Maja Bak Herrie

ELUSIVE BORDERS: VIRTUAL GRAVITY AND THE SPACE-TIME OF METADATA

The digital has become an important part of everyday life in terms of virtual and physical objects filtering and forming our experience of the world, often without our awareness. Countering this imperceptible or even 'immaterial' relation to the technologies that shape and facilitate our lifeworld, a number of contemporary artists are working with what can be understood as the more 'physical' parts of the infrastructures of data transmission, storage, and reception. However, analytical potential emerges when these two poles are juxtaposed with particular sensibility to the continuity between them. Indeed, this continuity creates opportunities for studies of the physicality of the virtual – the 'stuff' of signs, norms, beliefs and representations, and the imaginary and ephemeral aspects of seemingly 'solid' objects as borders and boundaries.

In this article I discuss the themes of movement and restriction inherent in digital technologies in two very different artistic projects, both of which offer aesthetic material for debating the politics of data. I approach this discussion through the term gravity as used by philosopher Levi R. Bryant (*The Gravity of Things*; *Onto-Cartography*). Through an analogy to Albert Einstein's theory of relativity, Bryant suggests the term gravity to denote how both semiotic and material entities influence the becoming and movement of subjects and collectives in time and space (Bryant, *The Gravity of Things* 10). I use this as a point of departure to investigate the shared space between physical and virtual borders, and the streams of data that are formed by, and also form, the space they traverse. The term gravity is used to elucidate the contours of the digital space that determines the paths between sender and receiver, as well as draws and erases borders, restricts and enables movement.

Introduction: Physical and digital borders

Whether portrayed as boundaries or frontiers, borders are often conceptualised with reference to political geography (Basaran). From a legal perspective, borders are constantly transformed, negotiated, and contested as they are determined by enforcement rather than geographic stability. However, the border, as a geographic boundary between two entities, may be defined in a more formal or mathematical way. For example, the Euclidean definition describes space in terms of proximity or metric closeness, or, more simply, as the distance between two points defined by a straight line drawn from the first point and subsequently ending with the other (Weisstein).

The differences between legal and mathematical approaches to borders seem to define a very distinct quality of this phenomenon: It occurs between actual localities with or without a *physical* barrier, and between legally determined spaces with or without an executively enforced *virtual* barrier. Questions concerning borders seem to represent this conundrum: One may be at Europe's doorstep, physically only a few metres from the soil of a European country, yet the legal border forms an even more fundamental spatiality related to possibility. In Euclidean space, two locations may be close to one another, but because of the presence of fences and the way borders are laid out, it may be difficult to reach a particular location. The ongoing Syrian refugee crisis is an example of this. Europe's borders exercise a certain gravitational effect on movement affecting social relations. Borders include not only actual physical hindrances, such as a dangerous sea or an impenetrable fence, but also virtual interruptions, such as images

of crowded ships, documentation of deaths at borders, deployment of border guards in so called "hot spots" of border regions, and military imagery and language (De Genova, Mezzadra and Pickles 13). These 'virtual' appearances of the border all serve to present what Nicholas De Genova has identified as the "spectacle of the border", deepening and extending the physical architecture of the border (1181). Although in Euclidean space the Syrian refugees may be physically close to the Greek border, spatial and temporal closeness are understood differently in lived space and time, because of the administration and control that impose both a physical and a virtual architecture of exclusiveness. Thus, the European border functions as a spatio-temporal gravitational field, warping the possibility of movement in various ways, impacting the ability to move to and live in certain spaces, or, as Bryant describes it:

> *Space and time are not the same everywhere, and movement is not materially possible in all directions […]. The way in which roads are laid out in a city play a role in what is related to what, how one entity has to move in order to reach another place, as well as the time it takes to get from one place to another. (Bryant,* The Gravity of Things *28)*

In much the same way as the layout of roads and borders in cities matters for the movement of individuals, so does the layout of cables and the locations of sources and receivers for data transmission. And much as the virtual needs the physicality of cables and routers, so do seemingly solid objects such as borders and boundaries, as they are deepened and extended by the immaterial 'stuff' of signs, norms, beliefs and representations. Movement and restriction are formed by, and form, the spaces in which they unfold.

In this article I consider the politics of data as it is embodied in two different works of art. Both artistic projects address the ambiguity between relations and matter, data flows and bodies, and transactions and the places of things (Meade). A recurring question in this article is how artistic strategies of exploring hidden or unnoticed infrastructures may help address the questions concerning the ephemeral and complicated status of some of the objects that facilitate and determine everyday life.

A space-time of information flow: Subterranean cables

The first project I bring into this discussion is artist Nina Canell's subterranean cable project. Among the works included in this project are two from 2015: The *Mid-Sentence* series, exhibited at Moderna Museet, and the *Shedding Sheaths* series, included in the Satin Ions exhibition in Seoul, amongst others. Canell's work is based on subterranean cables of various sorts: fibre-optic cables used for long distance telecommunication or for providing high-speed data connections between various locations, electrical and communication cables, and a variety of sheathings designed for diverse contexts. The artworks allow the viewer to perceive normally imperceptible infrastructures as they are exposed by aesthetic means. To follow the material qualities of the work requires more than a discussion of 'the digital', or as media archaeologist Jussi Parikka suggests, we have to "pick it apart and remember that also mineral durations are essential to it being such a crucial feature that penetrates our academic, social, and economic interests" (Parikka 5). Parikka calls attention to the

components and materials that facilitate the functionality of technologies and media, and instead of exclusively theorising about the social or economic phenomena of networks, he advises that we also remember the importance of copper or optical fibre for such forms of communication (5). In this case, 'matter' is rather complicated. As Bruno Latour remarks, assemblages are "simultaneously real, like nature, narrated, like discourse, and collective, like society" (Latour 6). To draw attention to the optical fibres of the networks constituting and facilitating everyday communication, the 'stuff' of signs, norms, beliefs and representations, or the complicated ways in which things are interrelated in societal assemblages should not be ignored. Bryant approaches this discussion by proposing the use of the term gravity to investigate how different kinds of power unfold. Moreover, the advantage of the term gravity is that it accentuates the ways in which non-human machines such as technologies, infrastructures, and geographical features also contribute to the forms taken by social assemblages (Bryant, *Onto-Cartography* 10).

The important intuition in the Einsteinian approach to the discussion of gravity in physics is – in consonance with Bryant's views – the understanding of gravity as something other than *force* (Bryant, *Onto-Cartography* 186). Building on the Newtonian understanding of gravity, Einstein diverged from Newton on this particular point. According to Einstein, gravity is an *effect* of how the mass of objects curves space-time, rather than being a force that *attracts* or *repels* other objects. The movements of the moon do not originate in a dynamic of force initiated by the relationship between the moon and the earth, but occur because of the mass of the Earth curves space-time, creating a path the moon follows. From this perspective, gravity is a field or a topology that other objects' movements follow (Bryant, *Onto-Cartography*

186). Whereas Einstein's account of gravity pertains only to mass, the use of the term here in a broader philosophical inquiry refers to physical motion and fields produced by signs, technologies, infrastructures, and so on (Bryant, *Onto-Cartography* 194). In this context, the term sheds light on exclusions and inclusions of data flows and electricity, as it is ascribed to the space-time of the information flow along fibre-optic cables. Here, material entities – exemplified by Nina Canell's cables – play a pivotal role in the movement of subjects and collectives across time and space.

Following the idea of the subterranean cables series, Canell has transformed her (and her artistic partner Robin Watkins') website into a *tracerouter*, tracking the information about, and length of the cables used for transmitting data from her atelier in Berlin to the visitor's local server (Canell and Watkins). When loading the website, one becomes aware of these paths, as the functionality of the servers involved in the data transmission becomes apparent. The content of the website is visible only because of thousands of kilometres of subterranean cables constituting a network of data. Whereas the operating cables constitute the space-time of the information flow – the space for every possible movement of the signal – the routers, however, create the gravitational function that curves space-time and forces the messages along particular paths. Without this complicated network of copper and plastic sheathing there would be no flow of information. The shape and the curvature of the network space-time are determined by the things in it, or, as Bryant states: "Space-time does not pre-exist things, but rather arises from things" (Bryant, *The Gravity of Things* 12). The cables do not move, but the path along which the message travels is dynamic. The things populating virtual space-time, in this case the routers

that constitute the network, create a curvature that shifts the direct path of the system based on an optimising logic of throughput and speed. Canell's tracerouter shows the direct path through the current formation of the network.

Silenced *mid-sentence*

To make the subterranean cables perceivable sculptures lying on the gallery floor, Canell unearths the electrical and communication cables from their hidden locations. To make them visible and tangible, she has to dislocate and interrupt their functionality. One could argue that in order to present her critique, she has to destroy the objects, fixing them to white gallery spaces. Whereas the tracerouter on the website shows the functionality of the cables as the signal passes through, the cable bodies on the gallery floor have been interrupted, almost violently cut away from their functionality as a medium of communication. Neringa Černiauskaitė's review of the cable sections in Canell's exhibition at Moderna Museet notes:

> They appear as open mouths with half-pronounced words hanging like dead sound in the air […] Almost surgical incisions in the cables reveal their internal "organs" for the viewer's inspection: Dead slices of the flow of information. (Černiauskaitė)

The way in which Canell makes infrastructures accessible is in some way similar to the way in which an entomologist collects insects to inspect them without having them "flapping around" (Černiauskaitė). The functionality of the infrastructures was never visible, the electrical transmission of the message never apparent. When the signal of

the cable function is lost, it is like examining a screen that is turned off. The cables become symbolic relics of the invisible distance that is only ever traversed immaterially, as it is stated in the catalogue for one of Canell's exhibitions (Ayas, Hoare and Kleinman 60), and the names of the sculptures seem to refer to the paradoxical 'life' of the cable sections, going from being conducting hosts of information that erase geographical distance with connective, distributive and compressive operations, to becoming shedded *sheathings* removed from the sequence of interconnection, silenced *mid-sentence* as dead sound in the air.

Metadata and the 'about-ness' of signs

The second artistic project included here is Trevor Paglen and Jacob Appelbaum's installation, *Autonomy Cube* (2014), shown in many art museums, galleries and civic spaces. The sculpture is made of several connected computers housed within the piece to create an anonymous Wi-Fi hotspot. It routes all Wi-Fi traffic over the Tor network, a global network of thousands of volunteer-run servers, relays and services designed to help anonymise data. The sculpture itself is also a Tor relay, and may be used by others around the world to anonymise their internet use. When *Autonomy Cube* is installed, sculpture, host institution and users become part of the infrastructure (Paglen).

The Tor network (which is an acronym for The Onion Router) has sparked considerable debate, as its encryption potentially interferes with law enforcement. Tor uses the so-called *onion routing technology*, which encrypts metadata surrounding the actual content of the information sent. The data is encrypted several times and is sent through

a random selection of Tor relays. Each relay decrypts a layer of encryption to reveal only the next relay in the circuit in order to pass the remaining encrypted data on to it, hence the name, 'onion routing'. The final relay decrypts the innermost layer of encryption and sends the original data to its destination without revealing, or even knowing, the source IP address (torproject.org). Metadata is a key concept here. Metadata constitutes the context or milieu of the content, revealing the 'surroundings' of the data (e.g. time and date of creation, information about the author and location of the computer network where the data was created). This 'data about data' is crucial when the original data is put to use, as it emphasises the material aspects of the generated of data. It is metadata that gets the attention of the activists behind Tor, the context of the content is what seems to be important: who is sending what, from where, and who receives it?

The Tor network removes the origins of the signal that reveals the metadata as a meaningful identifier, and thereby foils any attempt to compile a history of actions of the sender. By spreading out the locations of the signals in physical space, convergence to a single 'solid' assemblage as a useful representation of a human individual is no longer possible. Indeed, the signals are no longer related to that same individual. Another example of data obfuscation through diffusion is the ad blocker *AdNauseam* that, instead of keeping meaningful parts of the signal secret, as the Tor network does, sends all possible signals at once by clicking every ad that it hides once, as the slogan, "Clicking Ads So You Don't Have To", indicates (Howe). By flooding the surveillance the actual movement of the body becomes impossible to distinguish from all the fake signals. It becomes as impossible to find a pattern in the space of all possible signals as it is to find one in the space of no signal. As metadata constitutes

an increasingly powerful resource for pervasive digital surveillance, "our mainly non-conscious or habitual [actions] count more than our words", as Wendy Hui Kyong Chun puts it. We are "constantly captured and compared to others, our moves determine past and future narratives" (Chun 363). Ad blockers and alternative networks such as *AdNauseam* and Tor seek to obfuscate and obstruct such strategies of bodily capturing in different ways.

Returning to Bryant, metadata may be understood as a crucial part of the data stream representing the geographical distribution of data. Like a virus or a microbe in a particular environment, the message has an epidemiological distribution in the world. Because every text requires a material manifestation in order to travel throughout the world, each is located at a particular time and place (Bryant, *The Gravity of Things* 20). This is precisely the point of the encryption used by the Tor network. Whereas a normal router would use the shortest path from A to B, using the metadata to decide the most efficient path, the Tor router uses a random path, leaving no trace and no metadata, as it is continually peeled off. To address the problems of surveillance, the people behind Tor use virtual space to overcome the problem of proximity, but simultaneously adopt the advantages of physical space by avoiding any traces. Virtual space is used to construct a random path that is impossible to trace backwards or to infer, whereas the physical space is used to deposit the necessary information needed to guide the information flow to its destination. In this way, Tor's use of metadata may be seen as a mediator between two kinds of spatiality: It determines the direction of the message in physical space as a kind of envelope for the mailing system, but it does so based on a principle of randomness, sustaining a borderless space. Instead of 'snowballing' content by adding

more and more metadata, Tor discards the used 'envelopes'.

When comparing the two artistic projects addressed above, a discussion of the borders of the digital emerges, as they both present different aspects of movement and restriction, inclusion and exclusion in digital spaces: Whereas Canell's subterranean cable project exposes the infrastructures of data transmission, providing transparency and accuracy, Paglen and Appelbaum's Wi-Fi hotspot exploits the opportunity of secrecy, using the limited infrastructures of physical space to create an autonomous and border-less space. Although Canell's artwork serves as an example of a peculiar interruption, of unearthed cables that are no longer functional or operational, *Autonomy Cube* is an artwork in flux – it shows the functionality of the infrastructure as a running printing press connecting, transmitting, and receiving. And whereas Canell's artwork explores questions of proximity, of distance between two servers, Paglen and Appelbaum's work concerns autonomy and tracelessness

Both Canell's, and Paglen and Appelbaum's artworks present interesting perspectives on digital spaces. However, an analytical potential emerges when the two types of digital spatiality are comparatively juxtaposed with a particular sensibility related to the continuity between these poles. Indeed, this continuity constitutes a space for an emerging 'digital object' – a term philosopher and computer engineer Yuk Hui also proposes in his 2016 book, *On the Existence of Digital Objects* – in the form of the metadata, potentially being both a representation of a physical location and an obfuscation of this location. Contextualised in this way, the metadata becomes the surface or the shell around the message, both interacting with and being formed by the network as it is transmitted. In one case, the metadata becomes an onion-like envelope in the Tor network, shedding its layers on the way to its destination, and in the case of the tracerouter, the metadata is assembled, noting every individual location it has visited, incorporating the entire path from sender to receiver. The data package inhabits these different spaces and the metadata becomes its surface, both encountering and becoming marked by the physicality of the network.

The cartography of mobility

We now return to the relation between the legal and mathematical definitions of borders sketched in the introduction: the mathematical definition based on proximity, on metric closeness between two objects, and the legal definition that relies on the idea of enforcement as a constitutive power of the border phenomenon. When dealing with machines, both approaches are needed. The concept of metadata may be understood through these two kinds of spatiality: on the one hand, the physical path travelled by the message, exemplified by the nodes visited along the way (where either the message is sent along the optimised path or a layer of metadata is deposited in the Tor protocol), and on the other, the way the path is chosen in the first place (by either selecting an optimised shortest path, or selecting an untraceable randomised path). Metadata is operational in nature, and its objective is the transmission of information, and therefore it both forms and is formed by the space in which it exists. Metadata is *both* the interpretation and the realisation of the message-sending operation.

Space as we perceive it is not operational input for a machine. A machine can only process metadata, and therefore suggest the location of a server. With high

probability, the computer determines an exact location that in a 'normal' network should be correct. However, if you browse Canell's website through a Tor relay the server monitor will suggest locations and cables from all over the world. The metadata indicates the locality, somewhere in the global network of thousands of servers and relays. In line with Bryant's assertion that space does not pre-exist things, but rather arises from them, the metadata becomes the digital object that both forms and is formed by digital space. In this manner metadata becomes both the physical space with fences, walls and barriers, and the borderless space where law enforcement is inoperative. Canell's trace-router captures a glimpse of the underlying infrastructure, a snapshot of the path of least resistance along which a message has travelled. Although this picture is accurate for a network based on a throughput optimising logic, when taken from the Tor network it becomes distorted. This distortion stems from the introduction of a different logic into the construction of the network – a logic of privacy preservation: although the physical layout of the cables remains the same, the cartography of the digital space changes. By changing the routing strategy and protocol, a new network is created, and the nature of the direct path changes as a result of the changing gravity. In effect, this redraws the borders of the map.

The infrastructures of virtual space are just as restrictive, formative and determinative as the borders and walls of physical space, because they are deeply integrated into the infrastructures of everyday life. The two artistic projects I have presented expose the infrastructures of data transmission, storage and reception, and a central question is how these strategies of exploration of hidden infrastructures may help us to address matters concerning the digital objects that facilitate and determine social and political

agency. They both explore the physical and virtual infrastructures that constitute the network, albeit in two different ways: Canell's cables offer a surgical dissection of the body of the network, whereas Paglen and Appelbaum's sculpture shows an alternative mode of operation for these cables, as they transmit packages of information. *Autonomy Cube* may be said to distort the process that enables Canell's website to lay out the entire scope of the physical infrastructure used for sending a package from one destination in the network to another. Instead of tracing the path of the message in the metadata that surrounds it, Tor creates a layered construction of encrypted metadata to begin with, which is peeled off layer by layer as the message traverses the network. In this way the artwork operates as a mediator between physical and digital space, exploiting precisely this intersection.

The digital border resembles the physical border, such as those between nations, yet is a much more extreme version of it. Whereas the physical border leaves room for the actual border in the form a bordered no man's land, the digital border seems to be completely binary. There is no label for the border location itself; one cannot be on the border, only on either side. Although there is a nuanced vocabulary that encompasses both physical and virtual borders and boundaries in real space, exemplified by De Genova's border spectacle, where the 'stuff' of signs, norms, beliefs and representations hinders and restricts movement, such a vocabulary seems to be missing in the case of digital space. Here, only virtual borders exist, and the binary nature of the digital border obstructs any attempt to identify a possible continuity between the discrete entities in the network. In order to explore the physicality of digital space, I propose the analytical concept of the digital object that emerges from the continuity between physical and digital

spaces. The digital object, exemplified here by metadata in the transmission of a message, both forms and is formed by the digital space it traverses. With Bryant's expanded concept of gravity, the contours of digital space may be explored, contours that determine the paths between sender and receiver as they draw and erase borders, restrict and enable movement.

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