / space. Afterwards, typologies of code / spaces are analyzed to demonstrate their correspondence to social and economic relations of our everyday life. In support of this argument, several examples are provided on how code transduces urban, as well as domestic spaces. Also, smart cities are addressed in order to set the urban scale in the broad framework of code / spaces. Finally, code is examined as a design tool from the architect's standpoint. Two pressing issues that are worth mentioning are identified. There is an alarming possibility that code / spaces are still not enough concrete against their potential misuse as fields of surveillance. Also, solutions of social nature are rarely included in the 'smart' agenda, posing a risk of excluding lower social groups from their right to the contemporary city.

The contribution of this essay to the ongoing discussion on space and its relationship with code could be summarized in the following points. First comes the argument that code / spaces are a product of the convergence of time and space. Not only does code add degrees of temporality to space, but it also has the ability to build spatial stratifications of meaning. Secondly, contemporary cities hold great potential for smartness, as long as, and only if, it is created through a gradual, strategically planned engagement of their citizens in the process. Finally, architects will manage to understand their digital tools and unlock their potential only if they are willing to cross the boundaries of their profession.

REFERENCES

Bauman, Zygmunt. Community: Seeking Security in an Insecure World, Polity Press, 2000.

Benjamin, Walter. The work of art in the age of its technological reproducibility, The Belknap Press of Harvard University Press, 2008 (originally published 1936).

Branzi, Andrea. Weak and Diffuse Modernity: The World of Projects at the beginning of the 21st Century, Milan: Skira, 2006.

Cohn, Joanne D: Gravitational Lensing (December 2010, last access: December 2016) http://w.astro.berkeley.edu/~jcohn/lens.html

DeLanda, Manuel. Philosophies of Design: The Case of Modelling Software, Verb: Architecture Bookazine, Actar, 2002.

Fisch, Michael: Tokyo's Commuter Train Suicides and the Society of Emergence, on Cultural Anthropology journal, Volume 28, Issue 2 (May 2013), p.320-343. Available online (last access: February 2017): http://onlinelibrary.wiley.com/doi/10.1111/cuan.12006/full

Galloway, Alexander. Protocol: How Control Exists After Decentralization, The MIT Press, 2004.

Galloway, Alexander and Thacker, Eugene. The Exploit: A Theory of Networks, University of Minnesota Press, 2007.

Gourdoukis, Dimitris. Digital Craftsmanship: from the Arts and Crafts to Digital Fabrication, Archi|DOCT #4: Matter, Vol.2, ENHSA (European Network of Head of Schools of Architecture), 2015.

Halpern, Orit. Beautiful Data: A History of Vision and Reason since 1945, Duke University Press, 2014.

Harvey, David. The Condition of Postmodernity, New York: Blackwell, 1989.

Hill, Dan: Dark matter (August 2012, last access: December 2016) http://www.cityofsound.com/blog/2012/08/dark-matter.html

Hill, Dan: The Commodification of Everything, published at Medium (October 2015, last access: January 2017) https://medium.com/butwhatwasthequestion/the-commodification-of-everything-2057f07bd03c#.vqgiioakn

Hubbard, Phil et al. Thinking Geographically: Space, Theory and Contemporary Human Geography, Continuum Press, 2002.

Jacob, Sam: The Communicative Mode of Architecture – MAS CONTEXT (2012, last access: November 2016) http://www.mascontext.com/issues/14-communication-summer-12/the-communicative-mode-of-architecture/

Kitchin, Rob and Dodge, Martin. Code / Space: Software and everyday life, The MIT Press, 2011.

Lefebvre, Henri. The Production of Space, Blackwell, 1991 (originally published in 1974).

Lynn, Greg. 'Architectural Curvilinearity: The Folded, the Pliant and the Supple'in Greg Lynn – Folding in Architecture, Architectural Design, 1993.

Mathews, Stanley. From Agit Prop to Free Space: The Architecture of Cedric Price, Black Dog Architecture, 2007.

McCullough, Malcolm. Digital Ground: Architecture, Pervasive Computing, and Environmental Knowing, The MIT Press, 2004. McLuhan, Marshall. Understanding Media, The MIT Press, 1964.

Mitchel, William J.T. There Are No Visual Media, MediaArtHistories, 2007.

Mitchel, William J.T.and Hansen, Mark. Critical terms for Media Studies, The University of Chicago Press, 2010.

Negroponte, Nicholas. The Architecture Machine, The MIT Press, 1970.

Nigel, Amin, Ash and Thrift. Cities: Reimagining urban theory, Polity Press, 2002.

Price, Cedric. Re: CP, ed. by Hans-Ulrich Obrist, Birkhäuser, 2003.

Shepard, Mark. Sentient City: Ubiquitous Computing, Architecture and the Future of Urban Space, The MIT Press, 2011).

Siegert, Bernhard. Nach der Wand, Interferenzen zwischen Rastern und Schleiern / After the Wall: Interferences among Grids and Veils, GAM: Graz Architektur Magazin, 2013.

Till, Jeremy et al. Spatial Agency: Other Ways of Doing Architecture, Routledge, 2011.

Townsend, Anthony. Smart cities : big data, civic hackers, and the quest for a new utopia, Ney York: W. W. Norton & Company Inc., 2013.

Vanstiphout, Wouter, interviewed by Rory Hyde (August 2011, last access: December 2016) https://www.australiandesignreview.com/architecture/historian-of-the-present-wouter-vanstiphout/