Anomaly Detection: The Mathematization of the Abnormal in the Metadata Society

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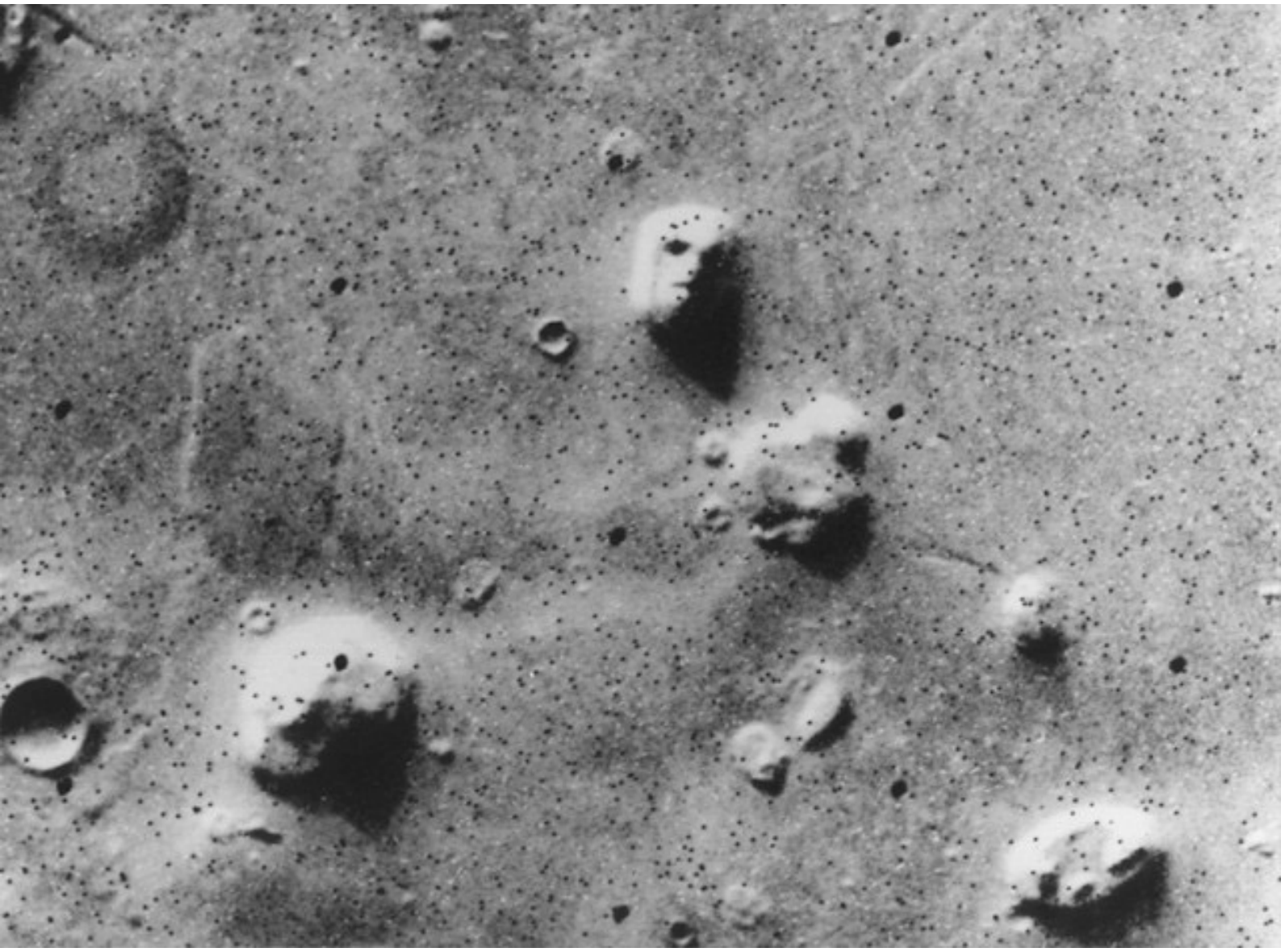

Canonical example of apophenia: a 'human face' recognized on the surface of Mars (photo: NASA, 25 July 25, 1976, Wikipedia Commons)

Introduction

In a book from 1890 the French sociologist and criminologist Gabriel Tarde was already recording the rise of information surplus and envisioning a bright future for the discipline of statistics as the new eye of mass media (that is as a new computational or algorithmic eye, we would say today). In his biomorphic metaphors, he wrote:

> The public journals will become socially what our sense organs are vitally. Every printing office will become a mere central station for different bureaus of statistics just as the ear-drum is a bundle of acoustic nerves, or as the retina is a bundle of special nerves each of which registers its characteristic impression on the brain. At present Statistics is a kind of embryonic eye, like that of the lower animals which see just enough to recognise the approach of foe or prey.[1]

This quote can help to introduced four fields of discussion that are crucial in the age of algorithms. First, as the reference to enemy recognition suggests the realm of battle fields and warfare, military affairs and geopolitics (and therefore of forensics, as counter-practice). Second, as this reference brings us to the field of sociology and criminology, to the definition and institution of the 'internal enemy' of society (that is the *abnormal* in the tradition of Foucault and Canguilhem). Third, we see clearly an enemy also from the point of view of labour exploitation, according to which the worker is an anomaly to measure, optimise and often criminalise (as Marxism would records). Forth, we could envision an autonomous agency for the supercomputers of statistics as in the idea of General Artificial Intelligence and the nightmares of so-called Singularity, where it is this very alien scale of computation to become inimical to the human (see the recent neorationalist/accelerationist debate).

In these cases, of course, the position of the enemy, of the anti-social individual as much as of the reluctant worker that falls under the eye of statistics and algorithms for data analysis, can be reversed and a new political subject can be described and reconfigured, as the research project *Forensic Architecture* has recently stressed.[2]

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[1] Gabriel Tarde, *The Laws of Imitation*, New York: Holt, 1903 [first published in French in 1890], p.136.
[2] See: Forensic Architecture (ed.), *Forensis: The Architecture of Public Truth,* Berlin: Sternberg Press, 2014. And also: www.forensic-architecture.org

A further evolution of that primitive eye described by Tarde, today's *algorithmic vision* is about the understanding of global data sets according to a specific *vector.* The eye of the algorithm records common patterns of behaviours in social media, suspicious keywords in surveillance networks, buying and selling tendencies in stock markets or the oscillation of temperature in a specific region. These procedures of mass computation are pretty universal, repetitive and robotic, nevertheless they inaugurate a new scale of epistemic complexity (computational reason, artificial intelligence, limits of computation, etc.) that will not be addressed here.[3] From the theoretical point of view, I will underline only the birth of a new epistemic space inaugurated by algorithms and the new form of augmented perception and cognition: what is called here 'algorithmic vision'. More empirically, the basic concepts and functions of algorithmic vision and therefore of algorithmic governance that I will try to explain are: *pattern recognition* and *anomaly detection*. The two epistemic poles of pattern and anomaly are the two sides of the same coin of algorithmic governance. An unexpected anomaly can be detected only against the ground of a pattern regularity. Conversely, a pattern emerges only through the median equalisation of diverse tendencies. In this way I attempt to clarify the nature of *algorithmic governance* and the return of the issue of *the abnormal* under a mathematical fashion.[4]

1. The rise of the metadata society: from the network to the datacenter

As soon as the internet was born, the problem of its cartography was immediately given, but a clever solution to it (the Markov chains of the Google PageRank algorithm) came only three decades later. The first datacenter set up by Google in 1998 (also known as 'Google cage')[5] can be considered the milestone of the birth of the metadata society, as it was the first database to start mapping the internet topology and its tendencies on a global scale. In the last few years the network society has radicalised a topological shift: beneath the surface of the web, gigantic datacenters have been turned into monopolies of collective data. If networks were about open flows of information (as Manuel Castells used to say), datacenters are about the accumulation of *information about information*, that is metadata.

These sorts of technological bifurcations and form of accumulations are not new. The history of technology can be narrated as the progressive *emergence of new collective singularities* out of the properties of older systems, as Manuela Delanda often describes in his

[3] For a treatment of these issues see: Luciana Parisi, *Contagious Architecture: Computation, Aesthetics, and Space,* Cambridge, MA: MIT Press, 2013.
[4] See: Michel Foucault, *Abnormal: Lectures at the Collège de France 1974-1975*. New York: Picador, 2004.
[5] Angela Moscaritolo, "15 Years Later, Google Remembers Its First Data Center", PC Mag, 6 Feb. 2014.

works.[6] A continuous bifurcation of the machinic phylum: labour bifurcated into energy and information, information into data and metadata, metadata into patterns and vectors, and so on… These bifurcations engendered also fundamental epistemic shifts. That is, for instance, the passage from industrial political economy to cybernetic mathematisation and digitalisation and today to a sophisticated topology of datascapes. In fact, today, it is the emergence of a complex topological space that we are discussing with the idea of algorithmic governance and computational capitalism.

Specifically metadata disclose the dimension of *social intelligence* that is incarnated in any piece of information. As I discussed earlier in an essay for *Theory, Culture and Society*, by mining metadata algorithms are used basically for three things: first, to measure the collective production of value and extract a sort of network surplus-value (like in the case of Google and Facebook business models and in the case of logistic chains like Walmart and Amazon); second, to monitor and forecast social tendencies and environmental anomalies (as in the different surveillance programs of NSA or in climate science); third, to improve the machinic intelligence of management, logistics and the design of algorithms themselves (as well known, search algorithms continuously learn from the humans using them).[7]

Datacenters are not just about totalitarian data storage or brute force computation: their real power relies on the mathematical sophistication and epistemic power of algorithms used to illuminate such infinite datascapes and extract meaning out of them. What is then the perspective of the world from the point of view of such *mass algorithms*? What does the eye of an algorithm for data mining actually see?

2. A new epistemic space: the eye of the algorithm

Modern perspective was born in Florence during the early Renaissance thanks to techniques of optical projection imported from the Arab world where they were first used in astronomy, as Hans Belting reminds us in a crucial book.[8] The compass that was oriented to the stars was turned down and pointed towards the urban horizon. A further dimension of depth was added to portraits and frescos and a new vision of the collective space inaugurated. It was a revolutionary event of an epistemic kind, yet very political. Architects and art historians know this very well: it's not necessary to repeat it here.

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[6] See specifically: Manuel Delanda, *Philosophy and Simulation: The Emergence of Synthetic Reason,* London: Continuum, 2011.

[7] Matteo Pasquinelli, "Italian Operaismo and the Information Machine", *Theory, Culture & Society*, first published on February 2, 2014.

[8] Hans Belting, *Florenz und Bagdad: Eine westöstliche Geschichte des Blicks*, Munich: Beck Verlag, 2008. Thanks to Clemens von Wedemeyer for pointing me to this source.

When in the '80s William Gibson had to describe the cyberspace in his novels *Burning Chrome* and *Neuromancer*, he had to cross a similar threshold, that is of interfacing the two different domains of perception and knowledge. How to render the abstract space of the Turing machines into a narrative environment? The cyberspace was not born just as an hypertext or virtual reality: since the beginning, it looked like an "infinite datascape".[9] The buildings of the cyberspace were originally blocks of data and if they resembled three-dimensional objects, it was only to domesticate and colonise an abstract space, that is, by the way, the abstract space of any augmented mind. We should read again Gibson's *locus classicus,* to remember that the young cyberspace emerged already as a mathematical monstrosity. Gibson said of the cyberspace:

> A graphic representation of data abstracted from the banks of every computer in the human system. Unthinkable complexity. Lines of light ranged in the nonspace of the mind, clusters and constellations of data. Like city lights, receding.[10]

The intuition of the cyberspace was about the *meta-navigation* of vast data oceans. The first computer networks just happened to prepare the terrain for a vertiginous accumulation and verticalization of information that would occur only in the age of datacenters. As Parisi reminds in her book *Contagious Architecture*, the question is how to describe the epistemic diversity and computational complexity inaugurated by the age of algorithms. She then quoted Kostas Terzidis:

> Unlike computerization and digitization, the extraction of algorithmic processes is an act of high-level abstraction… Algorithmic structures represent abstract patterns that are not necessarily associated with experience or perception… In this sense algorithmic processes become a vehicle for exploration that extends beyond the limit of perception.[11]

As a provisional conclusion we may say: the cyberspace is not the internet — the cyberspace is the datascape used to map the internet accessible only in secret facilities that belong to media monopolies and intelligence agencies. The cyberspace should be described as the second epistemic scale of the internet.

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[9] William Gibson, *Neuromancer,* New York: Ace, 1984.
[10] Ibid.
[11] Kostas Terzidis, *Expressive Form: A Conceptual Approach to Computational Design,* London: Spon Press, 2003, p. 71. Quoted in: Luciana Parisi, *Contagious Architecture,* cit., p. 66.

3. Algopolitics: pattern recognition and anomaly detection

In his latest interview with Wire magazine Edward Snowden has revealed an artificial intelligence system allegedly employed by NSA to pre-empt cyberwar by monitoring internet traffic anomalies. This program is called MonsterMind and apparently it is designed to 'fire back' at the source of a malicious attack without human supervision.[12] Tarde's initial quote on statistics as a biomorphic eye to detect enemies was prophetic — a prophecy we can extend to supercomputers: "Statistics is a kind of embryonic eye, like that of the lower animals which see just enough to recognise the approach of foe or prey".

'Anomaly detection' is a technical term of data analysis that has recently become a buzzword in business solutions of any kind, together with another technical term that is 'pattern recognition'. What does an algorithms see when it looks at a datascape? The only way to look at vast amount of data is to track patterns and anomalies. Despite their different fields of application, from social networks to weather forecasting, from war scenarios to financial markets, algorithms for data mining appear to operate along two universal functions: *pattern recognition* and *anomaly detection*.

What is then pattern recognition? It is the recognition of similar queries emerging in search engine, similar consumer behaviours in population, similar data in seasonal temperatures, the rise of something meaningful out of a landscape of apparently meaningless data, the rise of a *Gestalt* against a cacophony. It is what Delanda, more precise in this than others, describes as the emergence of new singularities.

On the other side, anomalies are results that do not conform to a norm. The unexpected anomaly can be detected only against a pattern regularity. And conversely a pattern emerges only through the median equalisation of diverging tendencies. Anomaly detection and pattern recognition are the two epistemic tools of algorithmic governance. Mathematics (or more precisely topology) emerges as the new epistemology of power.

Another program by DARPA, started in 2010, is probably much more interesting to clarify algorithmic governance. It is called ADAMS: Anomaly Detection at Multiple Scale.[13] But this one is somehow public and attracts less curiosity. This program is currently used for the detection of threats by individuals within a military organisation and its application to the society as a whole can be much more nefarious than MonsterMind. Curiously it has been developed to forecast the next Edward Snowden case, the next traitor, or to guess who will be the next crazy sniper shooting his mates out of the blue back from Iraq or Afghanistan.

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[12] James Bamford, "Edward Snowden: The Untold Story", Wired online, August 2014. Online: www.wired.com/2014/08/edward-snowden

[13] See: en.wikipedia.org/wiki/Anomaly_Detection_at_Multiple_Scales

How does it work? Once again the algorithm is designed to recognise patters of behaviour and detect anomalies diverging from the everyday routine, from a normative standard. ADAMS is supposed to identify a dangerous psychological profile simply by analysing email traffic and looking for anomalies. This system is promoted as an inevitable solution for human resources management in crucial organisations as intelligence agencies and the army. But the same identical system can be used (and it is already used) to track social networks or online communities, for instance, in critical geopolitical areas. Anomaly detection is the mathematical paranoia of the Empire in the age of big data.

The two functions of pattern recognition and anomaly detection are applied blindly across different fields. This is one of the awkward aspects of algorithmic governance. An interesting case is the software adopted by the Los Angeles Police Department developed by a company called PredPol founded by Jeffrey Brantigham, an anthropologist, and George Mohler, a mathematician. The algorithm of PredPol is said to guess two times better than a human being the block of Los Angeles where a petty crime is likely to happen. It follows more or less the 'broken window' theory based on decades of data collected by LAPD.

What is surprising is that the mathematical equations developed to forecast earthquake waves along the San Andreas fault are applied to forecast also patterns of petty crimes across Los Angeles. This gives you an idea of the universalist drive of algorithmic governance and its weird political mathematics: it is uncanny, or maybe not, to frame crime as a sort of geological force. But perhaps it means much more pride for organised and not-so-organised crime to be compared to an earthquake rather than to the emergent intelligence of a slime mold.

4. The mathematization of the Abnormal

In a recent essay for *e-flux* journal the artist Hito Steyerl recalled the role of computation in the making and perception of everyday digital images.[14] Computation entered the domain of visibility some time ago: as we know any digital image is codified by an algorithm and algorithms intervene to adjust definition, shapes and colours.

Aside from this productive role of algorithms, we can also trace a normative one. One of the big problems of media companies like Google and Facebook, for instance, is to detect pornographic material and keep it away from children. It is a titanic task with some comical aspects. Steyerl found that specific algorithms have been developed to detect specific patterns of the human body and their unusual combination in positions that would suggest that something sexual is going on. Body combinations are geometricized to recognise reassuring patterns and detect offensive anomalies.

[14] Hito Steyerl, "Proxy Politics: Signal and Noise", *e-flux*, n. 60, december 2014.

Some parts of the human body are very easy to simplify in a geometric form. There is an algorithm, for instance, designed to detect literally 'ass holes', which are geometrically very simple as you can imagine. Of course the geometry of porn is complex and many 'offensive' pictures manage to skip the filter. In general, what algorithms are doing here is to normalize the abnormal *in a mathematical way*.

According to Deleuze, Foucault explored with his idea of biopolitics the power relation between regimes of visibility and regimes of enunciation.[15] Today the regime of knowledge has expanded and exploded towards the vertigo of augmented and artificial intelligence. The opposition between knowledge and image, thinking and seeing appears to collapse, not because all images are digitalised, that is to say all images are turned into data, but because a computational and algorithmic logic is found at the very source of general perception. The regime of visibility collapses into the regime of the computational rationality. Algorithmic vision is not optical, it is about a general perception of reality via statistics, metadata, modelling, mathematics. Whereas the digital image is just the surface of digital capitalism, its everyday interface and spectacular dimension, algorithmic vision is its computational core and invisible power.

Canguilhem, Foucault, Deleuze and Guattari, the whole French post-structuralism and post-colonial studies have written about the history of abnormality and the always political constitution of the abnormal. The big difference with respect to the traditional definition of biopolitics, as regulation of populations, is that, in the society of metadata, the construction of norms and the normalisation of abnormalities is a just-in-time and continuous process of calibration. Bringing Foucault to the age of artificial intelligence, we may say that after the periodisation based on the passage from the institutional Law to the biopolitical Norm, we enter now what we could provisionally define as the age of Pattern Recognition and Anomaly Detection.

Today the Abnormal reenters the history of governance and philosophy of power in a mathematical way, as an abstract and mathematical vector. Power in the age of algorithmic governance is about steering along these vectors and navigating an ocean of data by recognising waves of patterns, and in so doing, taking a decision anytime an anomaly is encountered, taking a political decision when a thousand anomalies rise their head and make a new dangerous pattern emerge.[16]

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[15] Deleuze, *Foucault*. Paris: Minuit, 1986.

[16] Starting from the seminal: Georges Canguilhem, *Le Normal et le Pathologique*. Paris: PUF, 1943.

5. The anomaly of the common

Gabriel Tarde, from which we read the initial quote, had a particular interest in the imitative behaviour of crime, in the way crime patterns spread across society. Nevertheless, another aspect of Tarde's research was his focus on the cooperation and imitation between brains: the way in which new patterns of knowledge and civilisation emerge.

William Gibson already dedicated to the issue of patter recognition the homonymous novel from 2003. As we know, this fundamental capacity of perception and cognition was also investigated by the Gestalt school here in Berlin a century ago. However, Gibson brings pattern recognition to the full scale of its political consequences. "People do not like uncertainty", he wrote. One of the basic drives of human cognition is that to fill the existential void by super-imposing a reassuring pattern, never mind if under the guise of a conspiracy theory like it happened after 9/11.[17]

Specifically Gibson's novel engages with the constant risk of *apophenia.* Apophenia is the experience of seeing patterns or connections in random or meaningless data, in the most diverse contexts, also in gambling and paranormal phenomena. When religious pictures are recognised in everyday's objects or a humanoid faces on the surface of Mars.

Algorithmic governance is *apophenic* too, a paranoid recognition and arbitrary construction of political patterns on a global scale. There is an excessive belief, indeed, in the almighty power of algorithms, in their efficiency and in the total transparency of the metadata society. The embryonic eye of the algorithm, algorithmic vision, is growing with difficulties. For different reasons. First of all, due to information overflow and the limits of computation, algorithms always have to operate on a simplified and regional set of data. Second, different mathematical models can be applied and results may vary. Third, in many cases, from military affairs to algotrading and web ranking, algorithms often influence the very field that they are supposed to measure. An example of non-virtuous feedback loop, algorithmic bias is the problematic core of algorithmic governance. As Parisi has underlined, aside from extrinsic limits, the regimes of computation has to cope with specific intrinsic limits, like the entropy of data, randomness, or the problem of the incomputable. The eye of the algorithm is always dismembered, like the eye of any general intelligence.

An ethics of the algorithm is yet to come: the problem of algorithmic apophenia is one of the issues that we will discuss more often in the next years, together with the issues of the autonomous agency and epistemic prosthesis of algorithms and all their legal consequences. Apophenia, though, is not just about recognising a wrong meaning out of meaningless data, it may be about the invention of the future out of a meaningless present. Creativity and paranoia share sometimes the same perception of a surplus of meaning. The political virtue, then, in the age of algorithmic governance, is about the perception of a

[17] William Gibson, *Pattern Recognition*, New York: Putnam, 2003.

different future for information surplus and its epistemic potentiality. Aside from the defense of privacy and the regulation of the algorithmic panopticon, other political strategies must be explored. We need maybe to invent new institutions to intervene at the same scale of computation of governments, to reclaim massive computing power as a basic right of 'civil society' and its autonomy.

I'd like to conclude going back to the issue of enemy recognition and the perspective of the world from the eye of the algorithm. In a short chapter titled "Algorithmic Vision", Eyal and Ines Weizman stress that "the technology of surveillance and destruction are the same as those used in forensics to monitor these violations". The practice of the Forensic Architecture project has shown in different cases that the same technologies that are involved in war crimes as apparatus of vision, control and decision can be reversed into a political tool. They continue:

> But even if the human rights analyst must look at the same images as the [air force] targetier, they can be tuned to other issues, establishing more extended and intricate political causalities and connections. They must see in these images not only the surface of the Earth but the surface of the image — that is the politics that is embodied in the technologies of viewing and representation. More importantly they should seek to understand the conditions — technological and political — that have generated the gap between the images. This is because the gaps between the photographic or algorithmic representation in before-and-after images will forever keep the subject represented uncertain, discontinuous, lacunar, open to ever-new interpretations that will emerge every time we look at these images.[18]

We could leave this quote as conclusion. Yet we could extend the same approach to the technosphere in general and imagine a different political usage and purpose for mass computation and global algorithms. Humankind has been always about the alliance with alien form of agency: from ancestral microbes to Artificial Intelligence. A progressive political agenda for the present is about moving at the same level of abstraction of the algorithm — in order to make the patterns of new social compositions and subjectivities emerge. We have to produce new revolutionary institutions out of data and algorithms. If the abnormal returns into politics as a mathematical object, it will have to find its strategy of resistance and organisation, in the upcoming century, in a mathematical way.

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[18] Eyal and Ines Weizman, "Before and After: Documenting the Architecture of Disaster", Moscow and London: Strekla Press, 2013, p. 40.