Ephemer(e)ality Capture
Glitch Practices in Photogrammetry

Introduction

Ephemer(e)ality Capture: Glitch Practices in Photogrammetry details artistic practice using photogrammetry. During the research project, I have developed glitch practices through a disturbance of the imaging algorithm by utilising optical phenomena. Reflective, transparent, specular and patterned/repetitive objects were used to confuse the imaging algorithm to produce spikes, holes and glitches in the mesh and textures of the 3D objects produced. The research tests the limits of photogrammetry in an effort toward new image-making methods. It builds upon the research of Hito Steyerl's Ripping Reality: Blind spots and wrecked data in 3D in which she outlines the errors of 3D scanning media in her work. This research explores the potential gaps in Steyerl's approach, building upon investigations into 3D scanning's 'constructed imagery' through methods that explore 'fractional space' more thoroughly through glitches caused by capturing of optical phenomena.

The exposition centres on an initial research residency at JOYA: arte + ecología in Spain in 2018. During this period, a number of experiments within the landscape become muses for further development of glitch-based works. The exposition starts with a diary entries of explorations and reflections on creating 'reality captures' of the landscape, and the inevitable issues of trying to image ephemera.

'Reality Capture' or 'Recap' has become the expression used in the creative industries for the process of photogrammetry. Reality Capture uses algorithmic processing to create 3D models from imported photographs. Autodesk state on their website that their ReCap Pro tool is:

> Reality Capture and 3D scanning software for intelligent model creation. ReCap
> Photo processes photographs taken from drones to create 3D representations.
> (Autodesk 2019)

Although photogrammetry can be used to create 3D models from any imagery (not just drones photography) photogrammetry's apparent objectivity in displaying three-dimensional spaces has made it irresistible to a number of industries invested in the understanding and production of space.

Autodesk's photogrammetry tools are aimed at Architectural, Engineering & Construction industries and while the technology is fragile and limited in many ways, it has become a popular tool for visual artists too. Reality Capture has emerged as an umbrella term for photogrammetric and lidar-based scanning technologies. Both technologies construct 3D models by finding similar recurring visual elements within the inputted images. Photogrammetry (using photographs) and lidar (commonly using infra-red laser scans) assemble a vision of 3D space through a consensus of the position of these recurring points from multiple angles, then processing this assemblage as a digital 3D model, or 'reality capture'.

This clunky term is perhaps an emblem of the over-ambitious assertions of technology marketing and technological idealism; a claim that suggests reality can be acquired through technological processing of optical media. The relative ease of use and the uncanny mimetic qualities it produces have been utilised by artists working with video, VR or sculpture. However, little research discourse exists exploring its digital materiality, or critiquing its claims of advanced 'realism', or exposing its

counter-mimetic qualities. Photogrammetry struggles to capture certain objects and environments due to their optical nature. Transparent, repetitive, patterned, indistinct, plain, reflective, and ephemeral objects and environments cause problems for photogrammetry. As briefly explained above, photogrammetry works by using quantifiable data, by plotting key points in the multiple photographs in order to understand how objects are situated three-dimensionally. These key points are called 'cloud points'.

It tries to understand where certain identifiable shapes, textures or colours reoccur in multiple images. In doing so, the technology is able to calculate how to make a 3D model from them. Ephemeral qualities make it harder for the technology to do that. As a result, the photogrammetry technology makes things up.It gets things wrong and estimates the forms of the objects based on the information it has. It visualises these estimations and extrapolations as glitches and errors. Stretched images and warped textures, as well as phantom forms or holes and spikes in the 3D mesh.

I have developed a series of artworks using these processes. The artworks use photogrammetry in a way which explores the issues of mimetic visuality that concern 3D capturing technologies, issues which unpick their representational nature as being heavily mediated. As a result, this research is an assessment of the use of photogrammetry and proposes a methodology to expose the mediation of the technologies. A mediation by algorithms which make decisions on 3D space based on 2D images. Through a series of artworks, I detail the practical techniques for exploring the errors generated by the technology's perceptions of space as an exploration of the agency of technology.
 The artworks become a critical investigation of visual capturing technologies by forcing them to visualise the invisible , temporal and ephemeral. This is not meant in a metaphorical or figurative sense, the technology is literally being used to visualise objects that are transparent or that change during the process of recording them. The deliberate negation of technical instructions pushes the technology to speculate, and from these speculations we get a glimpse of the technologies decisions and how it constructs the images. This reveals how 3D media imagery is mediated and constructed using automation, although often this is disguised or unclear until the point of error. Errors become useful in understanding the workings of a technology which you have little or no access to. Presented is a methodology which encourages a 'détournement' of automation, exploring agency of technology through errors in models of transparent, plain, reflective and ephemeral objects and environments. The works probe at the limitations of algorithmic understanding and force the technology to visualise uncertainty. The research promotes a self-reflexivity and critical reflection in users to deliberately side-step, avoid or actively ignore prescribed workflows of digital tools through use of a dynamic methodology.

Diary in JOYA – Ephemera

The following text documents a project developed during residency/retreat at JOYA: arte + ecologia in Andalusia, Spain in Spring 2018. JOYA is a residency designed for artists, writers and musicians to focus on work which centres on ecological issues or connections to the landscape. JOYA was established by Simon and Donna Beckmann under sustainable principles: producing their own electricity through wind and solar generators, burning wood for heat and hot water, and collecting drinking water from the nearby village spring. It provides artists an escape from the trappings of contemporary living such as digital media, with little or no mobile data signal and intermittent satellite WiFi. Released from these modern burdens, residents of JOYA are free to read, write, create and explore the landscape. During this period, I focussed mainly on work using photogrammetry and natural ephemera.

It seems an odd place to base a digital project – far removed from the resources necessary for a cloud-based, digital media technology. However, I was intrigued to investigate how the issues I'd previously explored with cloud-based photogrammetry, the parameters of what the technology can visualise, would manifest themselves whilst working at JOYA. Having established previously that photogrammetry works 'best' under certain conditions (dictated by the manufacturers guide), JOYA seemed to provide conditions contrary to those stipulated in a commercial product's guidelines. In essence, the project's aims were to test what were the limitations, vulnerabilities and peculiarities of photogrammetry's visualising of ephemera. The assumptions of ubiquitous connectivity and electrical infrastructure make the technology fragile to harsher, less anthropocentric environments. Even visually, the rural environment contains a number of conditions and ephemera which cause issue for photogrammetry technologies. The incomprehensible complexity and yet confusingly homogenous visuality of forests, rock formations and clouds mean that interesting errors emerge from capturing these environments. The vastness of the landscape, the changeable weather and light conditions, the indistinct and repetitive nature of the terrain; all are the antithesis of the 'ideal' for capturable photogrammetric conditions.

Below is a diary of notes documenting the time and works made there – an environment which is unstable, vast and somewhat contradictorily multifaceted yet repetitive. I feel the diary provides reflection on decisions of the development to the works made, influenced by the landscape, sites and encounters.

5th March 2018

I arrived at JOYA late the night before. Getting off the bus from Granada, I was met by Simon in an old Land Rover sprayed with chalky mud. We headed north, past the 16th Century Castillio of Velez Blanco which was uplit imposingly, until the tarmac road turned into dusty trail. The road steadily became more treacherous as we got closer to JOYA; the characteristic starchy sludge of the mountain earth shifted under the tread of tyres.

Emerging around the corner, the refurbished farmhouse - JOYA sits 1074m above sea level in a mostly deserted former agricultural parkland of Sierra María-Los Vélez. The region is scattered with abandoned farms, not uncommon in rural Spain, a depleted agricultural community which used to contribute the areas almond production. Simon mentioned in the morning, that due to the unusual amount of rain, the delivery of wood hadn't arrived, which is why there was no heating or hot water. Owing to a combination of climate change and agricultural abandonment, the area is untraversable at times. Landslides, forest fires and floods are not uncommon and yet the land is amongst the most arid in southern Spain.

In the afternoon, I perused the immediate area. JOYA sits in a bowl between several peaks, 12 km east of María and 14km due north of Velez-Blanco. The hills north of the residency site were covered in woods, save for a stripe of felled trees for fire prevention purposes. I ventured up the belt of cleared woodland hoping to be able to view over the adjacent hill. Halfway up, the weather changed, with strong gales and torrential rain making my ascent impossible. I could hear the wind turbine at JOYA whirring increasingly as the gusts intensified. I headed back to the farmhouse.

6th March 2018

After breakfast, I ventured up the opposite hill to the previous day, in order get to a view of the landscape. I aimed to capture the area in from these vantage points. The ground underfoot was

chalky white and crumbly, dry and baron from the persistent breeze that is perennial. I'm told that Sierra María-Los Velez sits in the rain shadow of the Sierra Nevada. The almond trees which were dotted around this landscape were suffering from this drought, although despite that, were starting to bloom.

From the top of Sierra Larga María, the hill to the south of the farmhouse, I could see the Sierra Nevada was snow-capped; partially hidden by cloud. I could also see that the cloud was moving in our direction. I took photos on my phone of the landscape below me. In the images the ground appeared as a pixelated mass of homogenous grey/brown, the limestone soil had no discernible features. The granular earth appearing like noise or static on the phone screen. I captured the landscape to the east. As, I panned around, clicking the shutter, the images of the vista became increasingly engulfed in fog. North-westerly cloud swirled and began to obscure the view of the thousands of Allepo pines that stretched towards the valley. The lichen covered limestone at my feet began to bear the droplets of rain as I tried to capture the lunar-esque terrain. Images began to resemble a smeared lens or blurred texture, an image degraded in definition from compression or reduction.

The crystallisation of the rock appears as a fragmented image, reminiscent of pixels. Grainy and abstracted. Clear rock forms are peppered with indistinct blank spaces. Triangles of grey-blackness.

Textures are smeared across the surface.
In areas adjacent to the camera textures are clear.
However, areas behind the view of the
capturer are blurred, stretched,
and warped. This implies a directionality
to the captured image and areas
which indicate an algorithmic
estimation of form and texture.

Forests become dragged across the landscape.
Their far-side is empty and open.
These numerous structures appear as if melted.
Or, as if a paint-brush has dragged through them
 leaving a streak of foliage remnants across the land.
These directional stains leave clues
for the construction of the image,
showing the trajectory of vision
in the formation of the image.
There is a clear vantage point
and what is not imaged shows quite significantly.
This is far from the omni-directional
authorless image method touted.
Complex structures like tufts of grass
become just colours sprayed across the surface of other objects.
Their structural objectivity is lost to just textural data.

The fractured face of
the rocks reveals a mosaic
of blank, digital lichen.
The glitch lichen of
un-imaged textures.
They interrupt the illusory
nature of the texture and
force the viewer to be confronted
with an emptiness of the unknown.
These fractals of triangular
multiplication stretch beyond
the far sides of poorly imaged models.
They reach and encircle the
perimeter of the models;
creating an envelope of patchwork outlines.

8th March 2018

A clearer, warmer day meant I could venture further toward the abandoned farmhouses around the perimeter of the Embalse de Valdeinfierno - the nearby reservoir. On the dirt track I headed east, towards the border of Andalucia and the Region of Murcia. Collapsed stone buildings dotted the path. Fallen timber, smooth and silvery through weathering, jutted from piles of rubble from the dilapidated dwellings. Unenriched by the acquisitions of prior colonial knowledge and hindered by the austerity of Fascism in the 20th century, many agricultural communities in Spain were abandoned in favour of life in the nearby cities. As a result, most of the structures in the vicinity were deserted. I took images encircling the remnants of the walls of what was once a barn.

I continued down to the 'shores' of the reservoir. Reeds and shrubland had long replaced the pools of water, as the reservoir had dried up decades before. Standing oddly and ominously out of the reservoir, as a barrier to the possibility of flash floods, was what Simon called the 'Fascist Dam'. Meticulously and uniformly engineered, it contrasted against the desolate landscape. Built as flood defense for the flash flood-prone to the region of Lorca, it now mainly provides a road link between the bordering regions. From here I captured the openness of the reeds and shores of the reservoir. Plain yet complex, the constantly moving reeds and plantlife meant objects appeared in different configurations in each shot - shifting and shimmering in the wind. I side-stepped around the banks, strafing the shoreline, in order to capture the stark soil from several angles. As I maneuvered around, I could see the etchings of an abandoned quarry over the other side. The craggy hills disrupted by clean incisions revealed the bright white limestone which shone in the sunlight. Here, several dormant quarries could be seen. Their sharp, geometric cuboid excavations juxtaposed the weathered contours of the landscape surrounding. I ventured back to JOYA, encircling the quarries from on high.

These environments prove particularly tricky for photogrammetry, therefore they expose many useful characters of its image-making properties. Complex and homogenous; the repetitious reeds are indistinct. At the time of capture, they were swaying and moving in waves with the breeze.

This movement, coupled with the non-distinct featureless character of the objects, render this expanse bland and fractured. Although we can create distinct markers in the far landscape: dunes, rocks, and edge of reeds, the photogrammetry software needs more markers throughout to render it fully 3D.

In one half of the 3D model, fractional patterns occur where dunes and ripples in the sands should be. Remnants of the undulating sand occurs in the patterns of blank spots that permeate this hall of the model; replicating the patterns of the dunes but failing to capture its form or texture accurately. Around the perimeter of the photogrammetric model are smudged or fuzzy textures - fragmented perimeter, seemingly arbitrary. This represents the liminality of the visual concurrence of the images. The limits of knowledge for the algorithm of the reservoir's spatiality.

10th March

I went back to the quarries with the drone to capture some of the inaccessible areas. Inside, several levels of excavation meant some areas of the pit were not accessible on foot. I started the drone in order to see the stepped layers of stone which escalated above. High winds made the navigation tricky, as the drone collided with some stacked rocks and then into a drooping tree. The heavily compressed, glitching images it sent back display the technology's own grainy texture which permeates the images of stone. White limestone surfaces – surprisingly unpatterned and indefinite – unremarkable in their uniformity and blandness yet grandiose by their sheer size. I took extra images on my phone to compensate for area not covered in drone footage. Grey flecks pervade the images. The confusing rubble - repetitive textures and tones could be confused with the digital grain of glitching corrupted MPEG images of the drone footage. I recovered the drone and ventured on around the perimeter of the site.

I continued to capture around the quarry; areas of rubble, sections of dirt track with remnants of previous excavations. Huge cubes of stone were placed outside of the quarries, ready for collection. I stepped around these features, clicking the shutter and capturing from several angles. At times, the sun would catch the faces of the marble, scorching a white-hot shape onto the image sensor. This would affect the surrounding environment's exposure and capture.

Glitch textures are stretched across the geometric cuboid and the surrounding rubble. The appearance of melted dirt runs like a stream towards the edges of the composition. Holes appear in the middle of the faces of the cube - as if seared into the image by its ashen heat. Textures of dirt and rubble around it stretches out as if speeding away from the centre-point. A confusion of greys pepper the shapes, signifying details of stones bordered on each side by vast areas of blank smudged forms. Grey holes appear in the rubble that fades towards the perimeter of the scan.

12th March

The soft magnolia sunlight that beamed into the residency studio cast a diagonal glow across the floor and adjacent wall. As the light hit the floor-length mirror, it projected a peachy hue throughout the far side of the room. A glass of water, perched up against the mirror, refracted colours tangentially onto the floor beside it, echoed symmetrically in the mirror as the colours

conjoined at point of reflection. The light shifted and faded as I moved around the object taking images. Beams of light dimed and altered as the environment outside changed; clouds passed and leaves dappled.

Light flared into the lens of the camera from the mirror as I duck to capture the rear of the glass. I moved around incrementally, the water in the glass warps the objects behind differently each time I move - itself a lens, refracting the surroundings and confusing the spatial structure. I unavoidably blocked the light as I encroached on the far side, capturing images from above the glass. The captures become a time-based media: warped by the changing of states, altered by the photographer and camera themselves.

Models display the glitches, warped textures, holes and blank spots of an algorithm confused by shifting optics. The transparent object is completely ignored: the glass has disappeared, aside from its base. The refraction of the light has caused a warped entity to appear, creating a strange, grey pixelated form at the back. The reflection of the mirror becomes not a reflection, but a window to another world. From this world we see a confused set of objects, blank parts of a form which should be the glass' reflection become a twisted entity itself. The repetitive carpet gets merged with the mirror at the point of reflection. The algorithm approximates and forges the reflected carpet with other objects, enveloping them into other areas. Holes are blown in the skirting and floating sections appear in the background made up of composites of boxes and wall. The surface of the water appears undulating, moving as if rising up within the invisible glass. Its surface is frosted with pixilation, bizarrely opaque. An impression of the surroundings is smeared across the glass, stretched and pixelated. The surface of the floor stretches out in a funnelled shell, arching away from the furthest point of reflection from the camera. The floor is punctuated with inconsistent bumps and lumps. Objects caught in the reflection float disconnected from the central isle. As they get further out, they become less clear; blurred and fuzzy with indistinctness.

Vanitas series

Vanitas ephemera, 2020.

The development of the experiments above has led to a series of vanitas work that explores ephemerality through a still life of objects. The objects chosen test photogrammetry and how it perceived ephemera or visibility. The objects are also symbolic of the vanitas works, including references to death and the ephemerality of life and wealth. Objects such as a glass skull, dried flowers, and gold appear in the works. Within the works, reflective, transparent, refractive, complex and symetrical objects create confusion for the imaging algorithm. Whereas symbols of life and death are symbols of human existence in traditional vanitas works, the difficult-to-visualise objects are contemporary symbols of ephemerality for automated imaging technologies. Their existence becomes liminal and causes difficulties for the technology.

 The vanitas has all of the conditions for causing photogrammetric issues. It has transparent objects, reflective surfaces, light-emission, and confusingly complex and repetitive patterns. In the images shown you can see glitches caused by the reflective nature of a circular mirror and transparent, glass objects. Also, the light shining from the lit candle becomes part of the adjacent object, confusing the position of objects to the algorithm.

Dried flowers represent preservation, loss, or death. Symbolic amongst vanitas. They are also complex three-dimensional structures that are confusing for photogrammetry. The depth of the overlapping, thin petals is difficult to gauge from images.

Colours are smudges across and smooth, homogenised form. The detailed delicacy of the flowers' structure is not captured in parts but replaces by an averaged mass form with texture

superimposed. The texture is freckled. Spots of blank areas a dotted with purples and yellows from the petals

14th March

As I ventured outside in the morning, I could hear the distant sound of bees encircling the almond orchard, that were attracted by the blooming of the trees. The low cloud passed by steadily as I crouched down to take images of the trees. I shot the branches from underneath, the blossom fluttering in the breeze. Some delicate leaves fell away as I captured shots around the circumference of its roots. The complexity of the overlapping branches and petals made the images confusing devoid of depth. The bright petals matched the soft white of the sky, at certain angles petals forming clusters similar to a wispy Cumulus. Its brightness resembles a digital saturation of light - a white balance error. The distinction between foreground and background is lost. The ground around the trees was arid and harsh, broken yet indistinct. The stones and clumps resembling pixilation or grain of images. Sequentially, the images appear not to move in a circle but produce a strange buzzing of static; of stones and grit appearing and disappearing instantaneously.

When faced with uncertainty of the homogenous earth or confusing tones of the petals, it leaves blank spaces, holes or creates phantom forms. Floating parts of the blossom appear disembodied apart from the tree. Spiked forms and solid areas of 'neutral grey' appear within the negative space as a deformed extrapolation.
The technology extrapolates and approximates spaces and textures based on the information it has. Stretched and compressed texture images are collaged over the top, pixelated and translucently overlapping. A blurry vision of the trees branches and petals appear fuzzily overlaid on to an open funnel-shape estimation of branches and blossom which extends to the sky. Hole in it form punctuate it homogenous form and allude to its transparency. The ground is awash with dull green/brown tones of indistinct matter. Its pixelated nature belies its actual complexity and the repetitive optic nature has let areas of the group to be repeated in different places.
The models' edges seem chaotic but are the quantifiable limitations of what can be understood. The sky is fused with the matter of the earth through the tonality of the blossom. The smeared, confused textures are the limitations of the machines knowledge, trying to piece together an understanding of the space and form presented to it.

The results are 3D digital models which houses holes, glitches and blind spots in its form. When faced with uncertainty of the homogenous earth or confusing tones of the petals, it leaves blank spaces, holes or creates phantom forms. Floating parts of the blossom appear disembodied apart from the tree. Spiked forms and solid areas of 'neutral grey' appear within the negative space as a deformed extrapolation. The technology extrapolates and approximates spaces and textures based on the information it has. Stretched and compressed texture images are collaged over the top, pixelated and translucently overlapping. A blurry vision of the branches and petals of the tree appear fuzzily overlaid on to an open funnel-shape estimation of branches and blossom which extends to the sky. Hole in it form punctuate it homogenous form and allude to its transparency. The ground is awash with dull green/brown tones of indistinct matter. Its pixelated nature belies its actual complexity and the repetitive optic nature has let areas of the group to be repeated in different places.
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After previous attempts to load images to the cloud, I tried a different tactic. As the satellite internet connection at JOYA struggled to cope with the recent trend in ubiquitous computing which involves the automatic cloud-storage of iPhones - all imagery is automated uploaded to the iCloud as soon as it is connected to the internet. I connected my phone directly to the laptop and uploaded images through the photogrammetry software. The use of the technology was still an issue as Autodesk Recap's cloud-based processing (the functionality of the software which uses high processing function of server farms) relies upon the transfer of images through the satellite internet in order to process 3D models. As the software assembled the models, a progress bar would state "8%" or "Queued" or get stuck on certain percentage of upload and then 'time out'. Images would get lost, glitched or omitted at this stage, thus not informing the 3D model. At JOYA, the images became intrinsically linked with the environment. The satellite internet itself was powered by the wind turbine and solar panels. A pivoting turbine at the top of a scaffold tower located at the rear paddock stood high above the roof of the farmhouse. Next to it were two reflective panels, pitched diagonally at an angle in order to face them roughly towards the East. The energy produced from these were stored in a 24 battery cells located next to the kitchen. The two-dozen Tudor EAN 70T batteries stored enough energy for the modem and transmitter connected to the satellite dish. Energies which had disrupted images, changed weather and lighting conditions were also the entities which powered the images and transferred its data. An embodiment of the natural materiality of the area upholding the digital processes which it is hostile to.

Local Area Network. 2019.

These experiments and realisations have led to the development of work concerned with network objects and their intrinsic link to the image. In a later project, network objects such as data centres, cell masts, cables, routers, and transmitters were all capture in a local vicinity of the gallery the Glass Tank. This was for the exhibition Local Area Network in 2019. Viewers who experienced the works through AR would need to connect to the network devices imaged in order to access the images on their phones.

The network objects themselves provide affordances for glitch in their homogeneity, normally plain or repeated devices huddles together like the servers withing the data centre racks. There are also visually logistical affordances too. The objects are often concealed, hidden or truncated which makes them hard to capture. Their visibility is purposefully obscured and the glitched nature of the images reflects that.

Ephemer(e)ality Capture - Survey of approaches and aesthetics for glitching spatial images.

Fractional Space: Between 2D and 3D

The Ephemer(e)ality Capture research project was, in part, a response to explorations initiated by Hito Steyerl's investigation into 3D scanning as part of her EIPCP research project. The project titled Transformation as Translation consists of an essay and documentary imagery of the "testing

process". Together, the project "[It] argues that the translation from 2 to 3D is a transformation, that brings the limits of a specific representational paradigm into focus."(2012a) Steyerl starts her essay Ripping reality: Blind spots and wrecked data in 3D by extrapolating on the physicalisation of images through emergent 3D media. She does so through a set of speculative questions, such as "What if they transformed into the objects they claim to represent? What if the flat plane of representation acquired an extension and even a body?" (Steyerl 2012) These questions come in response to recent developments in 3D scanning and printing technologies. For Steyerl, images have the potential to become objects through processes of replication through technological representation. They are scanned and then they are printed. However, the process of images being scanned and then acquiring 3D form throws up a set of issues. Steyerl analyses the terminology of tech manufacturers who produce these technologies and outlines the issues present within these processes of replication, likening the rhetoric to those of previous documentary media. Issues of truth, objectivity, and transparent mediation.

The new technology promises all the things that documentary representation promised ever since: objectivity, full and truthful representation of events, only this time augmented by an additional dimension. A 3D point cloud is no longer a flattened image, missing depth and extension. It is a copy with a volume, dutifully replicating the shape of the initial object. (Steyerl 2012b)

Steyerl goes on to test these technical limitations by capturing a kiss. As she describes, a kiss is a time-based action, something that the technology will struggle to capture because of the its reliance on a time-based, linear scanning of the environment.

Lets think of kisses. Kisses are travelling events. We can imagine them being passed on like messages or even virusses. […] But a kiss – seen from the point of view of scanning technology also merges various actors, usually two into one surface. Surfaces connect bodies and make them indistinguishable. They connect bodies to grounds and other objects they happen to be in touch with. Surfaces capture bodies as a waveform, entangled with their material environment. (2012b)

What Steyerl hits upon here (aside from its inability to distinguish between different unconnected objects) is that by capturing moving, time-based entities, she is creating error through optical phenomena. This creates an issue for the assertions of truth and objectivity of the technology. The technique reveals the mediation of the technology, its propensity to speculate or extrapolate from the contradictory information is has been given in creating a 3D image, one which Steyerl deems is problematic if considered a 'truthful' representation. Therefore, it reveals more about the construction of the image; the way the technology compiles the 3D model from flat imagery and the issues therefore inherent with this form of construction. Steyerl writes,

What emerges is not the image of the body, but the body of the image on which the information itself is but a thin surface or differentiation, shaped by different natural, technological or political forces, or in this case folding around a kiss. (2012b)

Steyerl terms this form of imagery "fractional space". A 3D model is not necessarily one entity but a series of fractured surfaces. Models that are peppered with holes or warped forms; spikes or anomalous forms jutting from the objects. Holes and floating forms display dislocated objects or areas which are disconnected from the rest of the image. The "fractional space" represents what the technology doesn't know or understand as well as what it thinks it does. Its mis-interpretations and its mistakes. Steyerl goes on to state that these types of images do not constitute full three-dimensionality.

This space is a fractional space, […] a space that hovers between 2 and 3D. It is for example a space in 2,3 or 2,4 D. To create a full 3D rendition one would need to scan or capture every point of a surface from every side. One has to basically use at least 3 scanners and then superimpose their results in virtual space. But if you have only one point of view, what you get is at best 2,5 D., a space between a surface and a volume […] 2,5D is created by 3D technology, yet it is imperfect 3D. (2012b)

Steyerl concerns move from a consideration of the image's construction to issues of technical proficiency and although Steyerl questions these technical issues and points to ways in which they could be overcome, the focus here isn't to overcome the technical aspects but to understand the

nature of the image. Steyerl posits that these images occupy a bizarre limbo state between 2D and 3D media because of their imperfect or time-based construction. Indeed, the images have no volume (unlike an MRI for instance); images are all surface, surfaces that appear strangely flat at times. The textures on the surface of the models are comprised of the 2D images used to create the model. The 2D photos are merged and spliced together, yet are often poorly aligned, stretched or warped. All these aspects degrade it's '3Dness' and leave it hovering in-between 2D and 3D.

However, issues of the 3D model's construction and composition are not extensively explored here by Steyerl. Whilst Steyerl goes on the describe the condition for their 'constructed' nature and the 'fractional spaces' produced, she does not elaborate on methods or discussion on how the images in question are composed by the technology. There are gaps in which a questioning of the composite or constructed nature of the image, as well as the vital role of algorithmic imaging and machine agency has on its creation. Steyerl hints at the issues of algorithmic construction but make no moves toward exploring it further through devised methods. Here, on the process of creating a 3D print of the scan, Steyerl considers the logistics of 'stitching', patching up of holes and making models 'watertight', as form of fictionalisation, and therefore a move away from objectivity.

In fact depending on data, a substantial amount of interpretation goes into the creation of such objects. In the case of this sample it is more than fair to speak of a deliberate objectifiction rather than an objectification or objective rendering of data, since about half of the surfaces are pure estimations, deliberate abstractions and aesthetic interpretations of data. (2012b)

Steyerl suggests an increased influence by technological agency as a result of less information being given but she doesn't hint at what further approaches could be taken to elucidate these. What conditions result in the creation of 'fractional spaces'? This has prompted my research to explore these questions. In what ways can the construction of a 3D image be exposed? Perhaps the answer has been alluded to above. An exploration of it's time-based nature and an examination of the issues which cause it to error. For answers to these, we look to glitch practices.

Forensic Architecture

Forensic Architecture use photogrammetry for investigative purposes. Often FA use it for the visualisation and extrapolation of data garnered from other image sources (video or photography) to discover new information – as a form of investigative journalism. For FA, digital media acts as a witness. For an audience, it visualises spatial details and factual events that are otherwise difficult to grasp. Their practice leans towards the use of photogrammetry for its kinship with a form of accurate spatial representation; an objective image that is formed using, and supported by witness testimony. Although these practices examine our relationship with representations through use of photogrammetry, it is not FA's purpose to examine 'the medium' and 'the image' of photogrammetry itself. In contrast, my research works inversely - using objects/subjects that are difficult to index as a way of examining the media itself. This research is not about acquiring 'truthful' representations of ephemera, but of using ephemera to discover the mediation present within photogrammetry, as well as its limitations.

On the limitations of remote imaging and the materiality of technology, Weizman states, "the forensic-architectural problem that arises forces us to examine the material limit of images." (2015) In light of this, Weizman reconciles the need for a return to witness testimony. "Facing the limitations of remote witnessing, one might turn to the testimony of survivors." (2015) The investigations rely not on the objectivity of technology but on the concurrence of witness testimony of events and acts. FA employ a technique of 'Ground Truthing' (Forensic Architecture 2018b) which describes the process of collecting testimony and imagery of disputed or recently disturbed/destroyed area through public and local sourcing. This act of 'Ground Truth' is a form of activism, in opposition to an invasive or authoritarian force. Interestingly, Forensic Architecture researcher and artist Ariel Caine has developed works which include multiple authorship. Caine

developed what he termed "civic-led counter practices" (Caine 2019) for his photogrammetric works.

Caine has developed work that moves towards a form of participatory spatial imaging, one that utilizes DIY techniques such as kite-photography or the sourcing of multiple residents' images. [Fig. Caine 1] As Caine argues, these practices work towards a de-authoring of the single-perspective photographic image, as the 'spatial photograph', as Caine terms it, is "an emergent form of three dimensional photograph processes and assemblages that constitutes not an image but a navigable, architectural environment." (Caine 2019) Not only does this acknowledge the shift in its construction, through his concept of 'constellation'(Caine 2019), but Caine notes a paradigm shift in the viewing of the image as 'navigable'. In doing so, it changes the ontology of the photographic image.

"It transpires that, in the process of photography's transition from the granular to the holographic, the singular body's viewpoint vanishes. Photographic space detaches itself from the single perspective and erases the looking body. In its place, the looking eyes and the camera become free-roaming, perspectival subjects within a multi-point constellation that forms the three-dimensional space." (Caine 2019)

Caine argues that the detachment of single perspective from the photograph is advantageous for his practice as it provides opportunity to create imagery from multiple authors, as a way of approaching a community-based form of imaging. My research argues that the author's perspective isn't completely removed from many images, and these affordances for vision appear in a strange and political fashion, especially through glitch. Directional glitches, such as textures and meshes form on one side from a central point or 'view' allude to the affordances and limitations of the author. However, the use of the image for Caine is still closely tied to its use as a representational tool, albeit in a changed form of representation which allows for multiple authorship. The acknowledgment of photogrammetry's construction and navigational qualities provide important benchmarks for an assessment of its aesthetics, yet the mediating agents for the image (the algorithm that constructs) isn't Caine's focus, which is where my research and Caine's diverge. Glitch can reveal the powers involved in the construction of the image.

Glitch Landscape

Many theories on glitch practices have dealt with issues of 'noise' and 'error' within communications media. Theorists and practitioners have focused on the issue of mediation and transparency with media, notably Shannon's (1948) acknowledgement of external influences on signal transfer as a significant issue for all communications media. Rosa Menkman has written about 'transparency' of a medium in her book The Glitch Moment(um) (2011) in which she discusses the issues of noise and glitch. With Menkman, there is a realisation that all communication technologies are affected by noise and that it is an impossibility to produce a perfect, unmediated transmission.

> While the ideal is always unreachable, innovation is nevertheless still assumed
> to lie in finding an interface that is as non-interfering as possible, enabling the
> audience to forget about the presence of the medium and believe in the
> presence and directness of immediate transmission. (2011)

These comments come in response to Shannon's writing on communications engineering and the acceptance that entropy and noise are inevitable consequences of transmission. If noise and

mediation are inevitable, then appearance of non-mediation and presence is paramount. And as Bolter and Grusin mention, there is a commercial and cultural impetus for this as "our culture wants to multiply its media and to erase all traces of mediation: ideally, it wants to erase its media in the very act of multiplying them"(Bolter and Grusin 1999). Menkman discusses the cultural desire to develop an optimally transparent channel, one in which the user is unaware of the mediation due to the directness and transparency of the transmission. In discussing the example of the Graphical User Interface,

[it] was developed to let users interact with multiple electronic devices using graphics rather than complicated text commands. This development made these technologies more accessible and widespread, yet more obfuscated in their functionalities. (Menkman 2011)

Menkman observes that the technology needn't be transparent nor direct, so long as the user's experience of it was deemed so. The user interface's accessibility allows for a non-technical user to perform complex computational calculations thanks to an easy-to-use operating system or controls. This is certainly true of cloud-based photogrammetry (CBP). CBP obfuscates its algorithmic mediation behind clear 'input' and 'output' interface. The construction of 3D models from 2D images is obscure and unseen but is easy to perform. Most users would be unsure of the exact manner in which their models are constructed. The technology displays the process with simple progress bars and buttons, with phrases such as "In Progress" or "Uploading" to signify its activity. Through this obfuscation of the processes in creating the images, there is an obscuring of the functionality of the algorithmic decisions on spatiality. Glitches, errors or failures in the models reveal how the technology struggles to calculate spatiality of the subject – leading to a displaying of glimpses into their true mediation and functionality. Their fragmented nature shows more clearly which images have been used and relied upon to for the 3D model, and conversely which areas of the model has insufficient information from image discrepancies. All this provide insight into the automated decisions and the way in which the 3D model is constructed.

This veneer of mediation can be unpicked through errors, showing a technologies materiality or functionality. Benjamin Mako Hill's essay Revealing Errors in the book Error: Glitch, Noise and Jam in New Media Cultures, is a guide through ways in which technologies have been shown to deliberately obscure the mediation of technology, only for the workings of this mediation to be revealed by errors in the system. Mako Hill gives examples of (in)famous systems errors that have displayed the political motivations for manipulations of information. Mako Hill argues that these intermediary codes, algorithms or technologies are hidden to the user until the point of error, which peels back the layer of the user interface, exposing not only the workings of the machine but also the political leanings of the developers. These user interfaces, Mako Hill explains, are known as "abstractions" (2011) to programmers. They allow the user to easily use the system (for instance, operating systems for laptops and phones) without the need to understand or manipulate code. Mako Hill lists several examples of the pervasive way in which technology mediates not only the information we receive but the way we behave. It provides an important insight when investigating the ways in which artists are also approaching systems, systems which deliberately control the direction of output. Artists become activists, as Mako Hill describes, "Errors can expose the particularities of a technology and, in doing so, provide an opportunity for users to connect with scholars speaking to the power of technology and to activists arguing for increased user control." (2011) For Mako Hill, artists uncover errors that reveal technology's manipulation of their movement or engagement, the control of their data or input, and alterations of their outputs and work. My research aims to put into practice Mako-Hill's assertions that errors uncover the mediations of technology by exploring the limitations of the photogrammetric processing, with errors/glitches appearing as a visual exposé of algorithmic confusion. But far from being a technical critique of the technology's inability to capture, the emphasis research is for an appreciation of the errors as more than merely a mistake. They provide a window into the workings of the machine but also promotes a reflexive, dynamic methodology which encourages users to work around the often narrow prescriptions of technical devices. Mako Hill too mentions importance of noticing errors in order to provide insights on systems of control, not least

because it provides information on the ecologies of media and the structures of power but also has provides a plurality of approaches to digital culture.

These approaches can be short-lived, susceptible to change and, superficially reproduced through pastiches. But these works often exemplify a current media temporality and provide a fitting snapshot of how media mediates at that moment. "The glitch's inherent moment(um), the power it needs or has to pass through an existing membrane or semblance of understanding, helps the utterance to become an unstable articulation of counter-aesthetics, a destructive generativity." (Menkman 2011) The temporality of glitch practices is worth addressing as these works and practices face disappearance. Notable glitch artists that include Jeff Donalson, Paul B. Davis, NO CARRIER (Don Miller) and JODI [Fig. JODI 1], are artists that demonstrate glitch practices in which the media is 'local' to the artist. In this sense, the materiality of the hardware and/or software 'hacked' was accessible to those artists. Either the artist changed the code of the software to make it perform differently or the artist altered the circuitry of the hardware in order to achieve alternative outputs. These works represent what could be termed as 'local glitch practices' and reflect the local nature of technology throughout these times. These practices are potentially under thread due to the cloud-based trajectory of contemporary technology manufacturers. In all aspects of digital culture, from gaming to graphic design, media are moving from a system of distributed media commodities (in which the individual user has access to the technology's materiality) to a centralised 'remote' or cloud-based model. This allows the commercial developer more agency in the distribution of the technology (allowing for greater control against piracy, for example) and for more control of security (easier to prevent 'hacking' of centralised system compared to thousands/millions of individual units). However, practices of glitch, Thinkering (Huhtamo 2010) or 'Zombie Media' (Hertz and Parikka 2012) could disappear due to the difficulty in accessibility of cloud-based media technology. Against these powers, methods of détournement must be employed. Are there ways of continuing a Media Archaeological practices with cloud-based technologies?

Glitch as paralogy

In The Postmodern Condition, Lyotard posited that culture and research would increasingly be imposed upon by economic, political and bureaucratic systems; legitimated on their service to the production of power (and not autonomously) - a condition he termed 'performativity'. His solution to the issue of performativity was an approach of 'paralogy'. Paralogical practices included methods of research and culture which highlight, critique or de-stabilise the systems of power which underpin 'performativity'. For Lyotard, in research, this meant the production of ideas needed to be sought by non-normative means or by going against the established norms. Lyotard problematizes the Habermasien notion of 'consensus community' with regards to legitimacy. For Lyotard, consensus opposes the heterogeneity and diversity necessary within research and culture as for Haberman "legitimacy [was] to be found in consensus obtained through discussion"(Lyotard 2005) Consensus favours a homogenisation of approaches whereas 'paralogy' seeks dynamism and difference. Andrew Prior suggests that "Glitch-art practices constitute a vibrant 'paralogical' response to a performativity within arts and research," (2013). Prior goes on to analyse the importance of cybernetics and systems in Lyotard's conception of performativity. "One of Lyotard's key arguments was that the cybernetic characteristics of contemporary culture legitimate knowledge not for its sake, but for its performance." (2013) Noting the issue of the subjection of contemporary culture through use of digital media to the performativity of economic systems. Artists involved in glitch practices are often interested in the limitations of systems, concerning their methods by testing them to the point of error. "Therefore glitch art might constitute a paralogous approach in drawing our attention to the materiality of its media, the conditions of technology and the constructed character of aesthetics." (2013) Perhaps then, methods which promote a reflexive and evaluative questioning of

photogrammetry's mediation represent a paralogical practice, and provide an approach in situations when the materiality of the technology is inaccessible. Methods which encourage a disruption of delimiting of subjects for expression. Methods which deliberately negate the exclusion of subjects based on their technical accuracy. And lastly, methods which explore the issues and problems of technology by exploring practices which go against prescriptions of 'best practice'.

Détournement, Spectacle and it's technical equivalent

Similar to paralogous practices, it's worth looking at acts of disruption as cultural methods which have been employed previously. In the late 1960s, in his book Society of the Spectacle, Guy Debord outlined the use of the term 'détournement' a process of resistance to what he termed 'the Spectacle'. For Debord, 'the Spectacle' encapsulated capitalism's political, societal and cultural powers, which transformed citizens into passive observers and consumers through seductive forms of visual culture. All that mattered for those powers was that citizens consumed and became politically disengaged and stupefied, which could be achieved through an array of pacifying, spectator-enducing media. Debord, through his activity as part of The Situationist International, employed acts of 'détournement' to disrupt, critique or challenge the socially controlling forces of the Spectacle. The use of 'détournement' was often employed when agency was limited, as a form of critique of a power or establishment for which they had no agency within or power to change. Disruptive acts or purposeful resistance to social norms resulted in actions which influenced the understanding of how artistic practice could be socially and politically engaged. These acts, although focused on pre-digital world, rally against many of the issues faced by users of commercial digital media: over-commercialisation, saturation of imagery/media, and a subjugation to manufacturers. It could be argued that because of the development of digital media through the late 20th and early 21st Century, the 'Spectacle's potency has increased with the multiplication of image producing media. The landscape has changed technologically and many of the issues of power structures and the production of imagery which Débord was concerned with seems ever more prevalent. Within the emerging world of photogrammetry, a shift of agency to commercial entities and automation is important. It is also interesting to note that the Spectacle, in terms of imagery, had previously been concerned with two-dimensional representations. With emergent 3D/CGI media, its imagery threatens to bring a new dimensionality to the Spectacle. It emerges with a promise of greater realism. These rhetorics and methods of producing images should be tested and pushed in order to understand their limitations. The techniques in this research could be likened to acts of detournement within digital media practices. Specifically, this research investigates ways to disrupt and challenge prescriptive outputs of commercial 3D media. The 'Spectacle' in this case is represented by commercial technology manufacturers who exert a control over user's output and cultivate dependence upon digital media. The recent cloud-based boom has led to a dramatic shift towards manufacturer control. Users submit input for 'rendering' or processing' which come with very few controllable parameters. Often this is because algorithms decide on parameters of filters, extrapolation and rendering based on the input of the user and adjust them accordingly. The agency of the user is limited by the input they provide, which are often coerced by 'good practice' or 'how to' technical guides. However, the questioning of 'good' and 'bad' technicality in favour of agency which qualitatively investigates limitations of technology is important quality for many artists. A form of questioning which aims to understand more about the algorithms and cloud-based tools which is shaping artistic practice. So, how is it possible to use 'détournement' to challenge these restriction of commercial digital tools.

Conclusion

This research acts as an unpicking of the complex chain of mediation present within photogrammetric images. The image itself relies upon digital translations of image data and of hidden automation from data set assessment of image spatiality. The glitches that occur reveal the unseen algorithmic interference which aims to give the appearance of transparency; one which aims to create a more sophisticated representation of the depth of optical reality. Steyerl's research initiates a method and a language for understanding these issues of mediation and digital translation. However, Steyerl's single project provides insufficient information on the true nature of the image's construction, if it is to be useful in bringing "the limits of a specific representational paradigm into focus."(Steyerl 2012a) Whilst she establishes that "What emerges is not the image of the body, but the body of the image", this reflection on the inadequacies of the image-making process is not thoroughly developed and problematised. The research presented developed further the nature of fractional spaces created by photogrammetry. This initiates a toolkit and conceptual framework for an address such issues of layering and automated rendering of spatial imagery for future research. This leaves scope for further explorations for researchers intrigued to investigate the particularities of 3D technologies construction of the image. From the works produced, the investigation focuses not on whether we get any closer to 'reality' in an optical representational sense, but whether we get any closer to the reality of understanding how technology construct images and the ways in which they mediate.

3D MODEL LINKS

JOYA Gasquez Landscape
Vanitas flores exaruit
Vanitas glass candelabra
Glass/water/refraction
Vanitas ephemera photografia
Sierra Larga Maria rocks 1
Sierra Larga Maria rocks 2
Embalse de Valdeinfierno
Stone Quarry Drone
Quarry cube
Almond Tree
HK e-waste dump
Data Centre Outside
Data Centre Inside

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