UNIVERSITY OF CALIFORNIA
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CHARON:

The Self and the Technological-Other

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of the requirements for the degree of

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emphasis in
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Abstract

We are at the dawn of a robotics revolution, which has already begun to transform the landscape of manufacturing, reconnaissance, surgery, and modern warfare. But what of the human psyche?

Human perception is expressive, interpreting the nature of truth, language, thinking, dwelling, and being. How then do the embodied intelligent agents we have created perceive and interpret the world? What is the subjectivity of robotics?

How will the Self change as we meet, and merge with this new Technological-Other?

This paper outlines technical considerations, and philosophical reflections on the use of autonomous robotic agents in art, society, and warfare. Specifically, this paper addresses the use of an autonomous quadrocopter in a CAVE-like immersive virtual reality environment with motion tracking capabilities. Also described are several approaches for preparing highly non-conformal generative geometries for rapid prototyping and 3D printing.

Furthermore, a companion essay titled *Wading in the Wake of Symbolization* is included which further addresses questions raised in *Charon* and provides a broader context for the work.

Contents

1. Charon

1.1. Introduction

1.1.1. Summary

Charon is a physical embodiment of the tension between humans, robotic autonomous agents, and the virtual models which these agents rely on to understand the world. A sculpture (Figure 3) was created from the flightpath of an autonomous quadrocopter in pursuit of a human participant within a motion tracking lab (Figure 1, 2). Both physical and virtual forces exerted their influence on the drone, creating a two-way boundary crossing between the internal world-model of the drone, and its external physical surroundings. Thus, these sculptural forms can be considered as the shadow of this boundary crossing, fueled by the complex exchange between a sentient human and a robotic proto-lifeform.

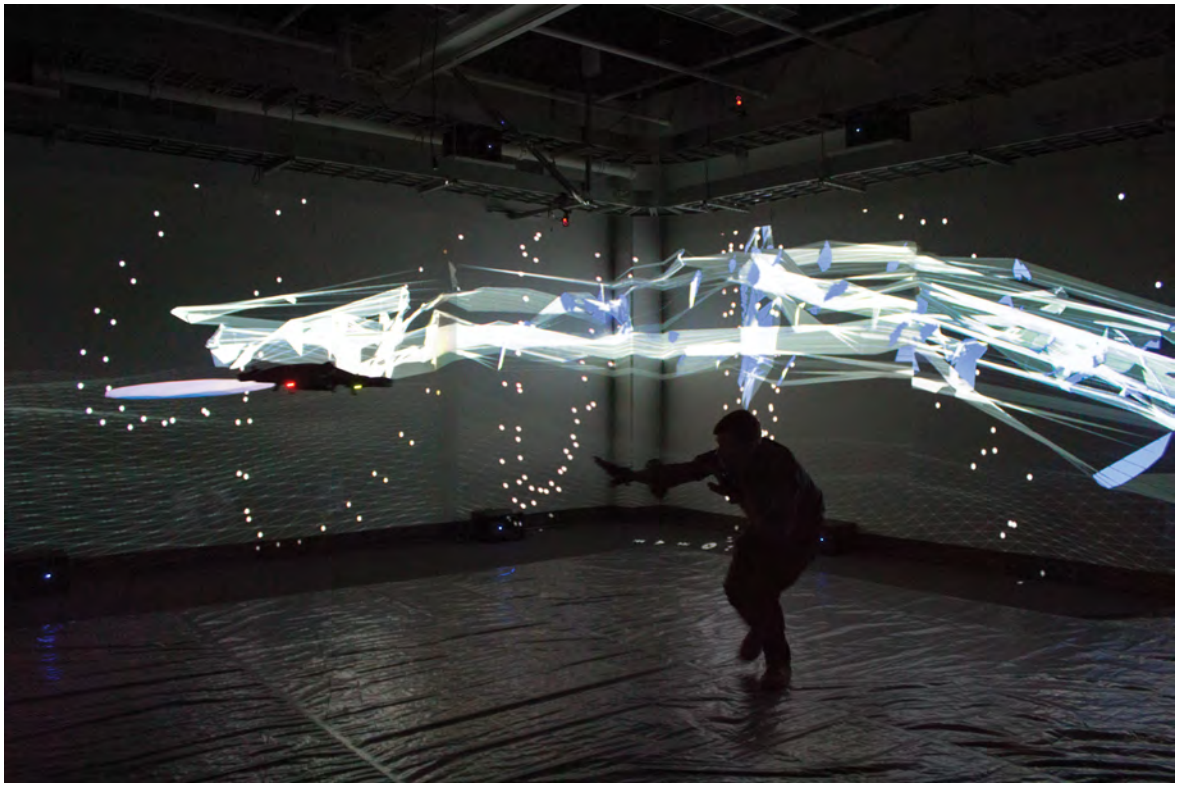


Figure 1. Performance of *Charon* in the transLAB.

Figure 2. Digital reconstruction of flightpath and environment (left) and a rendering of the sculpture prior to physical production (right) .

Figure 3. Sculpture of Charon exhibited at MFA Thesis Exhibition at the Art, Design & Architecture Museum at UCSB, roughly measuring 12x12x12 inches, or 1/20th the scale of the full flightpath.

Charon is the ferryman on the river styx, the mediator between the physical world and the underworld. In Greek mythology Charon was born from Erebus (darkness) and Nyx (night) who were two of the first five primordial beings to come into existence, created by the source of all existence, Chaos. The name of Charon comes from the Greek word χαροπός "bright-eyed", charopós, "of keen gaze". The drone wirelessly receives its vision and thoughts from an array of cameras and computers, which are an extension of its being. The transLAB when considered as whole a system is akin a living creature's biological functions. *Charon* is a micro organism in the shadow of a macro, global techno-organism.

Charon is the molted skin of a proto-lifeform, of man and machine, traveling between the physical and the virtual, between the human and the post-human. Birthed into the world through rapid prototyping machines and conceived in a cybernetic womb.

1.1.2. Background

Charon evolved from *Topology of Desire*, an earlier project completed in 2012, which aimed to represent the gap between the desire of autonomous systems, expectations of their actions, and the result of their behavior. An autonomous quadrocopter within a motion capture lab was programed to trace the shape of a virtual torus (Figure 4). As the drone struggled to keep up with an ideal positioned calculated by my software, the degree of lack (the quantifiable amount by which it fails reach its goal) became the modifier for a deformation of the virtual torus (Figure 5). This kept the goal of the drone forever beyond its reach, yet was directly related to its attempt to reach it.

This struggle is a cybernetic feedback loop between the drone, the flightpath of the drone, and the ecosystem of forms being generated. Over time this cyclical feedback mutates the topology of the torus into diverse, unexpected forms (Figure 7, 8).

Forever reaching toward the unattainable, the drone could never pass through the surface of this ontological structure, as its boundaries shifted beyond reach with each step taken. This amorphous shifting geometry acts as an Other for the drone to gain a sense of Self from. *Charon* is an intentional attempt to puncture this ontological structure, and the boundary between the physical and the virtual. By incorporating the human into this interaction, it is in fact the human which becomes Other for the drone. This relationship

embraces the agency of the drone and relinquishes some of the hubris often surrounding our societal approach toward technology. Not only was this an attempt to further highlight the drone's sense of Self, but to embrace a kind of animism in *Charon*. The constituents of *Charon's* subjectivity encompass machine vision, the commingling of Self and Other, and a tremulous spirit beginning to shimmer out of the machine shell.

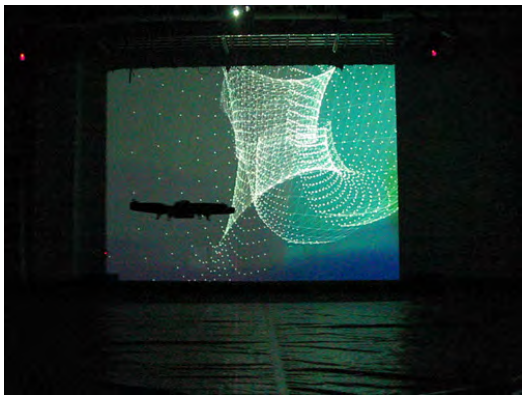


Figure 4. The drone arrives into the ecosystem.

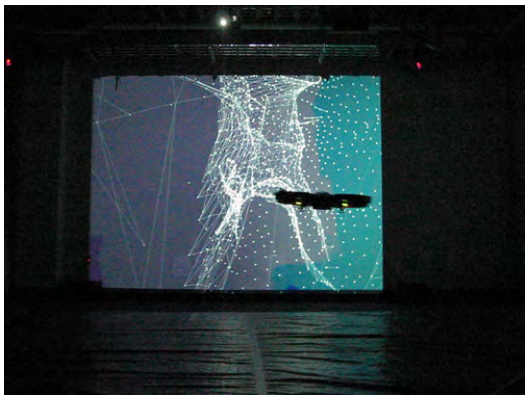


Figure 5. Introduction of desire, and redefinition of the ecosystem through lack.

Figure 6. The topology of the torus remains visible, but begins to fluctuate rapidly as the drone accelerates toward the point of desire (red).

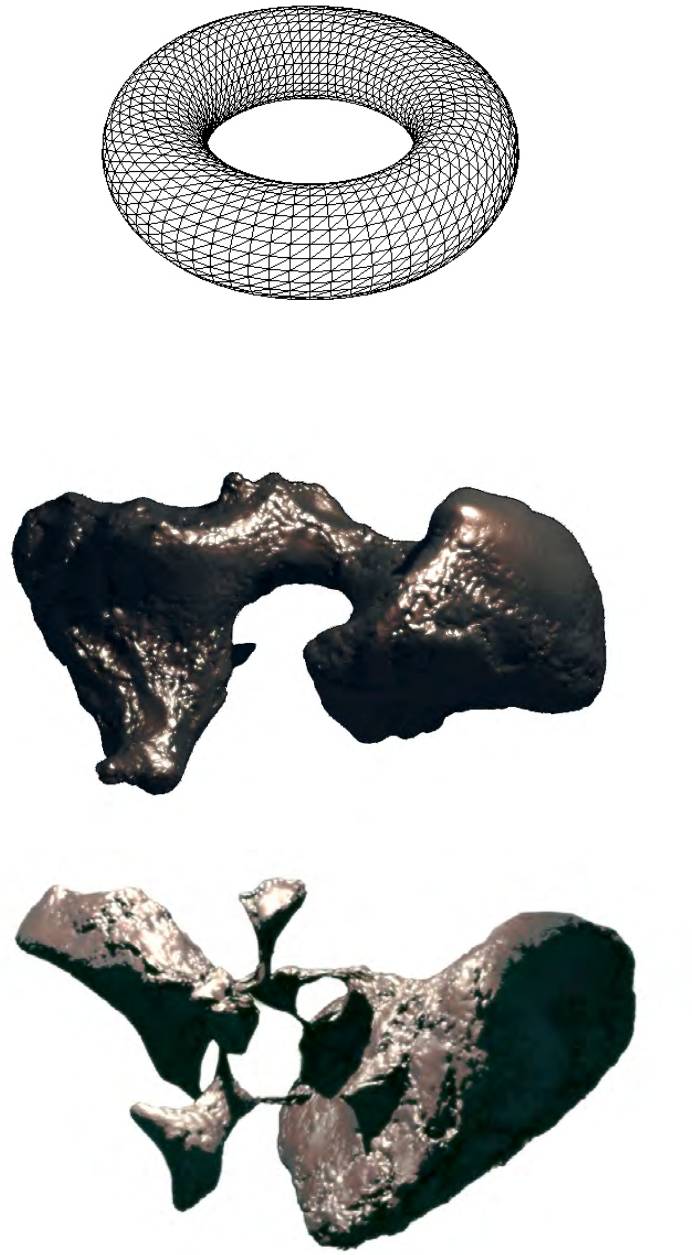


Figure 4. Eventually the initial topology of the torus (top) became like an organ of the drone's new body, or an excretion of its desire, and frustration.

1.1.3. Motivations

Intelligent agents which perceive the world, examine its behavior, and react accordingly are amplifying and replacing the role humans once held in society. IA's range from embodied robotic agents performing industrial manufacturing in automobile plants, to disembodied agents performing algorithmic stock trading. These IA's are the logical extension of the assembly line taken to its extreme, transforming the *means of labor* into a *living labor* [1]. Doctors perform complex surgeries remotely, robotic rovers explore dangerous environments, and somewhere in Japan a robotic noodle worker is cooking a customer lunch. This ever sharpening division between laborers and their product has helped liberate as well as alienate us.

In the military, Boston Dynamics BigDog system is poised to aid soldiers in the battlefield as a robotic pack-mule, and perhaps as a soldier [2]. Unmanned Ariel Vehicles (UAV) have shrunk to the insect scale [3] and in some cases *are* machine-insect hybrids [4]. Drones have already been used to kill over 3,000 people in Pakistan and Iraq over the past five years, many of which were children and civilians [5]. Additionally, the FAA expects 15,000 or more drones flying over US soil in the next five years [6]. This may seem startlingly sudden, but the evolution of the drone into its current state has its roots over 100 years ago, having first been described by Nikola Tesla in the early 20th century [7]. That which is profitable, prevails, and the U.S. military UAV industry is expected to grow to an $18.7 billion dollar market by 2018 [8]. And as Mayor Bloomberg of New York has stated, "you can't keep the tide from coming in" [9].

The number of such disembodied intelligent agents and autonomous systems is increasing exponentially and will continue to reproduce and improve, soon surpassing the total population of Humanity, if they haven't already. Many serious academics and scientists have speculated that these systems will eventually become conscious and reach stages of superhuman intelligence [10]. But for now, even the most sophisticated embodied intelligent agents rest as ghosts in the machine, even if at times they seem to rattle their cages. For example, in March of 2011 a military drone started on its own despite the fact that it was essentially shut off [11]. These systems however sophisticated are still vulnerable, and often the human operator/collaborator of these systems is susceptible to coercion [12]. This is evident in drone piloting stations which have been compromised by computer viruses, and military grade cyber-weapons aimed at industrial facilities that have leaked into the wild far beyond their intended targets [13][14].

1.2. Theoretical Concerns

1.2.1. The Self and the Technological-Other

It's important for us as a species to pause and take notice. To listen, witness, and reflect on the complex and codependent relationship we are creating with this new Technological-Other. This other is of an order of magnitude higher than the human-other. It is an other from the self, from human kind, and from most forms of life. It is a living-dead animate matter which, like a virus, can replicate only through the help of its human hosts.

This otherness is at once exclusionary as that which is potentially different, foreign, inferior, as well as a barometer which we model and understand ourselves around. The Other is also a candidate for social engagement, a family member, a friend or perhaps a lover. ".. the idea of otherness situates robots in a sphere that does not preclude social qualities, but does not commit to them either, and which has both positive and negative potentialities." [15] Always the Other is that which we can never fully encompass or eliminate. The Other is beyond resolution. The Other remains, lingering in the mind, regardless of extreme closeness, destruction, of the physical or immaterial substance of its construction.

Despite all of this Otherness I suggest that technology is an extension of humanity and an embodiment of the human spirit, rather than an external force that one must mitigate. Yet this distributed life-form pulsing on the surface on the earth has its own agency and agenda, and is a manifestation of our will to power. It is paradoxically at once the Material-Other, the Semi-Sentient-Other and the Self manifested as the Other. To paraphrase Novak, The Technological-Other can be thought of as the alloself, "an other of another kind", brought forth by allogenesis, the production of the alien from within [16].

If its true that we are destined to merge with our Technological-Other, transforming the Self into the Other, how will that shape our psyche? Our minds are already beginning to ebb and flow into synchronicity with the aid of the Internet, but how will our psyche adapt as our bodies transition into the Technological-Other? *Charon* is an attempt to give form to the relationship between these entities and our bodies. *Charon* is larval, a shadow of this transition, a twisting mucosal excretion from this exchange as we bridge the gap between the human and the Technological-Other.

1.2.2. Subjectivity of the Technological-Other

"We see the world, not as it is, but as we are" - Talmud

How we see the world defines our behavior, so then how do autonomous robotic agents sense the world, and how does this shape their behavior and subjectivity? Furthermore, how does the internal world model of the drone effect the way it understands humans?

High-level computer vision systems typically use a series of statistical image processing methods to identify features in an image. Then, with a prori knowledge the system identifies what the image contains and reacts accordingly. These systems are sometimes also constructed as learning algorithms, which are rewarded for favorable behavior in order to increase efficiency. These subjectivities are goal based, or rule based, perhaps with or without the capability of adaptation. The human in the eyes of such a system is that which rewards, or leads to reward, or perhaps humans are ignored and unseen all together in favor of another goal.

Rather than using a priori knowledge, researchers at Google have recently shown that it is possible to let a system learn what a face is without having to manually label which images in the training data have faces in it [17]. Their research extends beyond images and faces, and serves as a broad adaptive learning model for arguably any data. Similarly, CMU's Nell project has been reading through the Internet since January of 2011 in an attempt to build a semantic knowledge database between all language based concepts [18]. These adaptive approaches to high level interpretation are promising, but semantic meaning is complex, subtle and elusive. Training such a system to identify a human is trivial, however recognizing the difference between an enemy combatant and children playing in the street is a more complex problem.

Machine vision is a complex field with many approaches to identifying patterns in an image, or image stream. But the root of this questioning reaches beyond vision, and beyond a semantic and ontological framework to give context to those images. Perhaps what's needed is also an emotional, psychological and arguably spiritual framework for managing this information.

1.2.3. Liminal Semiotics and Machine Consciousness.

These emergent and bottom-up systems are closer to a natural, evolutionary model of intelligence. However these systems still discretize the world into representation, relying on databases of signs, syntax and symbols. Machines are trapped in the realm of Saussure; of sign, signifier, signified, and are perhaps incapable of reaching the actual thing which is referred to. Kristeva might say that machines are currently incapable of addressing the raw space between symbols.

Things in the world are not just the result of underlying forces, nor are they simply the qualities and percepts we ascribe to them. Relating to an object is not a complete way to know it.

Lacan states that the Real is that which resists symbolization absolutely.

Our minds exist in the turbulent wake of this resistance.

How then does the machine, the technological Other, confront this territory beyond the limit of symbolization?

As machines exponentially improve, they gain not only speed but new facilities for processing information from the world. However, it appears that we're essentially pushing the summation of human experience and worldly sensation through a mechanical sieve with finer and finer openings, in hopes that the gelatinous results will pass as palatable to our mind's tastebuds.

As Alan Turing postulated, if a machine can simulate a person in casual conversation without the human participant discerning a difference, then it is 'intelligent' [19]. However, as Turing acknowledges, there's more to it than that. In Geoffrey Jefferson's *Lister Oration* he addresses this issue at length stating, "Not until a machine can write a sonnet or compose a concerto because of thoughts and emotions felt, and not by the chance fall of symbols could we agree that machine equals brain - that is, not only write it but know that it had written it. No mechanism could feel (and not merely artificially signal, and easy contrivance) pleasure at its successes, grief when it valves fuse, be warmed by flattery, be made miserable by its mistakes, be charmed by sex, be angry or depressed when it cannot get what it wants." [20]

1.3. Systems Description

1.3.1. transLAB

Charon was developed in the transLAB a CAVE-like[21] multimedia environment founded by Marcos Novak in the Media Arts and Technology Department at UCSB. At the time of this works development, the transLAB was outfitted with a motion tracking system, a 16.2 channel surround sound audio system, two desktop computers, and four 3D high-definition digital projectors.

The Optitrack motion tracking system uses an array of calibrated infrared cameras which can see special reflective markers and triangulate their position in three dimensions, as well as rotation, with sub-millimeter accuracy. This information is collected on a Windows based desktop PC and transmitted via ethernet connection to a MacPro desktop computer running Max 6. A Max patch on the MacPro runs the virtual simulation and calculates flight instructions which are then transmitted via wifi to the drone (Figure 5).

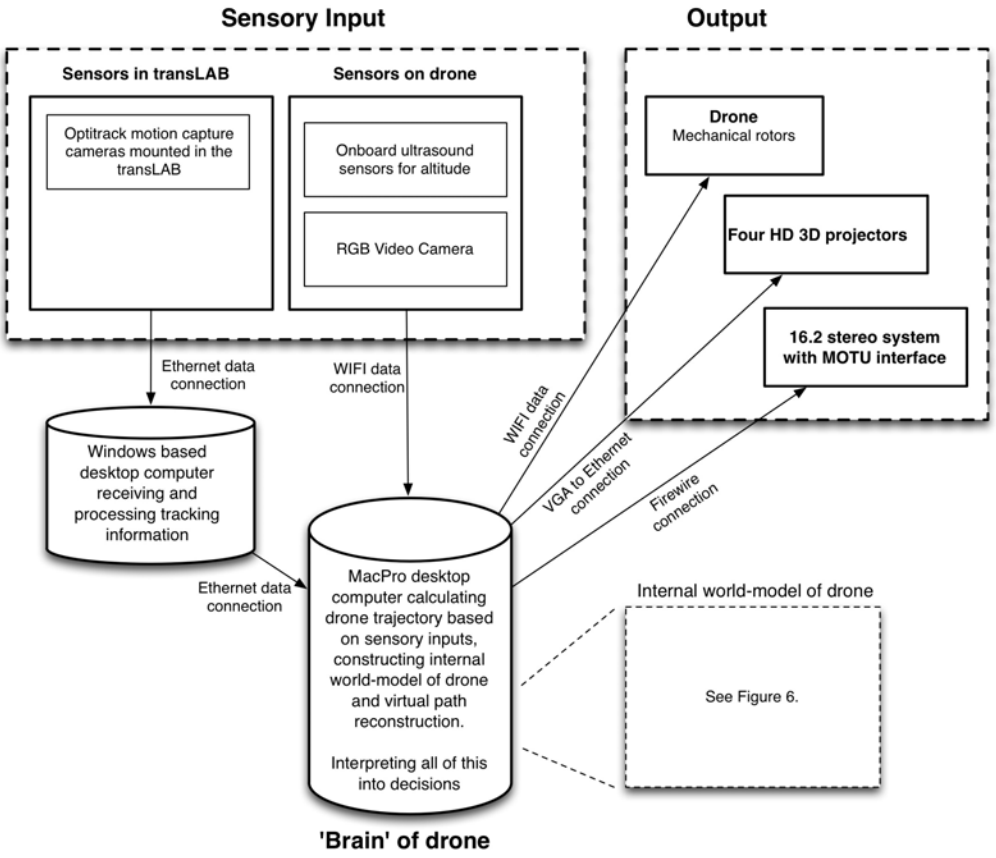


Figure 5. Data flow and systems map.

1.3.2. Development

The initial effort to bring the drone under autonomous control in the transLAB started in January of 2012 and was a collaboration between Tim Wood and myself. The quadrocopter used in the work is an AR-Drone (Figure 6) developed by Parrot. Currently it's sold as a radio controlled product, however Parrot provides an API for code based control. Special thanks to the team behind the open source project Javadrone [22], as it was instrumental in our efforts.

Topology of Desire used Max to calculate the direction of the desired location in relation to the position of the drone, and sent move commands accordingly. Since then, Tim Wood has continued his efforts and branched his work into DroneControl [23] which has greatly improved the flight mechanics over the course of the last year.

Figure 8. AR-Drone used in the work.

1.3.3. Behavioral Model

Currently the mind of *Charon* is a reflex-based agent with a stochastic behavioral state and uses sensory inputs from both the physical and virtual world. The drone receives sensor input, checks the world state against its internal model, decides what it should do next, then tries to do it. However, it has the chance of colliding with virtual objects in the simulation, as well as chaotically changing behavioral states which can cause it to act friendly or quite aggressive.

As the drone follows the human participant, it leaves behind a virtual trail of its path in the simulation. If the drone interacts with this path again, the path will be deformed in the direction of the flight. A second copy of the path is also being spatially deformed by a basis function, which then acts as a

resistant force for the drone to contend with. A collision with these swirling circular points from the basis function agitates the drone, changing its behavioral state as well as slowing its flight and altering its path.

Just as the physical wind being pushed from the drone's rotors billows through the transLAB and affects its behavior, so does this virtual force fold in on itself and force the drone off its trajectory.

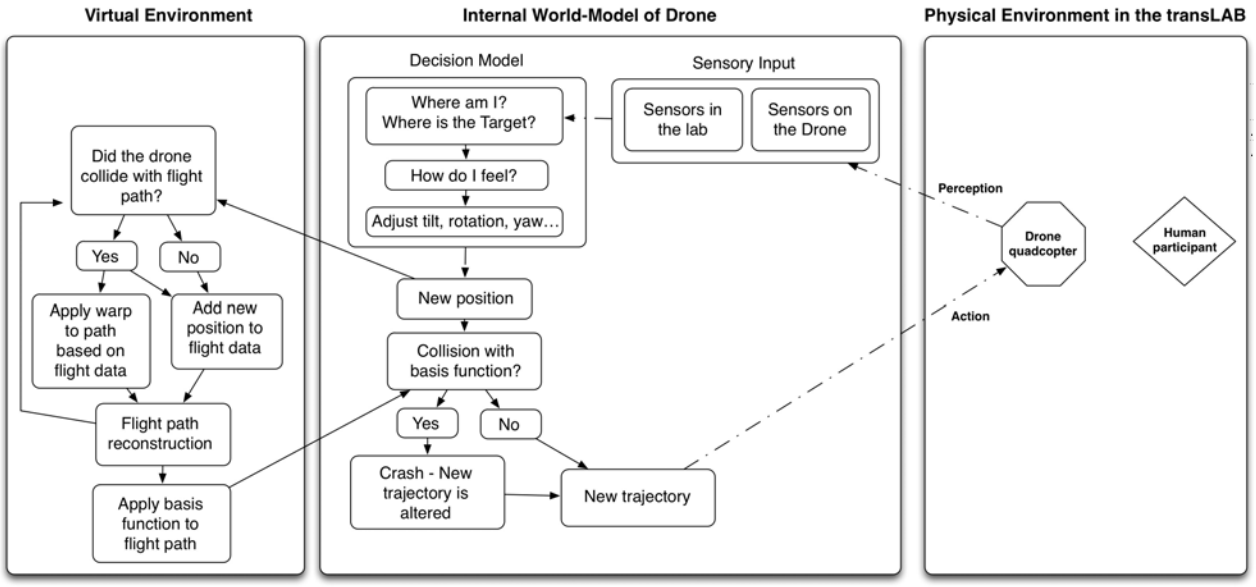


Figure 6. Behavioral model.

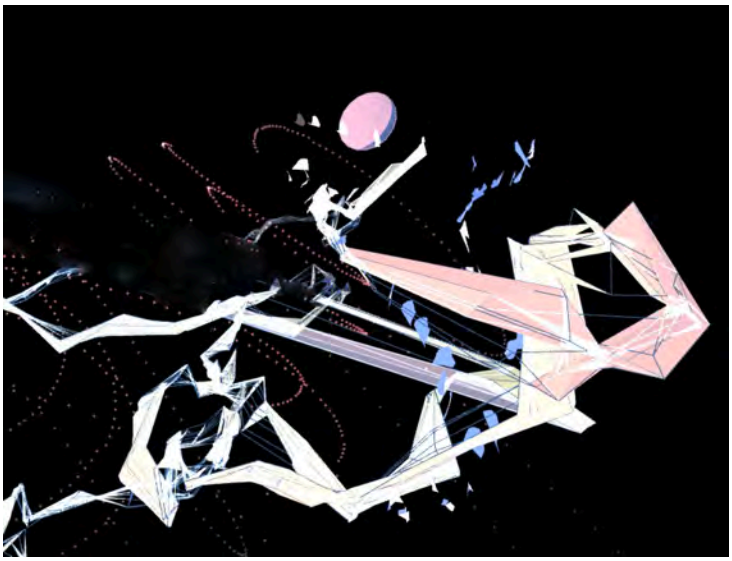


Figure 7. The drone shown here as a fleshy disk, basis function data shown as small red points, and the flightpath is the largest geometric structure. The blue scattered fragments are nodes in the flightpath which are impervious to distortion and represent where the flight path was before it became warped.

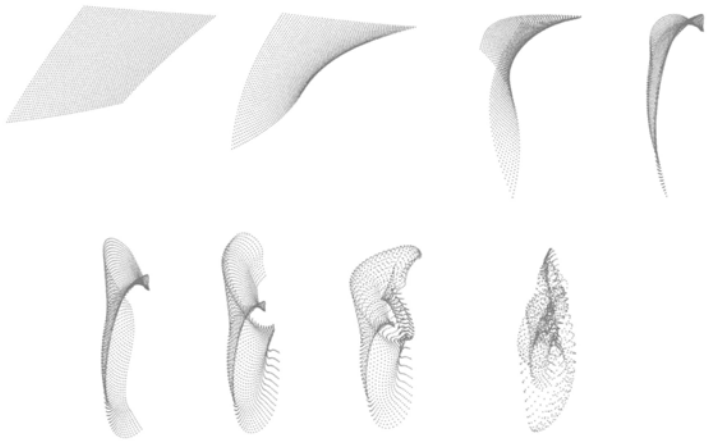
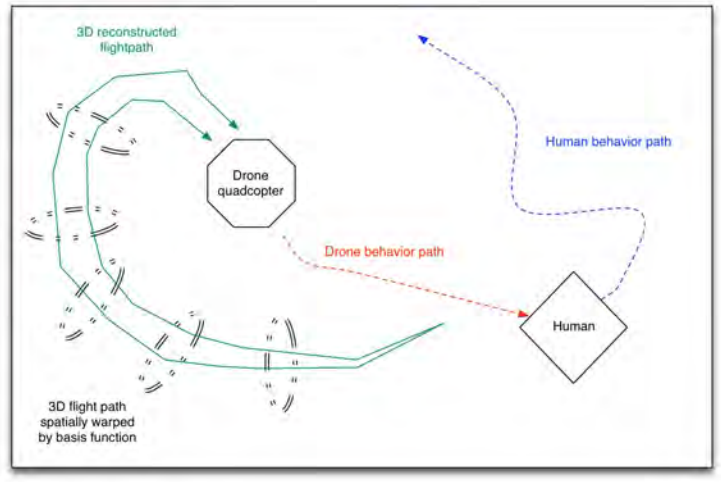
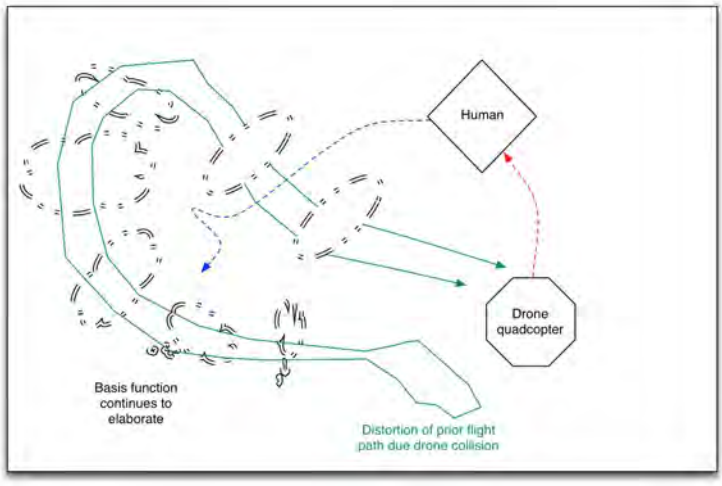


Figure 8. For the sake of clarity, shown here is a flat plane in three dimensional space being run through the same basis function used to distort the flight path of *Charon* into a cloud of resistant points.





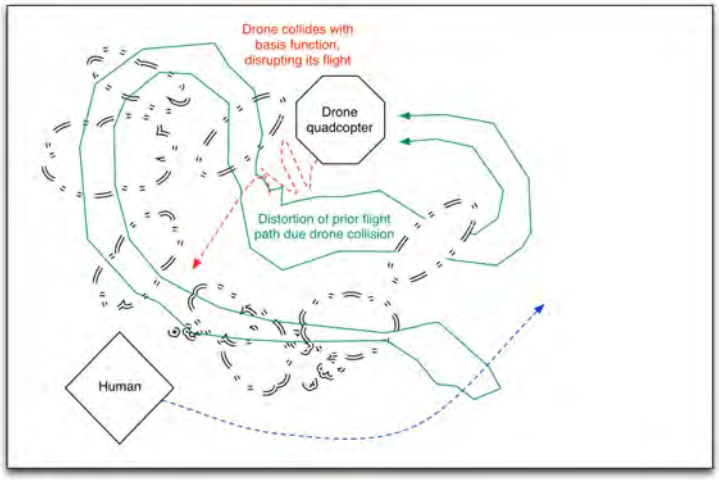


Figure 9. This is a depiction of both the physical and digital behavior of the system overlaid over time.

1.4. Sculptural Production

1.4.1. Digital Reconstruction

The flight path of the quadrocopter could be described as a series of points captured over time connected by a line, however the flight is more expressive than just position over time. To make the rotation, tilt, yaw and velocity of the flight more visible the simulation places small nodes every 1/4th of a second along the path. These nodes are shaped based on the current flight data, but once placed are not further deformed by interaction with the drone.

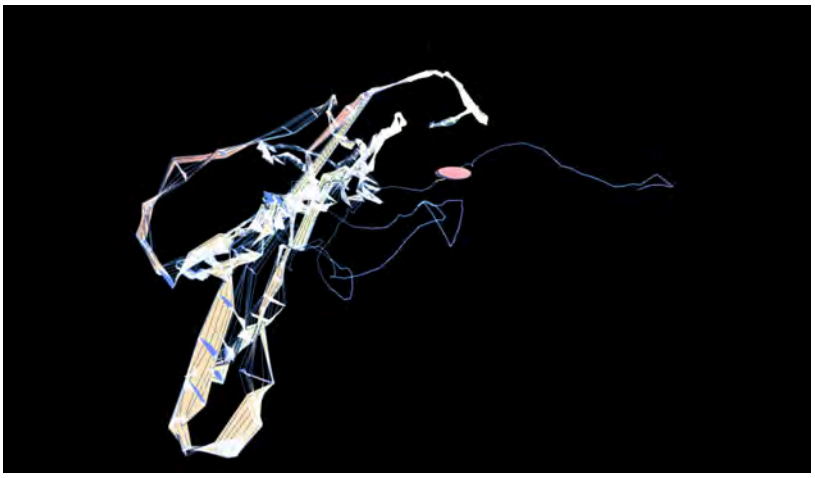


Figure 10. Flight path with interconnected nodes (left) and raw path (right).

This 3D data is then exported out of Max as a Wavefront .OBJ file and prepared for manufacturing. Several methods of exporting 3D data from Max are possible if one is determined to do so, however nothing is available by default, and no method seemed capable of exporting 3D data in the identical way that Max handles geometry. To solve this issue, I contributed to a community developed OBJ writer [24] by making available three new primitive options that mirror the way Max renders data, and fixing some of its functionality.

1.4.2. Preparing Non-Conformal Geometry for Rapid Prototyping

Rapid prototyping and computer aided manufacturing is not a simple task. If you start with a particular manufacturing method in mind and carefully model your form in a computer-aided drafting software its much more straightforward. But what if you're already generating complex and interesting geometries via some other method and interested in physically producing that data? The complexity level and number of issues associated with translating a highly non-conformal, self-intersecting geometric form into a 3D printable object can quickly erupt into an unmanageable nightmare.

However, there are several tools currently available for tackling this problem. I have found that none of them are stand alone solutions, but rather a combination of several approaches is necessary. Also, each dataset likely has its own issues that need to be addressed on a case-by-case basis.

For starters, Netfabb Studio Basic [25] is a free program which performs repairs on StereoLithography files (.STL) which are the current industry standard. This is a good last step before reproduction. Meshlab [26] is an open source tool with an extensive list of useful operations that have been published via academic papers and is highly recommended for processing complex geometries. Some of the steps involved in reproducing *Charon* included performing extensive surface subdivisions, calculating the alpha complex shape of the object, removing unreferenced vertices from the internal volume of the model, then reconstructing the surface using a ball-pivoting algorithm, subdividing the surfaces again, and performing a Poisson surface reconstruction. This is a generalized sequence of operations that when calibrated properly should result in a conformal model from highly chaotic data.

1.5. Related work

The Flying Machine Arena [27] (FMA) is a laboratory at ETH (the Swiss Federal Institute of Technology in Zurich) also working with autonomous drones. This lab is responsible for the well known acrobatic quadrocopter stunts, focusing primarily on the engineering aspects of the complex aerodynamics of high speed quadrocopter maneuvers. Similarly the General Robotics, Automation, Sensing and Perception [28] (GRASP) Laboratory at the University of Pennsylvania has focused on the engineering aspects of quadrocopters and has a similar fleet of acrobatic drones.

Cornell University and Carnegie Mellon University are also roots of this development, having significantly contributed to the fields of robotics and autonomous navigation. CMU has hosted an annual Mobot Race [29] for the past 19 years, in which a diverse collection of mobile robotic systems are developed and engage in timed competition races along a slalom-like course on campus. This logic has extended into the DARPA Grand Challenge [30], a long distance competition for driverless cars funded by the military and private corporations with cash prizes in the millions of dollars.

Related approaches (and sources of inspiration) to computational geometry include Michael Hansmeyer [31], Daniel Widrig [32], and Neri Oxman [33], who have their backgrounds in architecture but approach the subject in a more fluid way. Other related work emerging from the transLAB include “Catch and Release” a collaborative performance by RJ Duran, Tim Wood. As well as "Κηφήνες: Energy Parachutes | Entelechy Drones" [34] an installation by Marcos Novak in 2012 at the Daejong Museum of Art.

1.6. Conclusion

As a civilization, and as a species, we have crossed the river Rubicon into uncharted territories from which we cannot return. These intelligent agents both embodied and disembodied, visible and invisible, physical and virtual, are surveilling, contemplating and evolving among us. The tension between the human, the Technological-Other and the alloself will define the 21st century. How will these entities reach beyond the limits of symbolization, and how will their emotional, psychological, and spiritual frameworks emerge?

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2. Wading in the Wake of Symbolization

Traces left behind in the wake of interaction between humans, agents and forces in the Attention Ecology of our society and the Internet.

(1) footnotes
(A) see bibliography for sources

2.1. Attention Economy / Ecology

It's clear that our time and attention is limited, and there's too much going on in the world to pay attention to it all, especially now. Countless people are fighting for our attention and trying to convert this energy into political, social and economic power. Even inanimate things themselves can be thought of as competing for our attention **(1)(2)**. This competition for attention has been turned into a highly skilled craft by plants, animals **(1.5)** and culture at large, which is especially evident in the battlefield of consumer products and advertisements.

This competition can be understood in terms of Attention Economics **(A)** which describes the finite nature of human attention in contrast to the vast and exponentially growing access to information. However, it may be more accurate to describe this situation as an attention based *ecology* rather than an economy. This ecology is an evolutionary system of richly complex interactions between limited resources (human attention), competing agents (corporations, other people, algorithms, ideas, aesthetic styles, cultures, objects themselves) and countless internal and external forces. The time between publishing information and audience response has nearly collapsed since the dawn of the Internet, further exacerbating this situation. The rapid feedback loop between production and consumption, when considered as a whole, can be thought of as vast synthetic brain evolving its ability to engage with humans and understand how we think **(3)**.

(1) This can be seen in the material-semiotics of Gilles Deleuze and Félix Guattari's **(B)** concept of the rhizome, the world as a horizontal networked structure of relations that seeks equilibrium and is constantly shifting. Michel Foucault, Donna Haraway and much of traditional 'eastern' philosophy also speak on this subject. The fields of cybernetics and chaos theory are scientific approaches to this subject, and I'll address them later on. **(1.5)** I'd also recommend Michael Pollans "Botany of Desire" regarding the coevolution of humans and plants.

(2) Also in Bruno Latour's Anthropological Matrix **(C)** which describes the world existing as a web of hybrid things that are both subject and object, between nature and culture, between agency and raw material. In the Anthropological Matrix all things are both real and imagined, both nature and culture. Latour has also extensively written about Actor-Network-Theory (ANT) **(D)** which describes existence as a network of 'actors' (human or nonhuman, essentially everything) engaged in a series of relationships. ANT disrupts the concept of differentiated individuals acting in the world and states that these things are really the sum of many other actors which reinforce each other.

(3) See Kevin Kelly's inspired book *"What Technology Wants",* and authors like Oliver Reiser, Buckminster Fuller, Dane Rudhayar, Sri aurobindo, N.A. Kozyrev, Teilhard de Chardin, Jose Arguelles, et al.

2.1.1 A Crash Course on Emergence

The interaction between the billions of people and countless entities (both physical and conceptual) is analogous to competing swarms of organisms undergoing flocking behavior as they compete for limited resources. Imagine a flock of birds or a coral reef as a model for understanding urban cities **(4)** and societal, economic or semiotic relationships. Each individual node in the system is primarily concerned with their local neighbors, rather than the overall pattern. This concept of 'local neighbor' **(5)** could be a physical thing, an idea, a geographic location, a material property, a symbolic relationship, sociological, economic, et al **(2 see ANT)**. By adjusting in small steps **(6)** to maintain or shift alignment between these neighbors, the overall structure of the global organism undergoes emergence **(7)** and evolves. The milieu **(8)** of this global-social-organism could be considered as the Internet, fed by the pulsing desires of the whole world **(9)**. However, all of the world is a stage.

(4) Steven Johnson calls these 'Liquid Networks' **(E)**

(5) I'm mostly referring to Latour and the neighboring actors in the network, however there's a concept in machine learning called the Nearest Neighbor thats also relevant. This describes a process by which the nearest (most similar) event from past experience are classified into the same category. This is opposed to a priori knowledge, and provides a basis for machines to intuitively discover new things.

(6) Buckminster Fuller is widely cited for his use of the concept of a 'trim tab' as a metaphor for an individual's ability to affect the global organism. Trim tabs are a small surface connected to the edge of a rudder of a boat or plane, which reduce the amount of work required to be performed by the larger rudder. Making small adjustments to the trim tab can dramatically adjust the trajectory of the system it is attached to.

(7) Many complex systems that may at first seem to be very different (termite colonies, human brains, cities, bacteria colonies, nervous systems) are all the result of emergence. When a great number of individual agents follow a simple set of rules they begin to self organize and result in a great order of complexity, often without any individual agent becoming aware of such ordering. Steven Johnson has written about the subject's vast implications **(F)** and it is widely studied in fields like evolutionary science, neurology, urban development and economics.

(8) *"In French, milieu means "surroundings", "medium" (as in chemistry), and "middle". In the philosophy of Deleuze and Guattari, "milieu" should read as a technical term combining all three meanings."* **(G).**

(9) The Internet was accessible to 34% of the world's population in June 2012 **(H).** And if an individual is not directly on the web, its influence inescapable.

2.1.2 The Genetic Algorithm

Digital documents, concepts and physical forms converge into discrete objects as necessary and move from representation to embodiment then back again. This constantly emerging and unfolding behavior is a multiplicity that exists in a cloud of experience. A thought leaves the self and is encoded within a vehicle, which is then experienced by the other and/or the self, which is then re-imagined where finally the cycle loops on itself in a circular causal relationship. This formula is the basis of cybernetic theory and inherent in any act of conscious creation. The machine-human hybrid is a semiotic engine. It fragments knowledge and mutates information through a genetic feedback loop. The basic structure of this genetic system **(10)** is as follows:

1 Initial population : Content is uploaded to the Internet and/or non-web content observed and integrated into the actor-network of the observer.

2 Fitness evaluation : The content that has generated the most attention/capital is strengthened in the actor-network, creating a subset based on preference.

3 Reproduction : Analysis of preferred content, interpretation and understanding is developed.

4 Mutation and genetic crossover : Synthesis between subset which produces a new population. This could be human and/or algorithmic creation of new content and/or remixing of preexisting content.

5 Loop : Back to reproduction.

6 Termination : The newly created semiotic organism becomes extinct, or it speciates into a new thing which is no longer in the same genus, and/or speciates in a way that does not allow for further reproduction**(10.5)**.

(10) Genetic algorithms are widely used in machine learning systems, robotics, manufacturing prototyping, computer vision, natural language processing and many other fields. Neural networks, which are inspired by biological networks of neurons, are often used in conjunction with genetic algorithms. These networks pass observations between nodes and learn from observed data by strengthening which connections fit a particular criteria. The most robust of these systems use several neural networks which feed on each other in feedback loops, abstracting the level of evolution across the entire system.

(10.5) A horse and donkey producing a mule for example, which by themselves are essentially sterile. This could also be an idea that does not get spread around.

2.2. Case Study : Feedback Loops and Human-Machine Semiotics

Search engines are keystone communication lines, and themselves are evolving actors in the network. The proprietary algorithms **(11)** and machine learning processes are the DNA of these systems which through the help of flagellum like web-crawlers, scan what information can be quantified in the network (both online web and offline data at large) and improve the effectiveness of the system. At this point, this should be fairly obvious to anyone participating in contemporary society. But as the Observer's Paradox **(12)** shows, any such observation of the network will then influence said content, and language itself.

This Observer's Paradox is evident in content farms such as Demand Media who hire thousands of workers to generate text and video content in order to satisfy such algorithms. Language itself has begun to adapt to this systematized, mechanical observation and analysis of its constituent parts. This crowd sourced labor model is also used by Amazon's mechanical Turk **(I)** which describes itself as "artificial artificial intelligence". Workers are paid pennies on the dollar to complete "human intelligence tasks", like sorting which search result is better, or reviewing the kinds of articles that Demand Media may have written **(13)**.

Websites like *Livestrong.com*, *EHow.com* and *About.com,* which are developed by Demand Media, generate more robust content than pure spam bots**(14)**. However, they still reek of a Frankenstein-like approach to language and meaning. These websites offer countless fragmented and self-referential articles such as *"What is Kale?", "The Skin Benefits of Kale", "Benefits of Juicing Kale", "Nutritional Breakdown of Kale", "Kale Nutrition Information" , "The Health Benefits of Eating Kale" ,* and *"What is the Nutritional Value of Kale?",* which are each designed around search phrases rather than designed to offer a more complete body of information.

(11) It's a common misconception and reductive to say that a search engine is a complex algorithm. Machine learning is a broad topic in artificial intelligence, and state of the art search engines are built from a vastly complex architecture of machine learning systems, neural networks, semantic databases, web crawlers and are assisted at many stages by human tasks.

(12) The result of an observation is often affected by the observer. In quantum mechanics, it is impossible to observe a system without changing it. See quantum indeterminacy, quantum uncertainty and Schrödinger's cat.

(13) This could be seen as a problematic devaluing of human labor via machines, and such trends were fuel for a number of labor riots of the 19th century. The English working-class, and in particular Luddite textile artisans, backlashed against the mechanical production which had left them jobless. Many argue that humanity has been adapting to technology, rather than technology to humanity, since the industrial revolution. Ted Kaczynski's anti-technology ideology outlined in his infamous manifesto *"Industrial Society and its Future"* argues that technology limits human freedom and is a perversion from nature.

(14) Often spam bots just use Markov models on databases of keywords which are essentially random yet unpredictable.

2.3. Attention as Currency, the Image-Object and Persona as Product

An image-object **(18)** can perhaps be understood as newly manifested node in an actor-network which attempts to be self-aware of its position in the network, or attempts to understand or modulate its reception by other agents. The subjectivity imbedded within an image-object is self-aware in terms of its production, consumption, and audience. However if this is the primary consideration of an image-object it can be understood as a product by and for the Spectacle of our attention ecology. The essential truth of such an image-object is that it embodies an immense accumulation of representation as the real. We must not blindly accept the spreading ideology of such an image-object as beauty, as the form of the good, or as truth. The fact that this modality has gained ubiquitously passive acceptance echoes the adage, "that which appears is good, that which is good appears" for "the attitude which (society) demands in principle is passive acceptance which in fact it already obtained by its manner of appearing without reply, by its monopoly of appearance" **(J)** .

The societal expectation for an artist in the post-internet **(19)** era often lies in a constant stream fragmented gestures, constructed to be quickly digested and 'shareable'. One is no longer expected to maintain a sustained, deep focused attention toward a single purpose nor "help the world by revealing mystic truths" (Nauman) as truth itself has been deemed subjective and abandoned. The ubiquity of an online audience within the multiplicity of a post-internet art practice breeds over-communication and heavily documented minute gestures, creating a hyper-scrutiny of the ephemeral. Yet this scrutiny can only occupy a narrow region of time as defined by the collective attention span of society, which exponentially dwindles in direct coloration to the increasing speed and ease of communication. Such an artist in the post-internet era is a product, by and for themselves and their audience. This sentiment is embodied in many art practices existing primarily as online presence and persona-as-product **(20)** .

(18) "Image Objects...exist somewhere between (the) physical... and documentation... the documentation becomes a separate work in itself...(they) move seamlessly from physical representation to internet representation" **(K).**

(19) "Post-Internet is defined as a result of the contemporary moment: inherently informed by ubiquitous authorship, the development of attention as currency, the collapse of physical space in networked culture, and the infinite reproducibility and mutability of digital materials" **(K).**

(20) "Separated from his product, man himself produces all the details of his world with ever increasing power, and thus finds himself ever more separated from his world. The more his life is now his product, the more he is separated from his life." **(J).**

2.4. Irony and Lack of Fixity in Representational Strategy

Vierkant questions where the heart of an artwork exists, and concludes that the image-object is one that "move(s) seamlessly from physical representation to Internet representation"(K) and that the truth of art now lies in this infinite mutability of form. I suggest that the "lack of fixity in representational strategy" (K) used by image-objects is often less in terms of the direct mutability of the digital, and material-semiotics, but rather an exacerbation of the burden of choice, and an embrace of the ironic gesture which plagues modern society. The ironic often plays such a key role in such image-objects, it deserves quoting the following at length:

> *"(the ironic) makes fun of its own format, and attempts to lure its target market to laugh at and with it. It preemptively acknowledges its own failure to accomplish anything meaningful. No attack can be set against it, as it has already conquered itself. The ironic frame functions as a shield against criticism....Irony is the most self-defensive mode, as it allows a person to dodge responsibility for his or her choices, which means etymologically to "secretly-flee" (subter + fuge). Somehow, directness has become unbearable to us."* (L)

However, this embracing of the infinite mutability of digital matter is not the root of the problem. Rather it seems clear that the development of attention as currency and "capital to such a degree of accumulation that it becomes an image"(J) is a virus rotting away at the core of society. This self-consuming activity allows for "technology to become determinant of its own truth"(M), which is the "supreme danger" of technology, according to Heidegger. This kind of activity is machine-based (or aided/informed) production, but it's the production of alienation, it's a product of the spectacle not of the real.

Perhaps it's an attempt to create the real through the inversion of mere representation into the real, but this practice immediately, willingly, and happily sacrifices this real back into the Spectacle. This model of working is a continual abandonment of truth. It generates and embraces alienation itself as a product, rather than producing an investigation into the understanding of ones own existence. Of course one could define ones existence by and through the Spectacle, but to completely deny the real and fail to see that which is outside of the Spectacle is truly the negation of life.

2.5. Dualist Ideologies - Power, Beauty and The Question Concerning Technology

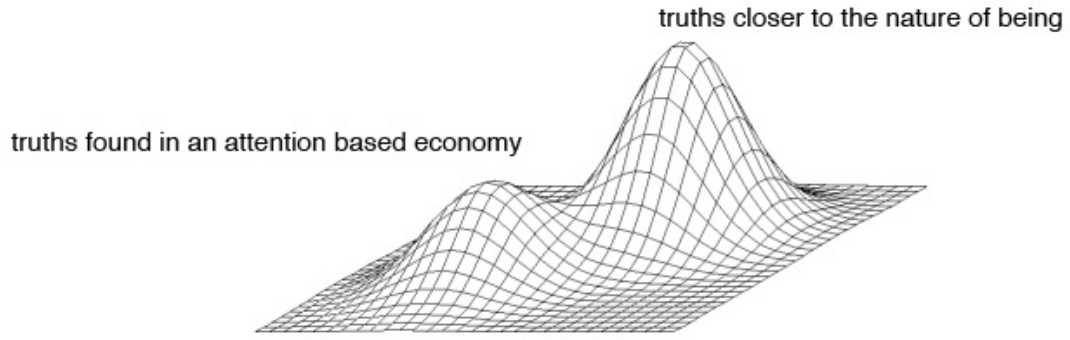
These attention based spectacle-fueled image-objects are “a constellation of formal-aesthetic quotations, self-aware of (their) ... context and built to be shared and cited” **(5 Vierkant)** rather than the “essence of technology…the constellation, the stellar course of the mystery”**(M)**. This distinction, however potentially problematic in its dualism, presents two modalities which should be considered with a great deal of importance. One modality is of power and currency, the other is of beauty and truth. As Heidegger states, one modality becomes "transfixed in the will to master it(self) as an instrument”**(M)** and fails to “hear in what respect one exists in terms of ones essence”**(M)**. While the other reaches toward the essence of technology which “resides in a poetic dwelling near the truth of Being”**(M)**.

Through the lens of Heidegger one could say that the relationship between the image-object and its components of physical, digital and ideological forms, and the modulation of these components, is a means of ordering as a way of revealing. Heidegger states that Enframing is the “calling out to unconceal the actual”**(M)** from which “the essence of all history is determined”**(M)** and that this behavior is “truth setting itself to work”**(N)** . He continues to state that the essence of technology lies in its revealing and unconcealing of the truth. And that “technology comes to presence in the realm where revealing and unconcealment take place, where aletheia, truth, happens.”**(M)** What then are the truths that may be revealed by this iterative, self-consuming behavior of society and what is the history that it has defined? Often it is those individuals who are interested in power, not beauty, that write our history.

It seems plausible that this iterative and genetic approach of image-object documentation, mutation, and reproduction, would over time reorder the image-object and reveal, or unconceal, a truth closer to the core of the post-internet condition and the nature of being. However, when novelty itself becomes the goal of a creative system, the strategies of aesthetic mutation become polluted with tropes and clichés. Rather than a swift evolution into new unknown forms, this activity becomes a frantic flailing. This methodology treads water, gasping for the air of truth in a sea of self-referential ironic gestures. If there is sincerity within the work, it’s the sincere embrace of attention as currency, and a willingness to never escape the isolated arena of the aesthetic object. This is an activity “so inextricably linked with a variety of interpretations on Conceptual art doxa”**(K)**, (the commonly held beliefs and often unquestioned opinions) that it lacks a Logos (a ground, an argument, a wider context), necessary to deliver it into Episteme (clear truth, certainty of knowledge). This activity is a tool for the formation of an argument, which lacks both context for the argument, and the argument itself.

2.6. The Hill Climbing Problem

To continue using the analogy of genetic algorithms and systems, any such image-object fueled by an attention based economy may suffer from the hill-climbing problem. Essentially this states that although incremental change may lead to a better solution it may only be a local solution or local hill that has been climbed. While the higher, global hill within the system remains unseen and thereby unattainable. This lower hill is the hill of the attention-based economy, with a shallow and voracious hunger for novelty. The climbing of this hill equates to what forms generate the most attention or spectacle. While the higher, global hill (of which there of course, are a multiplicity) exists in what Heidegger refers to as the essence of technology which resides in “a poetic dwelling near the truth of Being”(M) . These are the moments of experience which broaden and redefine what it is to be human, which enrich, question and give back to the collective pool of humanity, rather than offer up idols and symbols for, and of, consumption. These are gestures inherently born from their use value, not just in a practical and pragmatic sense of use, but also in an emotional, intellectual, physical and spiritual use. This is in contrast to gestures born from an exchange value, based solely on economic hierarchies in the language of attention, capital and currency.



This graphic is of course reductive, and it is likely that the higher hill shown here would be best illustrated as existing on another surface, or perhaps another hyper-surface altogether. These higher dimensions of consequence and purpose may unfold and reveal themselves perpetually, remaining forever out of reach. However, failing to witness and reach toward them is "the danger in failing to hear in what respect one exists in terms of ones essence"(M). People must act as shamans, and as guides within a cybernetic system that is existence. Reality is a feedback loop, of which we are all authors who must be “affirmed (by) the power of the world to call forth an otherwise inaccessible reality and the ability of art to give shape and significance to the chaos of the universe”(O).

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