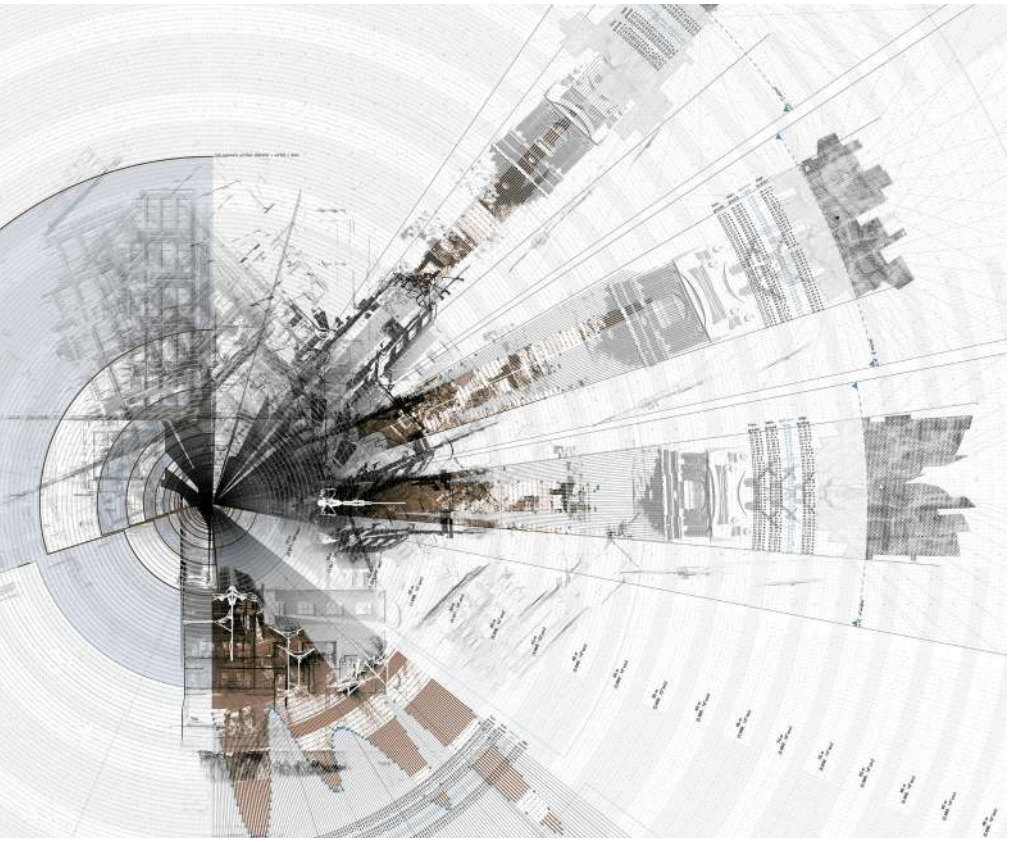
Orchestrating the Edge: On Schizophrenic Points and Indecisive Photons

Orchestrating the Edge

On Schizophrenic Points and Indecisive Photons

Thomas Pearce



Behold yon miserable creature. That Point is a Being like ourselves, but confined to the non-dimensional Gulf. He is himself his own World, his own Universe; of any other than himself he can form no conception; he knows not Length, nor Breadth, nor Height, for he has had no experience of them; he has no cognizance even of the number Two; nor has he a thought of Plurality, for he is himself his One and All, being really Nothing.

— Edwin A. Abbott

The danger is in the neatness of identifications.

— Samuel Beckett

Geometrical categories, more than being just tools for describing the physical world, always simultaneously serve as psychological projection planes for shared anxieties. Edwin A. Abbott, in his 1884 novel *Flatland*, explores the tormented personalities of elements of descriptive geometry and (mostly in vain) tries to free them from their ignorant attachment to their own limited dimensionality. In doing so, he not only foretells by decades the theory of a fourth (and n-th) dimension but also politically activates spheres, polygons and points as they become a soundboard for his satirical critique of the social immobility and narrow-mindedness of Victorian society.

The main protagonist of this article is a point with a faith no less miserable than Abbott's: it is the point in the 3D laser scanner's point cloud. This point cloud is well underway to become a dominant mode of seeing, measuring and mastering reality. In doing so, it is slowly but surely dissolving this reality into endless sets of unique XYZ values. The exactitude of these coordinates condemns the points, "being really Nothing," to a theoretical state of Cartesian weightlessness. What is left between them is a gaping interstitial shadow, a shadow that is pervasive and cannot be eliminated by adding ever more points—not even in a theoretical endless resolution.

The mesh (the triangulation of these points into a surface) is becoming a widespread coping strategy for the *horror vacui* caused by this interstitial unknown—to the point that many recent consumer-oriented 3D scanners no longer even output point clouds but merely meshed surfaces. The shadow-ridden and ambivalent state of the actual measuring mechanism, the dispersed point cloud, is bypassed as it is safely internalized in the black box of the scanner apparatus. What results are topologies with clearly defined extrinsic boundaries, the comforting discrete and stable identities of directly 3D printable solid subjects.

But rather than concentrating on the anxieties *resulting from* the point's non-dimensionality, I would like to zoom in on one single point and look at the anxieties that *produce* this very idea of weightlessness. Again, it is the projection of our own longing for stable, "neat" identities rather than the scanner's actual measuring process that abstracts its measurement to irrefutable and unique coordinates. For does the point in the point cloud, like the miserable point evoked in the opening quote, really "know no Length, nor Breadth, nor Height"? Is there really no "thought of Plurality" in its solipsistic mind? If we want to fracture this solipsism and recuperate notions of multiplicity and ambiguity, we will have to "unbox" the scanner's black box and analyze its internal workings.

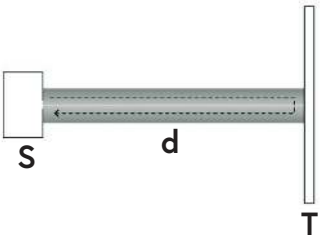
Facing Image: When scanned, the Masks dissolve into hightech surrealist mirages that deconstruct the veracity of the scanner and inject fractures of the imaginary into its supposedly realist representation of the city.

Modulating the Schizophrenic Point

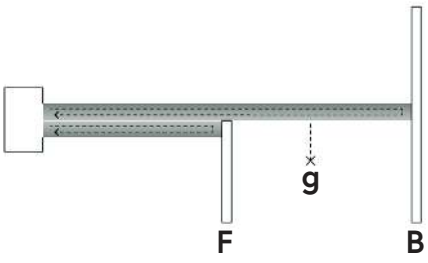
It all starts with the thickness of the measuring laser beam. The fact that the scanner's laser beam *does* have a "Breadth"—a diameter of a couple of millimeters[1]—has rather far reaching implications for the nature of the resulting point. I want to illustrate this describing a phenomenon called "edge noise." Edge noise occurs when a beam hits the edge of an object and the other part of the beam travels on to meet an object behind it. The range sensor, determining the distance by measuring the "time-of-flight" (the time it takes for the beam to reflect off an object and return to the scanner) receives a "mixed return" of two time-of-flight values.[2] The scanner deals with this by means of interpolation: it creates an average of these two measurement values, thus outputting a "fictional" point between the first object's edge and the second object behind it.

It goes without saying that the scientific papers discussing these "mixed pixels" are mainly concerned with the development of strategies for the identification and removal of these abnormal artefacts—say the noise of dense vegetation (twigs, leafs) for unmanned military vehicles.[3] For us however, these "ghost points" are fascinating as they start contesting the realism of the scanner and reveal that underneath the reductionist representation of the non-dimensional point, there is a plurality to be discovered—that the solipsistic point is actually a schizophrenic point.

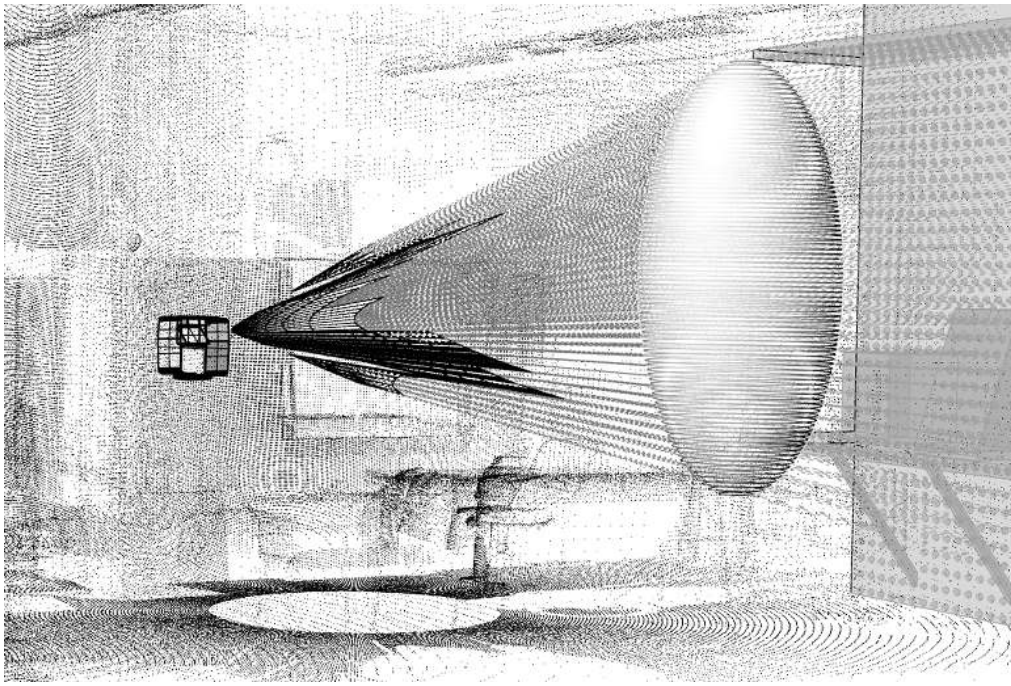
In fact—though this is an extrapolation that bears more epistemological than practical relevance—this schizophrenia is lingering in every point of the point cloud: every measurement can be defined as a "noisy" mixed measurement for even when the beam isn't split by hitting the edge of a discrete object, it will always hit a surface in an "abnormal" (meaning not perfectly geometrically normal or orthogonal) way. What starts to crumble here is the notion of atomism, the assumption of an "uncuttable" smallest unit, that as "the postulation of individually determinate entities with inherent properties" (Barad 2007, 137), not only functions as the basis of a realist understanding of the point cloud but also as the basis for the very notion of the individual (similarly meaning "indivisible").



Time-of-fight measurement: distance (d) between scanner (S) and Target (T) = laser return time/2 x speed of light.



Mixed pixel/edge noise: an interpolated "ghost" measurement (g) between foreground (F) and background (B).



Counter-algorithm calculating the (evenly perforated) foreground geometry needed to create an ovoid shape in front of a known (pre-scanned) geometry.

How then do we start defining a positive notion of this inherent mixed state—an understanding that neither eliminates these "abnormalities" by filtering them out, nor "resolves" plurality in a dialectical synthesis of interpolation? Can we think of these mixed pixels in a non-reductionist and non-dialectical way, seeing them as fleeting intensities that are neither foreground nor background, but "included middles" (Guattari 1989, 141)? Can we, and if yes, how do we *design* these included middles?

The schizophrenic point is not only a powerful *metaphor* for multiplicity but can also become an instrument or a *catalyst* for multiplicity. This is because understanding the nature of edge noise also has a practical implication: it allows us to rearrange the equation describing ghost measurements (g) as resulting from the interpolation between foreground (f) and background (b):

$$g = (f + b) / 2$$

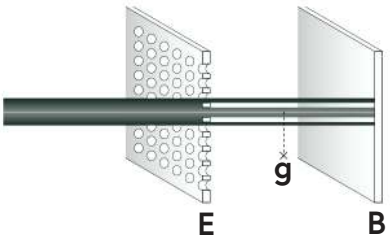
into:

$$f = 2g - b$$

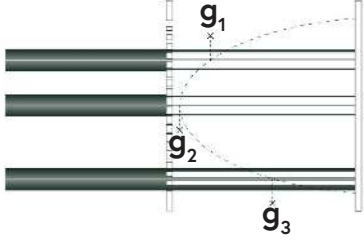
Translated, this reversal of the edge noise equation means that we are now able to actively *create* and control a ghost measurement, deducting the position of the foreground edge needed to create it.

The following images show a series of edge noise prototypes. These finely perforated screens are provoked by the ability to consciously instrumentalize and design the edge noise that results from 3D scanning them. As the diameter and spacing of the perforation of these screens is always smaller than the diameter of the scanner beam, these screens effectively are "all edge." This way, every single measurement going through the screen will produce a "ghost point," as every beam without exception will partially hit the screen and partially hit the background. Though initially producing rather scattered results, the experiments become increasingly successful by refining the perforation grid's resolution and by differentiating the aperture ratio.

As the resolution of the screens and hence the level of control over the resulting edge noise increases, these initially open-ended analytical "scanner eye tests" evolve into something much more powerful. Now able to design and build, through the scanner, any fictional point cloud outcome of choice, the screens, as deceivers of the eye of the scanner, open up an entirely new realm of illusion and phantasm. In this sense, they are similar to the early nineteenth century *phenakistiscopes* (from the Greek *phenakizein*, "to deceive, to cheat"), which instrumentalized the newly discovered fallacy of the eye called the "afterimage" to blend between two given images and create the illusion of movement.[4] The screens, as scanner phenakistiscopes, employ a parallel method of instrumentalizing the fallacy of edge noise to create illusory points that blend between two given measurements.



All measurements through the screen (E) create ghost measurements, the screen is "all edge."

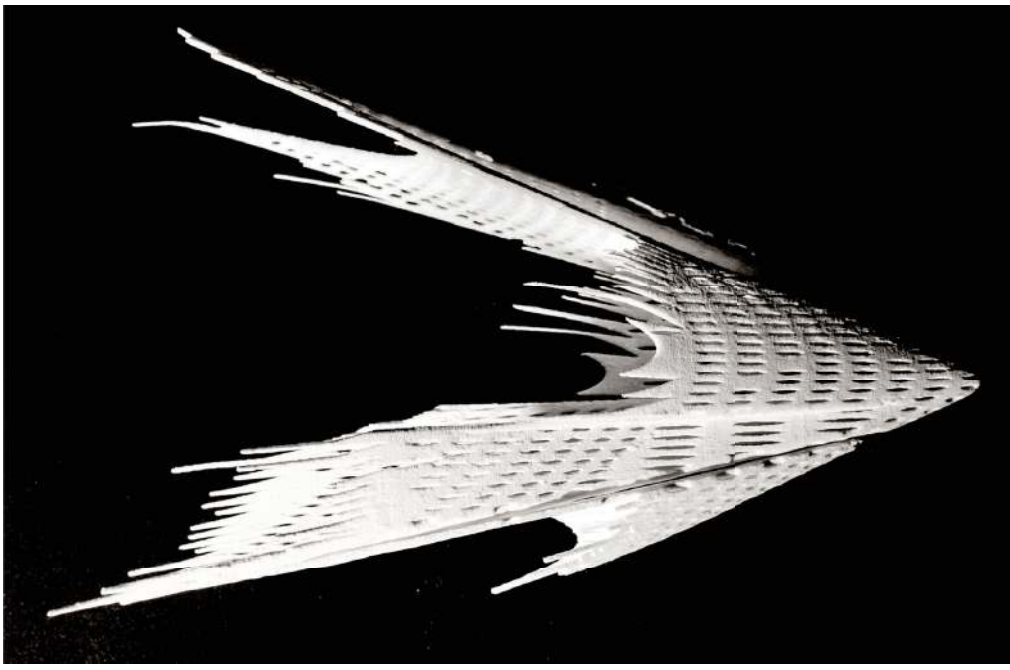


The differentiated aperture ratio defines precisely where between fore- and background ghost measurements are created.

The Irrelevant Choice of the Indecisive Photon

There is a certain modernist-positivist naivety, however, about the clear equations of this reverse engineered edge and its suggestion of measurability and control (even if over fictions)—so that we might be at risk of developing a "realism of the phantasm." The reason is that, even if we have assigned "Length, Breadth and Height" to the measuring process, we are still operating within purely geometrical definitions. Light has been treated as an abstract geometric entity, the beam as a homogenous cylinder performing calculable interactions with other geometrical abstractions. We have fallen, as Karen Barad would put it, into the "representationalist trap of geometrical optics" (2007, 78). To escape from this trap, we will now have to shift our focus to *physical* optics and look at what this cylinder of laser light is actually *made of*.

Strikingly, the experiment in physics that has been key for the demonstration of the nature of light, bears a strong similarity to our own experimental setup. In the famous double-slit experiment, a plate pierced by two parallel slits is illuminated by a coherent source of light (often a laser beam) while the light passing through the slits is observed on a screen behind the plate. While the experiment, conceived around 1800, initially served to prove the wave theory of light by demonstrating optical interference in the projected light patterns, it later came to illustrate what is called the wave-particle duality. Light, according to this principle of duality, exhibits properties of both matter (particles) and energy (waves). These properties



Nylon printed edge screen.

however, are not simultaneously observable or measurable, as they require a "particular choice of apparatus, providing the conditions necessary to give meaning to a particular set of variables, at the exclusion of other variables" (2007, 115).

Moreover, apart from excluding the possibility of other types of observation, every apparatus of measurement unavoidably influences the nature of the object observed. Again, it is precisely time-of-flight range finders that are often used to illustrate this idea. By shooting light (as both matter and energy) on the measured object, they essentially "push" this object away and change the very distance they are measuring. Similarly, by merely turning on the light in a room, one minutely alters the arrangement of the furniture within it. As practically irrelevant as such descriptions may seem, they do start to dismantle the "separability of knower and known" assumed by Newtonian (geometrical) physics—and by our earlier naïve equations (2007, 107). Enlightenment physics, by assigning physically and conceptually separable positions to objects and observers, understood "observation to be the benign facilitator of discovery, a transparent lens passively gazing at the world" (2007, 97).

By recorporealizing light—having given the medium a body—the body of the observer (the scanner) and the observed become inextricably entangled. The term "remote *sensing*," actually used to describe scanning's *lack* of physical contact (Manovich 1993, 124), now receives an opposite, and rather literal, validity. The belief in the realist veracity of the scanner starts to crumble while the "metaphysics of individualism and the belief in representationalism" are discarded in favor of an alternative described by Karen Barad as a materialist-realist onto-epistemology (Barad 2007, 107). Barad explains: "Practices of knowing and being are not isolatable, but rather they are mutually implicated. We do not obtain knowledge by standing outside of the world; we know because 'we' are of the world. We are part of the world in its differential becoming." She therefore abandons the binary model of ontology vs. epistemology and instead speaks of onto-epistemology as "the study of practices of knowing in being" (2003, 829).

Hence the scanner can no longer be seen as the designer's passive and immaterial *camera obscura* but instead receives a certain *creative complicity*. As such it plays a more active role as a productive agent of measurement, not just indexing, but actively creating the phenomena observed by physically assaulting reality with its laser beams.

So let us now throw a new (physical) light on our attempt to control and design our "ghost measurements." Zooming in further onto the laser beam, we now encounter a new challenge: the beam is not homogenous as the particles within the beam are unevenly distributed (note that we decide for a mutually exclusive description of the beam as *particles*). In fact, there are different zones of density and intensity within the laser beam.[5] This again has both philosophical and prac-

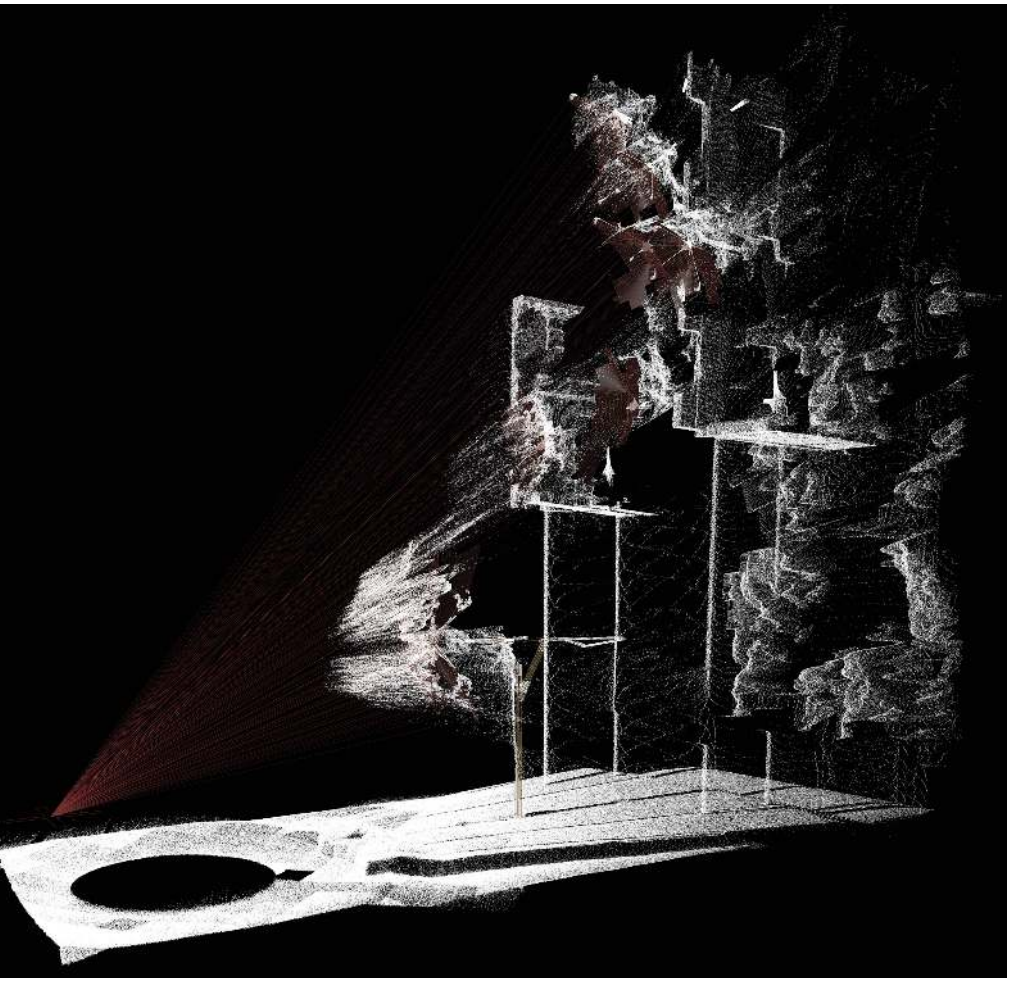
tical implications. The former is that the beam is inherently differentiated and exhibits multiplicity even before meeting the multiplicity of its targets.

The *practical* implication of this heterogeneous beam is that, even if we, with the perforated screens, manage to create an experimental setup in which the ratio of the beam diameter *hitting* the screen to that *passing through* is perfectly known, we are still unsure about (and not in control of) the measurement the setup will produce. This is because the particles may be distributed throughout the beam in such a way that either more or less of them than planned will either pass through or reflect off the screen. The obvious way to regain control and diminish this uncertainty is by increasing the resolution of the perforation even further—to the point that every single photon particle in the beam is confronted with the same aperture ratio of the screen. It is fair to say that, now that we have arrived at the order of magnitude of a single photon, we have in fact left the realm of practicability and are starting to describe the problem as a *Gedankenexperiment* (thought experiment) rather than intending to actually solve it. The issue now becomes not that a physical experiment at such a scale is impossible, but rather that its outcome is inherently uncertain. Niels Bohr, returning to the double-slit experiment, described the possibility of shooting a single particle onto the slitted plate and measuring through which slit it will travel. The problem however, Bohr continues, is that this measuring apparatus will unavoidably disturb the very behavior of the particle it is measuring as the act of measuring will destroy the interference pattern.[6] Having zoomed in this far, we are now confronted with the limits of control, as the uncertain behavior of the single photon performing our act of measurement implies the impossibility of a total knowing.

In the meantime, the result of our high-resolution screens has nevertheless become rather convincing. So although the "choice" of the "indecisive" photon may be *uncertain* this choice has also become, in the face of our techniques of high-resolution design modulation, *irrelevant*.

An uneven particle distribution within the beam diameter makes the result, even with a known aperture ratio, uncertain.

Increasing the perforation resolution reestablishes control over the resulting ghost measurement.



Reverse engineering imaginary point clouds through finely perforated, algorithmically controlled Masks.

The Masks of St Brides, details.

The Ubiquitous Edge of the High-Resolution City

The reason to dwell upon this "irrelevant" notion of the photon's choice goes beyond the success of our phantasmagoric screens. For, as Karen Barad argues, the "seismic shift in epistemology" which followed the development of quantum physics pervades all orders of magnitude, "from the smallest particles of matter to large-scale objects." The fact that this "essential discontinuity is examined on a micro-level does not mean it does not influence every scale of reality" (2007, 252). Following Barad's impetus but going one step further than the order of physical magnitude, I would argue that this "quantum shift" can also become a useful metaphor to critically describe (and counteract) contemporary modes of governance.

Would it be audacious to describe what Gilles Deleuze has called the "society of control"—in analogy to our screens—in terms of resolution and as a strategy for coping with uncertainty? Before, Foucault's disciplinary societies operated by disciplining the abnormal through the apparatus of physical boundaries and institutions—a physicality that has given his theories an overwhelming resonance in architectural discourse. Control societies however operate on a much less graspable level: having incorporated uncertainty, control ramifies and mobilizes the abnormal through strategies of modulation.[7] Modulation, instead of disciplining the body, addresses the brain (*noos*) directly through high-resolution media, which, embedded and ubiquitous, come to define a high-resolution urbanism.

Masking modes of vision: human, mechanical, post-human. The mask allows for the observer to look through the "eye" of the scanner. Reality dissolves into 3mm diameter fragments (the width of the collimated laser beam), the multiplicity within each measurement is exposed.

Rather than imposing a certain conduit ("I am being watched and hence should act correctly"), these modulations *induce* the decision made by the "autonomous subject" ("I want to act like this")—replacing the logic of coercion by the far more subtle logic of persuasion.[8]

The subtle smoothness of the society of control is complete when the hard edge of the coercive device (the building) disappears, not by becoming immaterial but rather by increasing the resolution of modulation to such an extent that it becomes barely visible—yet at the same time pervasive. "The city of control" (Hauptmann 2011, 18) thus becomes—like our perforated screens—"all edge." Its modulated citizens/consumers are constantly moving and crossing this ubiquitous and controlled edge. Inundated by a (consumerist) sense of continuous and pervasive choice, each singular choice of the citizen/consumer becomes—like the choice of our photon—irrelevant.

Should it then discomfort us that the "modulatory interventions" of our screens emulate the logic of a governmentality of control? I would argue quite the opposite: the critical dismantlement of the measuring apparatus— like that of the apparatus of governance—is just the first step towards the formulation of critical and aesthetic design strategies that are able to perform a meaningful counter-agency against these very apparatuses. Such aesthetic strategies should re-use, dis-use and invert the mechanisms critically analyzed and thus extract positive and affirmative notions of both biopolitics, high-resolution technology, and the high-resolution city.[9]

This text is an abridged version of one of three chapters of a thesis entitled "Orchestrating the Edge. Towards a Noisy Point Cloud Onto-Epistemology." The full thesis and more detail on the accompanying speculative design project can be found at THOMASPEARCE.XYZ.

Endnotes

1. The Lidar scanner used here is the FARO Focus 3D and has a beam diameter specification of 3mm.

2. To be precise, the Focus 3D's measurement is in fact phase-shift based, a process similar to time-of-flight and which also creates "edge noise."

3. For example, see Tuley et al. (2005).

4. The focus of Jonathan Crary's brilliant analysis of such eye-deceiving devices focuses on the "recorporealization" of the observer's eye and was of great inspiration for my upcoming attempt to materialize the "scanner eye" (Crary 1990).

5. See Tuley et al. (2005), Fig. 1.

6. And due to its indeterminacy this observation-disturbed behavior cannot, as opposed to what Newton assumed, be compensated by the measurement (Barad 2007, 119).

7. My description of Deleuze's notion of control societies builds freely on Moore (2013).

8. Moore (2013, 66) quotes Iain Borden's example of a more architectural strategy of noo-political persuasion, which illustrates that these techniques should not be understood as exclusive to digital embedded media.

9. This stance builds on examples like Donna Haraway and her notion of "stepping out of the negativity circuit" of criticism and instead extracting affirmative positions towards technology/governmentality (Braidotti 2006, 206).

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