Invisible Images:

Computer Vision, Algorithmic Images, and Machine Ontology in Trevor Paglen's *Adversarially Evolved Hallucinations*

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UNIVERSITY OF OSLO

June 2019

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2019

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Trykk: Reprosentralen, Universitetet i Oslo

Abstract

This thesis is researching computer vision and algorithmic images grounded in Trevor Paglen`s series *Adversarially Evolved Hallucinations* from his exhibition *A Study of Invisible Images* at Metro Pictures in 2017. Computer vision is the field of study that seeks to learn computers to analyze and interpret images and other visual input through algorithms and partly autonomous learning processes. To produce the series, Paglen has together with software developers created a computer vision system that can learn from the information it is given, recognize the objects it is trained on, and express itself in terms of images. These works are manifestations of the computer`s invisible operations in a form visible to humans, serving as physical objects that open up for speculation in how computer vision function. Paglen is through the exploration of this system exhibiting the alien and uncanny world of these seeing machines, but also how they are interrelated with humans and structures of power. It is an artistic engagement with a technology that is shaping how we see, act, and organize ourselves. The series is giving a glimpse into how these machines perceive the world, and how they're interpreting images in a way that is radically different from humans. The works are strange encounters with an unfamiliar form of vision that is increasingly operating in our everyday lives while remaining largely invisible. Through a selection of images from the *Adversarially Evolved Hallucinations,* this thesis strives to understand the aesthetic and visual relations of the new image technologies associated with computer vision, algorithms, and artificial intelligence. In an interdisciplinary manner with a broad range of theory from media-based and visual studies, this thesis is investigating how the changing status of images, autonomous vision systems, power relations, and the conception of the human is presented through these works. The *Adversarially Evolved Hallucinations* open up engaging explorations of the non-human agency of the machines and their understanding of images and serve as an invitation to think of images and vision beyond the scope of the human senses.

Acknowledgements

First of all, I would like to thank my supervisor, Aron Vinegar, for his stimulating and motivating feedback throughout this process. Thank you so much for always pushing me to develop my arguments further and believing in the project from day one. I am truly grateful to Mark Lee Wax and Emma Lennox for proofreading parts of the thesis. Finally, I thank my dearest source of support and encouragement, Maria.

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1 Invisible Images

There is a widespread belief that the increasing prevalence of images in our global society has shifted it into a predominantly visual one. In this line of thinking, images found in mass media, on the internet, and in our social networks have participated in making human communication overwhelmingly visual, where texts are less considered than images and symbols. Images seem to be everywhere, and they rapidly spread in our digital networks. According to Nicholas Mirzoeff, more photographs are taken every two minutes in the United States than were made in the entire nineteenth century. It is estimated that there were one billion photographs taken worldwide in the year 1930, while in 2014 there were produced one trillion photographs, most of them digital. While numbers like these can hardly be estimated correctly, they are still telling of a culture that is increasingly visual, where images are at once so ubiquitous that at times they can seem to be unimportant and part of the excesses of a consumer-driven world while at the same time have the potential to become powerful modes of thinking, experiencing, and influencing. We are learning to break down these visual codes in order to quickly and efficiently perceive the world and derive information and in turn they shape our understanding of the world we live in and of our collective history. Images have agency in that they produce meaning and understanding, and through circulation in the society they help determine social relation. Theoretical concepts have been developed to aid us in examining and understanding this visual culture. What has been less emphasized in the exploration of the influence of images today is that they are significantly and increasingly invisible to humans.

What has changed is that there has been an intensification of machines that operate on images in the form of data and information. A large amount of images are today read and written by machines, produced mainly for other machines, and are thus becoming invisible to humans. The digital images that are parts of our everyday lives are not simply the projections visible for human observers, they are also unstable entities that exists as continuous and ongoing computations in machines. Images are constantly translated and exchanged between different machines, and when presented to humans they are generated from the form of data into an image. This invisibility is a fundamental condition for digital images. In technologies as computer vision, images are analyzed by machines without having to be presented in a visible form. For computers, images are read as information, which means that they are

understanding images in a strikingly different way than us. The larger developments in computation and the applications of computers to make sense of the enormous amounts of data is also involving images. They are analyzed and recognized by computers in complex systems that are partly autonomous, and where the operations are invisible to humans. In these systems, computers are seeing the world for us, observing and gathering information through visual input. According to artist and writer Hito Steyerl, human vision is now losing its relevance to calculations such as filtering, decryption and pattern recognition by machines.[1] Digital images consist of large quantities of information which we cannot perceive unless it's translated to a human form. They are not stored as images in a way perceivable for humans, but rather as a numerical code in a machine or server, and are only later presented to human users in a translated form that is comprehensible to our sensory apparatus.

This demands a shift in the focus of images and visuality which implies a decentering of the human. Art history professor Jonathan Crary, who has written extensively on the role of human vision in a wider historical perspective, has a similar view, arguing that what has traditionally been seen as the most important functions of the human eye is now being replaced by technical apparatuses. He claims that this turns images into something that no longer has to reference the optically perceived world or any human observer.[2] Rather, images refer to mathematical data and code. Crary predicts that traditional forms of perception will persist, but that the new technologies of image production and distribution are taking its place as the primary models of visualization. This will, in turn, impact not only how and what we see and understand about the world, but also how social processes and institutions function. Following the relocation of vision into the domain of technical systems and code, Crary sees the formation of new networks of consumption, circulation, and exchange.[3] Rooted in the understanding of the physical, mental and cultural functioning of the human eye and ocular apparatuses, he suggests that there is a coming shift that is altering something fundamental about the human body, the role of our eyes, and vision. To begin with, it can certainly be stated that there is a transformation of image processing and perception from what we can see and interact with into the unknown, and into something increasingly non-human.

[1] Steyerl, *Duty Free Art*, 47-48.

[2] Crary, *Techniques of the Observer*, 2.

[3] Ibid., 1-2.

1.1 Computer Vision

One of the most recent technologies of image processing that has advanced into larger parts of modern society is computer vision, a term for the ability of computers to analyze and interpret information that they extract from images and other visual input. It emerged first as a field of study in the 1960s, closely connected to the scientific research in artificial intelligence and the aim of automating tasks through machine learning. Artificial intelligence can be defined as concerning systems that exhibit the characteristics we associate with intelligence in human behavior, which is able to understand language, learning, reasoning and solving problems.[4] It is the development of techniques to apply machines to perform tasks that earlier have been done by humans, where the machines themselves are learning and creating the rules of how they should operate. Today the scale at which computers operate at and the resources given to their development is remarkable. Artificial intelligence has in recent time progressed because of the increased processing power of computers and the intensification of data, which has made it a valuable industry. Computers are now able to find patterns in data that are too immense for any human to make sense of. Machine learning is a way in which computers are able to learn from large datasets more efficiently than through human programming. Instead of providing restrictive instructions, the computer can find patterns in large datasets and create rules in the form of algorithms for itself to operate on when later analyzing new input. These algorithms are then able to make sense of new data based on what it has been trained with. New information is processed in different layers in what is called a neural network, a computational model based on how the human brain processes information. This is the reason why these techniques are called artificial intelligence. The definition of the ”intelligent” is still problematic and might be an overstatement or misunderstanding according to media theorist Matteo Pasquinelli, who argues that because human intelligence itself always will be artificial, the design of artificial intelligence will itself be a form of the human augmentation.[5] This also means to limit the understanding of what is human by the measuring of effectiveness, which he argues is a very inhuman logic. Machines and humans are different kinds of entities, with different goals, skills, and interests, as art historian Mercedes Bunz

[4] Wilson, *Information arts,* 787.

[5] Pasquinelli, ”Introduction”, 11.

notes.[6] To question the concept of intelligence is also a way to demystify the perception of technology as operating in similar ways as humans.

Computer vision is then the field of learning computers to interpret and understand visual information. It can therefore be said to be an automatization of vision, of one of the human senses. The computers form of vision is one of calculation, where information is extracted from digital images and pixels. They are able to track, recognize, identify, analyze, monitor and authenticate visual information in order to accomplish tasks. New images are here compared to the databases that the computer is trained on, and images are in this way connected to a vast number of other images instead of being treated singularly. The computers are learned to perceive, interpret and autonomously act, all according to specific training provided by humans. In recent years computer vision has together with artificial intelligence had immense progress both in its technology and its implications. It is applied in the navigation of autonomous vehicles and robots as well as in facial recognition at borders, public spaces, and social media. It can observe changes in landscapes, be it the human body through medical images, or forests and rivers affected by climate change. As long as there is a sufficient database of images to train the network, it can be learned to recognize objects, diseases, license plates, or humans. These machines do not just passively register their surroundings, but are actively interpreting and are then acting according to their assignment. When a computer vision network is created it can be coupled to any type of visual live recording, like cameras, becoming part of a complex machinery that functions as technical sensors of the visible.

It is a technology that is rapidly expanded into new domains and that is increasingly impacting our lives and societies. With the arrival of more advanced autonomous seeing machines comes new structures of power and repression, notably kept in secrecy in non-democratic expansions of privacy and control. Here, vision is automated by machines in ways that make the processes imperceptible to humans, but whose operations and decisions are impacting everyday life. In these collaborations between humans and non-humans, the ones who have power to shape these systems have power over the meaning of the images that operate within it. Some see these technologies of artificial intelligence as a part of a new industrial revolution, advocated by entrepreneurs and business-owners as instruments of

[6] Bunz, *The silent revolution: how digitalization transforms knowledge, work, journalism and politics without making too much noise*, 13.

efficiency and cost-cutting. However, more critical voices foresee dark futures of mass unemployment, surveillance and increased social inequality.

1.2 Trevor Paglen and the *Adversarially Evolved Hallucinations*

Trevor Paglen's artistic practice has for a long time dealt with questions of invisibility. Paglen has both a Master of Fine Arts degree and a Ph.D. in geography, a combination that fuses aesthetics and studies of the physical features of the earth. This has led to an interest in how to render visible the structures of the world that are outside of the visible sphere, at least in the everyday life and with commonly available visual apparatuses. This involves photographing classified American satellites, military bases, and drones with telescopic lenses or locating and document data cables that lie deep under water. A lot of Paglen's projects can be said to deal with the planetary-scale infrastructures of communication and surveillance that are a part of our daily lives but that are invisible to the public. He is exploring how to visualize these things and goes long ways in exploring so, as modifying technical apparatuses to be able to see differently, learning to scuba dive, or spending days in the desert. His works involve issues of visuality, media, power, and landscapes. His projects are investigating the small gaps between the visible and the invisible, finding ways to interact and speculate in what is usually unperceivable. In this process of visualizing, Paglen often reveals the power structures that are hiding things from the visible sphere, showing us a glimpse of the forms of power that we don't notice. His works are showing us a complex part of the world behind what we usually see, from deep underwater to the earth's orbit, creating encounters with familiar landscapes that are seen in strange, new ways. He reveals the material basis for these infrastructures, and are putting the invisible out in the visible world for us to see in order to try to learn how to see the historical moment one live in.

This thesis is going to explore his series *Adversarially Evolved Hallucinations,* which was first shown in his exhibition *A Study of Invisible Images* at Metro Pictures in New York in 2017. The series deals with images produced by computer vision systems that have learned to perceive the world visually through machine learning. As with most applications of artificial intelligence, these machines are also automatizations of human function in that they are replicating visual perception. They are autonomous systems that perceive and interpret images on a large scale, but we lack insight into how they operate and how the systems are

constructed. The artworks in the *Adversarially Evolved Hallucinations* are produced through a machine learning system that Paglen created together with software developers. As in all conventional machine learning systems, the machines are fed with large quantities of images of one or many specific objects. They are then trained to learn to categorize the visual features that characterize a particular entity or phenomenon. After this process, they can analyze new visual material, and if the edges, values, size, and form coincide with the computer's understanding, it can recognize and label what it senses. Instead of making the computers interpret new visual input, Paglen and his team reversed this process, and the machines were asked to produce a new image based on its understanding of a specific category. In this way, they express themselves through images, to present something new in a form visible to humans.

The *Adversarially Evolved Hallucinations* gives a glimpse into how these types of machines perceive the world, and how they understand images in a way that is unique to our human visual world. By working closely with the technology, Paglen explores and exposes parts of how these images are produced. Through a selection of images from the *Adversarially Evolved Hallucinations*, this thesis strives to understand the aesthetic and visual relations of these new image technologies. These works open up engaging explorations of the non-human agency of the machines, and their understanding of the imperceptible images that are increasingly operating in our world. The images serve as an invitation to think of these matters beyond the scope of the human senses, to speculate and explore these types of processes and images. It is an artistic engagement with the perception of the visual world and the technology we are increasingly relying on to perceive that world while helping us to understand the way we organize ourselves. An important perspective of this thesis is that these are processes that we don't see and that are largely outside of our perception which makes it difficult to interact with and understand. Visuality in this context is understood as something that is constructed and access to that construction is connected to power, forming what we see, how we see, and how we understand the visual world. This, in turn, affects our sense of reality, how we understand ourselves, our society and the structures of power.

1.3 Research Questions

The way in which this thesis will approach Trevor Paglen's *Adversarially Evolved Hallucinations* is guided by the following questions:

- What do the works tell about how computer vision systems perceive the world?
- What is the series revealing about the new relationship between power, images, and visuality?
- How do autonomous vision systems challenge the traditional concept of the human?

1.4 Theoretical framework

This thesis has its foundation in art history and visual studies, but the topic necessitates an interdisciplinary approach that draws on different fields, such as media theory and cultural studies in order to confront the challenging issues that the topic offers. Some of the issues at state include scholarship on algorithms and software studies, which are crucial to the understanding of the technology behind the work and its implications. Certain strands of image theory are relevant to comprehend a new understanding of what these invisible images are, what they can do, and our relation to them. Needless to say, these issues are also raised, in slightly different and at times less technological and phenomenological ways in visual studies and aesthetics. This thesis will approach media and images as both a specific kinds technology and apparatuses, but also as networks, connecting and shaping relations in the world, and as actants which are shaping perception. Most importantly, it is the images themselves and their particularities and generalities that will guide my work and its theoretical commitments and choices.

In his book *Onto-Cartography: An Ontology of Machines and Media,* Levi Bryant develops a theory where all entities exist as machines, in an expanded sense. Here, their specific operations, what they are capable of doing, are the central focus of attention.[7] To see things as machines avoids the passivating term "object", which implies that there needs to be an

[7] Bryant, Onto-Cartography, 15-16.

activation by a subject, often a human, for it to be acting in the world.[8] Bryant's machine-oriented ontology understands things as having agency and certain qualities which informs how it relates and interacts with other things in the world. Machines are thus understood to be drawing on inputs or flows from other machines in order to perform their operations. Every machine is structurally open only to certain inputs and flows. For all the myriad of flows out there, only some of them will be able to have an impact on a thing according to its structural openness determined by its specificities. At the same time, the flows that are perceivable for the machine will also be transformed according to its operations and internal structure.[9]

In this machine-oriented understanding of existence, all entities are operating and producing something, while also acting as mediums for other entities in that they modify the becoming, movement, or sensing of other machines.[10] This view has roots in earlier media theory that explores the relationship between technology and humans, and in how technology correlates to the formation of social structures. This tradition builds largely on the work of Marshall McLuhan, which in his groundbreaking 1964 book, *Understanding Media: The Extensions of Man*, placed the technological medium itself as the central object of study, stepping away from the traditional study of the content of mass media. As his famous statement, "the medium is the message", implies, it is not what media communicates, but it does so. Emphasized here is their form and technological particularities in mediating and presenting the world, and in how they in different ways are activating our senses and establishing certain standards for our experience of the things around us. Bryant's theories and this thesis further leave McLuhan, who saw media as prosthetics for humans, as technologies that extend the human body and our senses. This argument will see technologies such as the radio and telephone as improving both speech and the ear, making the human senses able to communicate over vast distances, but this view of media is highly anthropocentric. It understands the apparatuses only as useful tools under the control of humans but ignores the capacity of technology that exceeds our bodily capability. For McLuhan, everything starts with the human and technology is thus familiarized as something we have knowledge of and that is there to aid us. Bryant however claims that what is unfamiliar, non-human and inaccessible is the most substantial and urgent to investigate.

[8] Bryant, Onto-Cartography, 37.

[9] Ibid., 54-56.

[10] Ibid., 34-35.

One of the thinkers that has challenged the problematic anthropocentric view on media, is the German media-theorist and philosopher Friedrich Kittler. 20 years after McLuhan's major work he published his book *Gramophone, Film, Typewriter*, which stands as one of his most important works. He follows McLuhan in his approach in leaving out the content delivered by technology, but he shifts the focus away from the emphasis on the human body. For Kittler, the media apparatuses in and of themselves were his main concern. He acknowledges the autonomy of media, insisting on its development separately from the human. He argues that technological apparatuses are substantially different from the human, and have qualities not able to be perceived fully by the human sensory apparatus. Thus, he argued that these technologies do not merely serve as extensions of man. Media has its own history and agency, and will never be fully comprehensible, as it operates on different terms from humans. Kittler criticizes McLuhan's desire to understand media, and argues that it is impossible because the apprehension of media is restrained by the dominant information technologies.[11] Kittler opened up the field of media studies to new approaches to technology and its effects on the senses. For example, humans can only hear certain frequencies and radio waves through apparatuses, and can only see a limited range of the electromagnetic spectrum, and we employ a different set of memory and storage capacities than technological media. Rather than being controlled by us, as McLuhan thought, Kittler saw media as setting the premises of human existence. Machines control us, they shape our surroundings and determine our situation, as he famously argued.[12] Kittler was therefore a bit more technologically deterministic than McLuhan, but they both to a certain degree saw history, society, and human life as conditioned by media, and they were both rooted in a material understanding of technology, seeking out how media affected society.

Bryant's theory of machines has much in common with both McLuhan and Kittler, but it expands on the concept of media to include a larger set of entities or things outside of solely human use or as what we think of as technology. Here questions of human significance and communication are less stressed than how media modifies activities and ways of relating to one another. Bryant provides a theory of relations and interactions between all kinds of machines, not only where humans are involved, and sees these interactions as closer to

[11] Kittler, *Gramophone, Film, Typewriter,* xl.

[12] Ibid. xxxix.

ecology than to mass media.[13] His theory is therefore suitable for venturing into the world of autonomous image-machines. In this view, these technologies will not be understood as solely for us, but as operating largely outside of human perception and senses, and which we are formed in relation with. Through the aid of Bryant's concepts of structural openness and operational closure, this thesis will seek to understand to what degree human interaction is having in the process of these machines. In dialogue with Kittler's work, the machine-oriented ontology will also give important perspectives on how the infrastructure of computer vision and their images are unfolding and forming our human society. Through this synthesis of media theory and contemporary philosophy this thesis will approach media and images as not only specific kinds of technology and apparatuses, but also as networks, connecting and shaping relations in the world, and as actants which are shaping perception. This theoretical framework forms a basis for exploring relations between humans and technology and how it affects the development of societies, social structures, and our understanding of the world.

1.5 Method and Thesis structure

The images in the *Adversarially Evolved Hallucinations* are produced by computers with a different mode of vision and logic than humans. They expose certain limitations and problems for many traditional art historical methods that put the human observer in the center of the experience. This thesis is therefore applying theories that give new and alternative understandings of the visual, and strives to go outside of the boundaries comprised of human perception. This thesis will focus on the selected works from Paglen's *Adversarially Evolved Hallucinations* and then will broaden its focus outwards to the larger topics of computer vision, artificial intelligence, media, and visuality. The artworks will serve as a starting point for the exploration of these issues and for answering the research questions. The works are understood as bringing forth something new to the world and as an artistic intervention which broadens our visual understanding of the scientific, economic and political dimensions of computer vision. Therefore, the thesis will also discuss the role of the artist as someone who can open up the visual sphere and gives us the tools to see things that remains largely invisible to us, which will perhaps also contribute to exploring the role of critical art for our time.

[13] Bryant, *Onto-Cartography*, 33-35.

In his book, *The End of Phenomenology,* philosopher Tom Sparrow explains that the aim of phenomenology as a method was to help us get back to the things themselves.[14] He argues that the loosely organized branch of philosophy that has been labeled speculative realism is a better-equipped tool for exploring the real. Where phenomenology examines reality through its appearance to a human observer, speculative realism strives to understand objects, processes, and operations in themselves, outside of a simply human reality. Speculative realism thus acknowledges the limitations of our human perception, and maintains that we are living in a world that exceeds human life, thought and construction.[15]

Levi Bryant, whose work falls into the category of speculative realism, refers to one of his associates, Ian Bogost, and his concept of *Alien Phenomenology,* for engaging with the experience of non-human entities.[16] Bogost's concept builds on Graham Harman's *Object-Oriented Philosophy,* which sees reality as something that is reaffirmed, and where humans are just one form of being alongside all of the others.[17] Ontology is the study of being and existence in the world, and Harman's philosophy insists that all things equally exist, and that no single entity has any special status over the others. To try to access the real, one then has to abandon the anthropocentric view of the world where our existence is the only, or a superior form of existence.[18] This opens up for investigation and speculation in the existence and relations of entities in the world, from the perspective of the objects, materials, animals or plants themselves. As of the computer, which is central to this thesis, Bogost notes that like everything else, it possesses its own unique existence, and is capable of more than the singular purposes which we humans draw from it.[19] This view of the world makes up a fundament for this thesis' understanding of so-called artificial intelligence, which in this way highlights its differences to humans and the human brain, rather than an anthropomorphic understanding of the technology, as is often done. It is an engagement with how the world is presented to another entity, with which flows a machine is open to, and how it operates on

[14] Sparrow, The End of Phenomenology, 1.

[15] Ibid., 12-13.

[16] Bryant, Onto-Cartography, 62.

[17] Bogost, Alien Phenomenology, 5.

[18] Ibid., 5-8.

[19] Ibid., 16.

these flows. To speculate in the existence and aims of non-human beings means to wander into the realm of the alien and inaccessible.

The second chapter of this thesis will deal with the process behind the works, giving an outline of the system that the machines are producing and operating with. Here, the focus is on the datasets that are fed to the computers to train them to recognize objects. This is where human interaction with the computational system is given the most attention, as it is the part of the process where the machines are open to particular forms of input which configures how its operating. The implications of the selections of the datasets and the strategies made by Paglen will be explored and further discussed in relation to political and infrastructural questions in the larger industry of computer vision and machine learning. Here, issues of meaning and the interpretation of images by machines are central, and this thesis will explore Paglen's specific application of the system that highlights some problematic aspects of the technology. This chapter will also examine how the relations between humans and machines are visible through the works. It will question the presumed agency and neutrality of these autonomous systems, and investigate how different human and non-human machines are affecting computer vision. The work *Vampire* (fig. 1) will be the image that these questions are explored through. This image is selected because it displays an apparent correlation between the datasets that are given the computer and the image it produces. *Vampire* also hints at some of the technological and ideological particularities that characterizes this system.

From the third chapter and on, the machines and the generating of images will serve as the main focus. This chapter will strive to clarify how the network processes and reacts to the input, and what it make out of it. It will venture into the concept of hallucination, which is used to describe the process when the computer is producing a new image out of what it knows. The relation between the world, the information that the computer operates on, and the image is explored through the work *Rainbow*. It is an image that is a result of information and computation that because of its unfamiliar aesthetic is emblematic of the shift in images from human to non-human, from being representations of the world to becoming abstract hallucinations based on information. *Rainbow* will be central to speculate in how the computer is structurally open to the world and how they operate on images in a form that is invisible to humans. It is a visualization of the machinic operations, and an exploration of

what can be made visible and what can be drawn out from the limited interface we can access in these otherwise invisible systems.

The fourth chapter will focus specifically on the work *A man,* to explore relations between non-humans and humans. In this work, the network is envisioning a human being in a disturbingly alien way, where our species is seen through the perspective of a computer. Such a shift in perspective challenges the humanist conception of man. The work will be the focus of discussion of posthumanist ideas of how to understand "the human". In *A man,* it becomes evident that the machine sees humans as information which is no more important than other information or other entities in the world. By decentering the human, this work imply a sort of a flat ontology lacking any hierarchical differentiations. This opens up for new understanding of the relations between different human and non-human machines, where humans are mediated by technology as well as being mediators for other technological machines. I will further discuss how the technology of computer vision is redefining human vision and perception as a construct that is just one of many natural and technological entities in which we coexist. Computer vision is here visualized as an infrastructure that is acting on our images and senses, as something we are becoming with, and that impacts our lives.

2 Learning Through Classification

Accompanied by a full-time programmer and other staff Paglen created a computer vision system through composing different elements of open-source programs and algorithms. The result was ”Chair”, a platform able to run its own computer vision tests, train AI on new datasets, and to generate images showing what the AI has learned. To train a machine learning systems it has to be fed large datasets of digital information. In the most prevalent form of machine learning, this data needs to be structured through categories in what is called a supervised learning process. In this part of the process, humans are defining some of the boundaries of what the machine can do. For the computer to recognize images, it has to be fed datasets containing vast amounts of images containing depictions of things or objects that are in the same category. This can be to give the computer thousands of images which can fall into the two categories of cats and dogs, where the computer is statistically analyzing the visual traits of the images. By classifying the visual input into the computer it is learning how to recognize and label structures, shapes, colors and materials of these categories. This means that the computer vision systems are first instructed by humans through the input and labeling before increasingly operating by themselves. If the computer is given tens of thousands of various images classified as rainbows, they will shape a visual understanding of what a rainbow looks like, as what colors, and shape it usually consists of. If this learning process is successful, the computer will be able to recognize new images of rainbows and categorize them correctly if they look similar to what visual traits the computer has ascribed to the category of rainbows.

Through the analyzation of these datasets, the computer is shaping an understanding of visual objects. The computer can then be said to have some attributes of seeing the world, and of understanding the world through visual means and categories. Vision is in these systems a form of pattern extraction based on algorithms. A newly constructed neural network is close to a blank slate in terms of its visual abilities to recognize things, and it must be trained with images in order to learn to see. After learning to identify the objects or phenomena that the computer is trained on, it can go on to operate on its own, recognizing things based on information about the past in order to perform actions in the present and future. The computer vision system can then be used to identify things that it has not seen before, but that fits into a category it has been trained to recognize. The datasets with digital images are therefore the primary source of information for the computer, as it creates a framework for what it can be

able to see. The compilation of images that it is presented with make up the flows of input that the computer can selectively operate on. If learning a machine human categories, one can hardly avoid imposing one's own meanings and understandings of the world into these categories. In the industry of computer vision, there are many standardized and widespread training sets, already classified and labeled in order to learn the machine to recognize a specific object and to fit it into a category. Instead of compiling one's own dataset of thousands of images, there are catalogs of datasets readily available online of what is easily seen as neutral collections of categories.

In the *Adversarially Evolved Hallucinations*, Paglen has fed the machines with intentionally subjective categories of images to highlight the biases inherent in the system of organizing things into categories. Paglen and his colleagues assembled their own classifications and training sets with their roots in literature, mythology, psychoanalysis, warfare, folklore, and politics. Only these selected images are becoming what the machines will know of the visual world. These datasets include series such as Interpretation of Dreams, American Predators, Monsters of Capitalism, Omens and Portents and The Humans, composed of groups of three to five image categories. For instance, American Predators consists of a large number of pictures of venus fly traps, drones, wolves, and Mark Zuckerberg. Omens and Portents relate to phenomena and objects historically seen as signs of change or precursors of future events, such as comets, eclipses, rainbows, and black cats. These categories are all decoupled from the conventional use of computer vision by being based on literature, and it is an intentional strategy to make an alternative use of the technology. By opening up computer vision to artistic practices Paglen is decoupling it from its interrelation to capital, policing, and warfare. Building on imagery from fiction, these images cannot be capitalized on in the same way as physical objects. Instead, they show the correlation between the input provided by humans and how the machines see. With these taxonomies, the machines are instead learned to see through literature or the ideas of Sigmund Freud.

Usually, computer vision systems are applied to use their existing knowledge to register, analyze and label new informational input from real-time video or images. This can be to register things like license plates on cars, or the movement of people in a street. However, they are also capable of reversing the process by forming a new image of how it visualizes a certain category. The exhibited work *Vampire* has been constructed by the computer after being trained on the dataset called “monsters of capitalism”, which contains images of

monsters and various creatures that have historically been allegories for capitalism.[20] To assemble this dataset, Paglen has collected a large amount of images of different vampires as depicted through popular culture, seemingly acquired through online image searches. It seems more like a gathering of all there is to be found, a hoarding of images to mirror the popular depictions of vampires, rather than a careful selection by the artist. These representations are depicting the visual appearance of this historically constructed character that expresses some human fears and fantasies. Blood-sucking creatures have been found in folklore from all around the world at different historical times. There is also a broad variety of attributes prescribed to the characters, and the stories about them are told in several distinct ways. The depiction of vampires is consequently connected to a specific cultural context, and the idea of vampires is therefore not a stable entity with a singular appearance. Paglen`s dataset consists of various depictions of vampires mainly from films, cartoons, television, games, paintings, and drawings. Compared to the rich history of vampire-like creatures, the representations in this dataset becomes more like a cliché found in western popular culture. A commodified and standardized version of the vampire that shares the same generic traits made familiar in a society that keeps it at a safe distance as entertainment.

This category of an imaginary and fictitious character places itself outside of the conventional datasets that are being used to train a neural network. Datasets are normally containing images of ordinary, material things that is found in the real world, like cars, faces, household objects, animals, plants, and landscapes. When a computer vision system is connected to live input from a camera, it can recognize the objects they are trained to see. Paglens system will in this case strive to see vampires in everything, for example in human beings. It will see literature and mythology, and a world of fantasy everywhere it looks. For this system, the visible world will be one of fiction, where categories of human imagination only elsewhere found in literature, will come to life and constitute the real. The depiction of the vampire made by Paglen`s system is somewhat familiar, but also unsettlingly strange. As with the typical characteristics of the vampire, this character has a sort of a hooded cloak, a red mouth, and frightening and supernatural eyes. It is very confronting, its face occupying almost the whole frame in a threatening manner as if it is coming towards the spectator from the dark. The face of the vampire is stretched out and pulled apart, it is incomplete with vague facial

[20] Boucher, "This Is the Project of a More Just World."

details. The colors are floating in what seems to be a more subjective impression of the character in what we see as a glimpse of the computer's internal operations. This is a more imaginative and creative process, through, as it often is called, a hallucination, a sort of thinking through images. The pictures are thus made by the machine when it's forced to express what it knows of the world in human-pictorial means. As the computer's preferred encoding is in zeros and ones, the way it is presented is not its favorable format, but one made so that humans can sense the images. The computer is given a large dataset containing familiar images of vampires found in popular culture and is able to produce a new image after processing and learning from the input. It becomes apparent through these images that there follows a certain power in constructing the datasets that these computer vision systems are operating on. It is creating something new, different and exciting, but on the level of ideas, it is very much grounded in a contemporary western culture. Through the programming of the software, and the selected images that the computer is trained with, some limitations of the possible outcome is set. The datasets construct what the computer has to work with, and what it can learn to recognize. That means that the ones who creates and selects the datasets have tremendous power. When visual culture turns into information culture, relations of power becomes important. As Jonathan Crary upholds in his understanding of visuality, problems of vision are always fundamentally questions about the body and the operation of social power.[21] As is reemerging in his works and his analyses of vision, the at any time inhibitors of power govern how we understand and think about vision, what we see, and how we are seeing. This, in turn, constructs our sense of reality, how we imagine ourselves and our futures and how we relate ourselves to the structures of power. Nicholas Mirzoeff describes this in his book *The Right To Look*. Here he understands visuality not as the totality of all visual images and devices, but rather as the aesthetics of power, as history visualized by the powerful, made up of information, images and ideas. He stresses that it follows a certain authority to decide what is to be seen and what is to remain unseen, the authority of being able to organize an available vocabulary of the visual. Visuality is classified and defined, organized socially through the separation of groups, and is further normalized and aestheticized, Mirzoeff argues. It then becomes a discursive practice of the aesthetics of power, which manifests in living bodies as affect and need.[22] Visuality is in this view a relationship between bodies and politics, where systems of forms make up what our sensual experiences can be presented to us. This view

[21] Crary, *Techniques of the Observer*, 3.

[22] Mirzoeff, *The Right To Look*, 2.

sees visuality as not only the eyes as a visual apparatus, but emphasizes the mind that processes the visual input. The violence that underpins the authority is made unseeable and the authority and its ideas is naturalized by the aid of visuality.

The category of vampires in itself is not so sensitive or offensive, but shows how even a fictitious character can be categorized and fixed into a stereotype through these machines. The traits of the vampire could likely be recognized by a western audience, but people from other cultures would have a whole different set of characteristics that fit into their conception of how a vampire looks. Even this category is far from universal, being grounded in a dataset that reflects only a small segment of the different images of vampires, leaving out a large part of the rich assortment of how different people would imagine a vampire. To simplify the machine learning process, the categorizations are made as narrow as possible, and the databases filled with a homogenous set of representations. The work then shows how cultural and subjective values permeate the selection of the datasets, and that the input is of great importance in constructing the systems. Paglens classifications are by its evident subjectiveness disproving the possibility for such categories to be universal. The categories are ways of organizing the world through active selections and value judgments, inclusions and exclusions, but by being classified they define and naturalize themselves as universal. Classifications hide the fact that they are selections, and are presented as natural and descriptive ways of ordering the world. Instead, they are simplifications that do not reflect the complexity of things. When Paglen is constructing categories in new ways, as with the category “Monsters of Capitalism”, which is the foundation of *Vampire*, he distances us from the taken-for-granted world of categories to reveal their artificialness as human constructions. To categorize things from mythology and literature is to highlight that other sorts of categories that we know from everyday life is also a sort of fiction. It is an argument claiming that classifications are subjective organizations of things in the world that is reflecting the values and prejudices of the ones who make them. Paglen's categories point to the absurdity of some of the categories that have to be applied in order to recognize and systematize the world. In computer vision, objects and phenomena have to be put into categories for the systems to function. That means that the network sees in categories, which is in opposition to how human vision and interpretation functions. We do not decode visual information in absolute classifications, but are open to more ambiguous understandings where we don’t necessarily have to draw conclusions of what we are seeing.

In numerous instances, the AI's and computer vision systems reflect the bias related to gender, skin color and class of the homogenous group of people behind them. One of Google's AI's identified an African American couple in their selfie as «gorillas», other systems take for granted that doctors are male and nurses are female. There are also seldom taken account for non-binary genders in gender-recognition algorithms, disciplining our viewing into "man" and "woman", shaping and conforming our vision. Issues like these are recurring in computer vision, where classifications and the lack of diversity is affected by bias and values. Facial recognition systems are found to perform better on males and people with lighter skin, while having a decreased ability to recognize women and people of color. This can largely be because the computers are trained on datasets lacking diversity, mainly depicting white men, as well as the homogeneity of those developing and testing the systems.[23] The datasets are in ways like these creating normative categories that are full of bias, and social data is used to discriminate. These patriarchal, racist and non-objective positions that are found in the society is transferred and learned to the machines.[24] The history of such categorizations of people is troublesome, but the pseudoscience of phrenology and physiognomy used to make racist justifications in the past, is having some re-emergence in these systems. Perhaps the idea of strictly categorizing our world itself is unnatural and limiting. Objects, concepts, gender, and feelings can be fluid, and in-between, where classifications would only be constraining, simplifying, or simply wrong. That these categorizations made by a rather small group of people are extended into the technologies of our daily lives is alarming. One of the main issues in Paglens work is to make this bias evident. The absurdity of the pictures themselves seems pretty constructed and unreal, and by revealing the steps taken it brings us into the process and displays the fundamental human agency that's integrated into the systems. This makes clear the lack of ethics and critical thought going into the process, and that other interests such as profit are of greater importance. Computer vision brings with it a new form of domination, but that operates largely in the invisible spectrum.

[23] Buolamwini, "Artificial Intelligence Has a Problem With Gender and Racial Bias."

[24] Paglen, "500 words."

2.1 The Fixation of Meaning

Images have for a long time been seen as visual representations of the world shaped by the person who has made it and the specific technology that has been used, be it brushstrokes of paint on a canvas or a photograph recorded with a camera. Images are one of our primary forms of visual representation, and they are often depicting something from the real world or one's imagination, and they are representations of the world, of dreams, myths, and events, of abstractions and ideas, of social relations. In a traditional sense, to see an image is to experience the world through someone and something else's depiction. Implied in an image is often a kind of worldview, a way to understand and to see one`s surroundings. A large domain of images are involving political issues of representation and significance, of how the world, oneself and social relations are visualized or symbolized. These issues, as well as what and how something is presented, and what is kept invisible, is some of the main fields of studies of art history and visual studies. At the same time, the interpretation of images varies from observer to observer. The experience of an image is formed by one's personality, history, cultural affiliation, political standpoint, social position, knowledge, and mood, among other things. According to Nicholas Mirzoeff, visuality is constituted by information, images, and ideas, and is a visualization of history rather than a totality of all visual images and devices.[25] He insists that visuality is something that is constructed and that the ability to visualize is connected to a form of authority. The production of visuality seeks to present and reinforce authority as natural and self-evident, and classifies, separates, and aestheticizes in order to maintain and legitimize itself and the social organization.[26] Images play a considerable role in visuality, and their meanings are surely affected by power relations, ideology, and culture, but at the same time, these are discursive practices that to a degree are open to change. With time the meaning of images is constantly re-interpreted and seen in different historical contexts. Images have been central to many social struggles through history and is important as a way to define, represent, and change the world. As the social and political is open to change in a democratic society, so should the constructed meaning of images also be.

In the computer vision systems Trevor Paglen is exploring, on the other hand, the meaning of images is becoming something that is fixed and that apparently has universal definitions. The

[25] Mirzoeff, *The Right To Look*, 2.

[26] Ibid., 3-4.

images in the training sets are divided into absolute categories which are learned by the computer. The system then interprets the world unambiguously, where the meaning of objects is the same as what is statistically corresponding the most to the computer`s understanding of categories. The training data acts as a blueprint of meaning, where new visual input becomes a puzzle for the computer to solve. If it resembles what the computer understands as a vampire, it is a vampire. If the computer sees what in reality is a pale man with a cloak, it is still certainly a vampire. These are normative systems where the datasets create a standard that the world is measured by. This is highly problematic as it implies how someone or something should be or act like based on the statistically average of what the computers are fed with and the given categories. Images can be powerful entities, and there lies an extraordinary power in being able to have control over the meaning of images. We look at images and make sense of them in different ways, and images are open to a broad specter of various meanings for different viewers. In computer vision, interpretation is automatically being done in the systems, where bias is hardcoded into the infrastructure. The specter of meaning is then limited to one fixed meaning. This is both a result of the technical structure which depends on categories and statistics and the cultural and political bias of the humans assembling the datasets. This bias is seemingly natural by being processed in what is seen as neutral machines, but these systems are demonstrating the centralization of power that follows their creators and programmers. To be able to assemble the datasets that constitute the basis for these machines is to have a large amount of power over the meaning of images, and intentionally or not, the meaning of images in these systems are made to favor the ones who make them. The automated systems are acting in response to the programming by the humans behind them, and if this is a homogenous group with little diversity or ethical thought, the systems are going to reflect their bias and automate it. So in terms of visuality, computer vision intensifies and concentrates the power of the ones who have the authority to visualize the world. It is a way to reproduce and amplify the forms of power and hierarchy that it has been deployed to optimize.

There is a tendency to see automated operations as more trustworthy than those performed by humans. We are having faith in the clear and nonambiguous decisions and information that is automated by computers. They are handed the responsibility to think, make decisions, and to perform other cognitive tasks for us because we trust their apparent objectivity as they are

working with data.[27] As the *Adversarially Evolved Hallucinations* are showing, the interpretations the machines are making of the world is not objective or neutral, but rather infused with culture and values. In this system, Trevor Paglen chose the dataset, designed and trained the network, and selected the resulting outputs. He gets to decide which sub-categories goes into the larger categories, putting it together to create a fixed reality. Paglen is therefore in control of not the whole, but of an important and defining part of the process that is central to machine learning. The distinct appearances of the images that follow his constructed categories highlight the human effort and influence in these systems. The vampire is both alien and bizarre, but it is shackled to a very human imagination and a modern portrayal of the character selected by Trevor Paglen. This strange and unknown form of vision is still influenced by humans. Despite its unfamiliar depiction, *Vampire* is closely linked to the digital images that were given to the computer. By providing the network with images of vampires, an abstract category that is so clearly a product of human imagination, the resulting output is disproving the possibility of these machines to be neutral. *Vampire* visualizes how the computer is not an objective observer, but that one of the ways it sees the world is through human values, categories, and meaning. The computers structural openness is to digital information, and when images are presented to it in categories, it is programmed to adhere to these. In this work the datasets that Paglen has fed it is clearly replicated in the image that is produced through the machinic operations of the computer. However, for a human observer, the image is still obscure, and there can be uncertainty about what the image predicts. What different viewers see in the image can vary broadly, but the computer declares persistently that it is a vampire. A vampire is what it sees, what it knows, what it can recognize, and what it can produce. When Paglen brings the inner operations of the machine to a visible form this becomes prevalent. Such absolute meanings of images stand in conflict to human interpretation and the way we make meaning of images both individually and socially. The problem is when the operations, the datasets, and the decisions are invisible to us, outside of the public sphere where we cannot see and interact. Paglen is through this series exploring how to visualize the processes involved in this system. giving some glimpses into what we cannot otherwise see.

Through this infrastructure, the present can be maintained. As artist and writer James Bridle note, the world is increasingly measured by data. What can be gathered as data is modeled as

[27] Bridle, *New Dark Age*, 40-43.

the way things are, and this information is then used for future analysis with the belief that things will not change from those past experiences. He argues that the most substantial thing about computation is that it constructs a future that best fits its parameters. What is computable then determines what is possible, while that which is difficult to format into models or patterns, that which is unknown or uncertain, is excluded from the field of possible futures. In this way, its projection of a future built on the past makes it incapable of dealing with the always unstable reality of the present.[28] By being trained on data that already exists through digital images, themselves recordings of what has been, machine learning and artificial intelligence are providing the technologies able to create contemporary futures where the present is reproduced. The machines are strictly following the rules it has been programmed to use or that it has created themselves, and the decisions are being made based on earlier data. Instead of making something new and using these systems for solving future challenges, they are prolonging the present. By constructing an infrastructure that is sensing and operating by the use of earlier data, it has the possibility to affect how we understand the things around us, how we think and how we act. They are largely invisible processes, but influences society and our lives. This reproduction of the past limits our collective ability to envision possible futures that departs from this automated repetition. The concept of imagination originates from the Latin word for image and is originally used for the process of forming mental images for oneself, to visualize something new, or in a slightly different way than what one`s seen before. Being surrounded by an infrastructure that keeps the meaning of images stable, constrains our capacity to imagine different futures. Here, even more important than what the images mean is what they do, the actions they are able to perform based on their information. In computer vision, images become a part of a system where they are analyzed by active agents that produces something based on them. These systems that are not so neutral is actually setting the standards for how we perceive the world, what we can think and say, and are thus regulating and normalizing. To let the already powerful dictate meaning and understanding of the world is to reproduce the past. *Vampire* shows how computer vision systems reaffirm the given when they interpret images based on past experience. Although the machines are creating something new and hitherto unseen, they are limited by having to make their decisions on former data.

[28] Bridle, *New Dark Age*, 44.

2.2 Algorithmic governance

We have a tendency to think of these technologies as either something we have control of, serving as extensions for human desire or as an autonomous, unstoppable force where agency lies all in the code.[29] In our contemporary focus on either the retro and nostalgic of past times, or the very present here and now, we often lack the skills of imagining the future and to stay in touch with technology. We think of technological development as highly advanced and incomprehensible where there's always something new, updating or replacing something now outdated. This is among other things because of the constant stream of new products, but especially a result of the obscuring and distancing terminology surrounding it. After all, the underlying structures of the technological industry seem to stay pretty constant. Ian Bogost and others with him stress the material basis of computation and algorithms, criticizing the camouflaging of the foundations that structure the operations. These are actually complex systems consisting of people, processes, materials, and machines, and the focus on terms such as artificial intelligence and algorithms is one of the reasons why we tend to forget that these systems are constructed by humans.[30] These are simplifications and abstractions, even though human actions and decisions clearly are at the very heart of these operations. This makes us conceive these systems as predetermined and neutral, alienating us from the economic and powerful structures behind it. It's an archetypical concealment of the modes of production defining capitalism, and of ideology, hiding its own interests and presenting itself as a natural, objective truth implausible to change. It distances us from intervention and to understand the fact that the outcomes we meet are, as Bogost notes, unreal caricatures of the world. These constructed systems are one perspective among many, not an absolute truth.[31] They are thus not just automatic operations, but are complex systems involving many different actants and materials. The datasets that are fed to the computers must rather be seen more as an archive and a basis of knowledge that is governed by the power of selecting and excluding what is to form these systems.

Shoshana Zuboff notes that technological development is often understood as autonomous, as if with a life of its own entirely outside the social sphere. There is a tendency to see

[29] Bratton, "Outing Artificial Intelligence: Reckoning with Turing Tests", 79.

[30] Bogost, "The Cathedral of Computation."

[31] Ibid.

technology as an unstoppable force making its way forward, and its implications as inevitable consequences. Zuboff`s focus is on what is called big data, the ability to capture, store and analyze enormous amounts of data made possible by faster and more powerful technology. Instead of seeing the characteristics of big data as an inevitable effect of the technologies it depends on, she argues that it is rather originating in the social. She understands the extensive accumulation of digital information as a foundational part of the new economic system that she calls surveillance capitalism. By extracting digital information about individual behavior from online activities, the capitalist logic of accumulation and revenue has found a new way of expanding the market into an even larger part of the social and private domain. Large corporations and internet platforms are gathering behavioral data with the aims to predict and modify human behavior as a means to produce revenue and to maintain market control.[32] The practice and industry of computer vision is a part of big data and is relying on many of the conditions of big data. In this view, the technologies are possessing a particular range of distinct affordances, but how it is employed and what qualities it gets to express is formed by the institutional logics in which the machines are designed, implemented and used. Zuboff then outlines the new relations of power that follows, where the owners of the means of behavioral modification now have surpassed the traditional power of the owners of the means of production. Here they use technologically advanced machinery to control and modify behavior to produce new forms of commodification, monetization, and control. She notes that is such a considerable shift that it now is the default business model for most online companies and startups.[33] The first time the *Adversarially Evolved Hallucinations* were shown, they were a part of Trevor Paglens solo-exhibition *A Study of Invisible Images,* at Metro Pictures in New York. This title highlights that these kind of images are invisible, both as being outside of the visible sphere of the public, and of operating from computer to computer as data. Zuboff argues that one of the reasons for this invisibility is that the logic of accumulation is so implicit in the industry that its operations are unstated and taken for granted. She claims that its power to shape the expression of technological affordances, their decisions, and operations, therefore goes unnoticed. By stating this, she ascribes significant agency to the logic of accumulation in organizing perception, technological affordances, and

[32] Zuboff, "Big Other", 75.

[33] Ibid., 81-85.

social relations.[34] In her view, it becomes a vital force itself that is determining the use of information and automatization.

Zuboff`s observations coincide to a large degree with Levi Bryant`s view in his theory of machines, in that they both see technology as created and utilized in a specific environment and affected by its surroundings. More importantly, it really points out perhaps the main argument in Bryant`s *Onto-Cartography*, that social relations are organized by the assemblage of all the machines, both physical and discursive, that make up a world. That means that they are embedded in a particular space or place.[35] Bryant stresses that these issues of social relations and power-structures are not just discursive, but highly material and non-human as well. They are not only shaped by politics, significance, meaning and human power. He argues that to focus exclusively on what we usually understand as power is to place signs, discourses, language, and human institutions at the center of attention. The traditional concept of power therefore excludes other forces that exceed human activity, as the entanglements and interactions of the other machines that influence and make up a world. These concepts are therefore providing restrictive explanations for studying these issues.[36]

So from these theoretical positions, it is not the technology itself that completely determine the specific uses it is having, but it has a wide range of uses where only some of them are carried out. The technology of computer vision is not neutral and objective, nor can it be solely responsible for the biased outcomes which automatically discriminate. It is formed by its technological specificity which allows and refuses certain modes of operation, as well as the human biases that are included in the datasets. At the same time, these computers are not mere carriers of human significance. They are rather part of an assemblage of corporeal and incorporeal, human and non-human, inorganic, organic and social machines that intersect and interact with another.[37] Bryant assert that concepts such as racism, patriarchy, and racisms acts as umbrella terms that are simplifying and obscuring in that they don't give sufficient explanations to complex relations between machines.[38] If seeing the issues that computer

[34] Zuboff, “Big Other”, 77.

[35] Bryant, Onto-Cartography, 6-7.

[36] Ibid., 188.

[37] Ibid., 255.

[38] Bryant, Onto-Cartography, 258.

vision brings up and that Paglen addresses only through the framework of capitalism will not give a sufficient analysis. It is rather the machines that make up a world that causes these things, Bryant argues, not the terms themselves.[39] For there are not only people, meanings and institutions that play a role in these operations, but also the non-human agency and material conditions that make them possible. The components of the computers and hard drives that enables the gathering and processing of data, the infrastructure of computation, as fiber optic cables, servers, computer code, and so on. Bryant insists that the current power structures rely on these technologies and their ability to send information over distances at a high speed.[40] This shows how other non-human factors, as materials, technology, and the logic of accumulation all have a significant influence in this infrastructure in that they facilitate certain possibilities. The character of the vampire becomes an expression of the machine and its vision. The computer does not simply see and recognize objects in classes, it also wants to feed on you in order to stay alive and make itself more powerful. The system is built to gather data that it can analyze and learn from. It is drawing out information from our images without us even aware of it. At the same time, these machines are used to extract value from the interpretation of images, and the technology is coupled to the form of capitalism Zuboff describes where information is monetized. Capital and governing institutions can access new domains of private lives through the computers analyzation of images. The technological particularities are also conditioning how humans are using computer vision. These systems need enormous quantities of data in order to properly function, and it needs a complex infrastructure to operate. Only some actors are therefore able to create such a system, and they are the ones that already have the platforms organized to gather large amounts of constantly new data. These specificities are instrumental in creating a centralization of power where the more encompassing the system, the stronger and more effective it can be.

By exploring this technology and these issues in the context of art, Paglen shows that there are other possible uses for it outside the spheres of surveillance, accumulation, and warfare. He thus expands the perceived limits of these systems, opening them up for other aims and intentions. The *Adversarially Evolved Hallucinations* takes us into the processes of what is a largely secretive industry and technology. Paglen demonstrates through this form of artistic research that the domain of art is one of the few spaces that allow these kinds of critical

[39] Bryant, Onto-Cartography, 258.

[40] Bryant, Onto-Cartography, 259-260.

practices to be done. The images in Paglens series are very much transformed from their original context as invisible coded images. Here they have a form resembling traditional and known forms of human images and of art as painting and photographs. Paglen has deliberately chosen images with this uncanny aesthetic, and the pictures are alienating in their appearance.[41] They are not at all illustrative of any simple computer-process, but simulations from coded form to a form visible to humans. If this is a visual artists presentation of the machine-automated images decoded for the human vision, we understand directly that this is something pretty strange and different from our modes of perception. Through the process, he wanders into the unknown world of computer vision and invisible images through trial and error. By making visible artworks that are exhibited to the public in a human form, he opens up for us to try to understand this new mode of vision and images, where we can try to relate to the ways in which a computer sees. It is an attempt to capture the historical moment we live in in terms of visuality, culture, and politics.

Since this larger industry of computer vision is so connected to power, values, and surveillance, and which intervene into everyday life unnoticed, Paglen uses art as a tool to get involved with larger political questions about technology, social relations, power, economics, and the meaning of images. From the domain of art, the works pose as an adversary to this industry and its logic. It gives a possibility to try to see as a machine, and to then also see from the forms of power that configures these machines. It is a way of making visible how power can be used to actively shape visuality. At the same time, Paglen`s practice challenges the sole authority of the corporations that dominate computer vision by using the technology with a different purpose. As Zuboff asserts, surveillance capitalism is relying on algorithms, sensors, and machine intelligence, but it is not the same as these technologies. It is possible to imagine the digital without surveillance capitalism.[42] The field of computer vision is dominated by computer scientists, mathematicians, and engineers with different interests and requirements that don't necessarily involve social and ethical issues. Paglen`s work shows how some of these problems are far from solved before the technology is applied and spread in the real world. *Vampire* is therefore a way to give the public an insight into these technologies that otherwise is invisible to us in both their human and machinic operations.

[41] Hu, "A MacArthur "genius" unearthed the secret images that AI uses to make sense of us."

[42] Naughton, "The goal is to automate us."

The vision machines at stake in this work are clearly operating with a partly human and partly technological agency. We have to remember that these developments are controlled by companies with monopolist tendencies not necessarily for the best of society. The *Adversarially Evolved Hallucinations* raises important questions about the basis of machine learning and computer vision. Although the technology is secretive, it is possible to construct the kinds of systems, as Paglen and his team have done, by using open source software and having the abilities to code. There are many ways that the common public could benefit from these technologies, but predominantly the rather opposite is what is done. Mercedes Bunz notes that governments tend to follow the neo-liberalist idea that the market should take care of innovation. Following this, it is also installing facilities for mass surveillance on its own population. Most important here is the division between the individual business entrepreneurs or the individual consumer and the mass population, the political body, which is apparently not to be trusted.[43] Even though there are open-source programs available, as Paglen has taken advantage of, the uses of the technologies mainly maintain and amplify the consisting power structures. We don't have to approach digitalization with profit as the only objective. As Mercedes Bunz proposes, since a society is not the same as its economy, we need to start demanding something different from it.[44] Images can have tremendous power and can be used to promote political point of views or to discriminate and there is a need for explainable and transparent systems that are more democratic and diverse to limit the problems that visible throughout these systems. If the public does not understand how this infrastructure is functioning, it is difficult to interact with them.

The *Adversarially Evolved Hallucinations* visualize the invisible operations done by non-human machines, and through the steps taken to produce them, they give a glimpse of the processes of non-human image production and the human interactions and biases that are involved in their premises, construction, and display. Through the works, it is possible to get some knowledge about the systems and the power relations that are involved, the ways in which the world is governed and presented to us, and the works then open up for critique this system. Paglen`s works nuances the conception that our societies are absolutely governed by technology, which some views as always mediating and as putting restraints and possibilities of what we can do. The works tell us instead that technology is at least as much dependent on

[43] Bunz, "Governments & technology – a productive relationship?!"

[44] Bunz, *The silent revolution.* 34-35.

us, our formation, creation, and framework, and there is a form of coevolution between humans and technology. It is important not to always abstract technology to something intangible, immaterial that has absolute autonomous agency, but to remember that there is a cooperation between humans and non-humans. Humans presents the visual input that teaches the computer how to see, and how to organize the world, and the datasets that the machines are based on are of great importance. Computer vision systems are therefore seeing partly through the ones that provide them with data. At the same time, there are succeeding steps in the process where the technology becomes too advanced, powerful, and complicated for our human understanding. The computer vision systems also have some agency of their own in their image making process which we cannot control. They are based on data that we can see in only some ways, but they are operating in a different language than us and thinking radically different from us so that we at a point in the process cannot follow it step by step.

3 Images as Information

After the datasets with the categorized images are presented to the computer, it increasingly operates on its own. Between the provided input and the generated output lie some important steps where the computer analyzes and calculates based on the datasets it has received. The datasets that Paglen has fed to the computer consist of photographs and other forms of digital images. These are representations of objects in the world in a way that is recognizable for humans, connected to human perception and closely resembling of how we are used to seeing them. For the computer, these images are read as information. Through these images, parts of the world are quantified into data about the visual characteristics of things and concepts, as their shape, colors, size, and texture, which the machine learns to recognize the common features of. Through code written in a programming language, the programmers have set certain rules and instructions for the computer to follow. While code dictates some of the computational operations, this is only one element in the diagram of machine learning. The computer is also instructed by algorithms, which are abstract recipes with sequences of steps that describes an idea for solving a problem.[45] These are later coded in a programming language to give the computer instructions regarding which calculations it should perform and in which specific order. These algorithms are crucial when operating with big datasets that contains an amount of information that is too large for humans to cope with. Algorithms are necessary to be able to discern patterns in the data, and they are therefore deployed to create code for the computer.[46] In machine learning, algorithms are able to learn and to update the software, and the computers are in this way writing some of their own programs. The use of algorithms is one of the mechanisms complicating our understanding of the processes of the computer. According to Adrian McKenzie, these algorithms cannot be read as text or as procedures in the way programs can be read.[47] Human control and understanding are sacrificed to employ powerful algorithms that are partly automated.

Another aspect that distances us from the computer's operations is the language. Different programming languages act as mediators between humans and computers. This form of code can be understood by both, but without being the primary language of any of them, the

[45] Horan, "The future is algorithms, not code"

[46] Ibid.

[47] McKenzie, *Machine Learners*, 22.

communication needs to go through several translations. Laura Marks point out that that the deepest levels of the computers language and code is inaccessible even to programmers. She claims that the layers of language are becoming more and more physical the further away they are from the human user.[48] This means that the abstract programming language we apply is through many steps translated into signals and material actions on which the computers are operating on. Programmers can through code and algorithms instruct the computer to do certain things, with what are seemingly strict rules, but it becomes increasingly difficult to track these decisions and actions because of the automatization, language, and scale of the operations. The machine is ordered to something, but the code and the algorithms can unfold in countless ways. When Paglen works with the computer, he is largely dealing with the software, the programmed interface that enables him to easily communicate with it. Here it is likely that he can present images to the computer in a simple way that also instructs it on which categories the images belongs to. The images are then read by the computer through code, not as the projected presentation that is visible to humans. In reading images as code and numerical data, the computer's vision is starting to diverge from human vision. The computer processes the input and learns from the given dataset in the machine-learning process accounted for in the previous chapters.

The images in the *Adversarially Evolved Hallucinations* are created with a Generative Adversarial Network, a GAN.[49] This is a machine learning technique in which the program is composed of two different computer networks, one in the role of a generator and the other one a discriminator, which are interacting with each other as part of the mainly unsupervised learning process. When asked to produce an image mimicking a certain category of real images, the generator is the network that is constructing an image. The role of the discriminator is to analyze each generated image and consider whether it classifies it as belonging to the dataset or if it's made by the generator. This is a continuous process aiming to improve the capabilities of the generator to produce seemingly authentic images, and the discriminator gives feedback to the generator so that it can produce images that are more like the ones in the dataset.[50] When Paglen asks the computer to produce a new image of what it

[48] Marks, *Enfoldment and Infinity*, 7-8.

[49] Metro Pictures, "Trevor Paglen: A Study of Invisible Images."

[50] Hui, "GAN—What is Generative Adversary Networks GAN?"

thinks a certain object or category looks like, it strives to make a new image that looks like the depictions found in the dataset. When asked to produce an image of a specific object, the computer does not reproduce a single depiction of it but rather, it visualizes a new image based on the information that is found in the thousands of images of that thing. The generator then strives to construct an image that resembles the images in the dataset to the degree that the discriminator validates it. Through the algorithms, the input is transformed into output. This is a very different operation than to simply reproducing a given image, as the computer now has to generate something itself by using the data and categories it has been given.

3.1 Hallucination

The programmers have constructed the basis of the computer networks, but now the generator is asked to operate on its own to produce a new image. This process is often referred to as computer hallucination and is reflected in the title of the series. Hallucinations refer to the state of perceiving or sensing something without external stimulation, where the sensory experience is created internally by the brain and experienced as being real. They can be triggered by experiences such as mental illnesses, drugs, or extreme physical conditions that in various ways disturb the brain, but can also be more common than we think. Bits and pieces of past sensory impressions are in hallucinations rearranged in new ways that have never happened before. The concept is somewhat anthropomorphic in that it ascribes a human condition to these machines, but it is telling of how the network produces new images based on the input it receives. The training sets that the AI is fed with largely dictates what it can perceive and hallucinate. It has learned to recognize and identify certain shapes, structures, materials, and colors, and when it is told by Paglen to show it's conception of something, it uses its creative abilities to visualize images. It can produce new images based on what it knows. This is bordering on what we humans perceive as mental images or the impression of seeing forms of light and color when closing our eyes, both resulting in abstract images that are twisted forms of reality. It is not the same mode of visualization as in humans, but the term hallucination is somewhat telling of the process that is going on to produce these images. The term describes the operations of the computer when it is computing and creating a new, visible image based on the information it has been given. The images are the result of the computer visualizing by itself, gathering it's information to compose an image that is never seen before. These images are synthetic, being composed of the networks of the computer, but

they are trying to imitate images that are found in the real world that is visible for humans. They have been exposed to thousands of images divided in specific categories, and have processed these images in order to recognize their characteristics. Based on its idea of the visual appearance of those things, the computer is now internally envisioning an image that it believes is fitting into a certain category. But it is also producing something new and expanding the visible by producing new realities.

The image titled *Rainbow* (fig. 2) does not look much like the multicolored arc that strikes us when sun rays hit raindrops at just the right angle. An impression of a rainbow perhaps, with a dominant velvety pink and yellow sky over a diffused cityscape. The colors drift seamlessly into each other as if they are in a smooth, constant motion. At the first glance it could be hard to detect what kind of entity that has depicted this image. No painter could ever carry out such a degree of softness, could we as humans even be able to visualize such a view? *Rainbow* is produced by a network trained on a dataset containing images of things that have been associated with omens and portents, like rainbows, comets, eclipses, and black cats. Without knowing the title, our human perception will have difficulties interpreting what the computer is trying to depict. The edges are blurry and unclear, with limited contrast, making the shapes abstracted and withdrawn. The fields of color are soft and blending into each other. It is dominated by different hues of pink and yellow, and although being colorful, it lacks the color spectrum we are used to seeing in a rainbow and is missing the arched bow that for us characterizes a rainbow. It immediately becomes apparent that these systems are not made to construct images for us. This is an outcome of the hallucinatory powers of the computer network to internally produce an image that it can project externally.

Hallucinations are for humans seen as extreme physical conditions, but in these machines, hallucinations are rather the normal state of operation. The network produces a new visual configuration based on the input it has received and analyzed, arranging the characteristics of the images in the datasets in different ways. Paglen has made the computer generate several images of each category, resulting in images based on the same datasets but with a distinct visual outcome. *Rainbow* is therefore just one of the endlessly many possible depictions that the computer can create. This means that the image could always have looked differently, always could have been something else. The computer's conception of how a rainbow, or anything else, looks, is therefore unfixed. There is not one definite image that constitutes the computer's visual notion of a rainbow, but there is a more extensive idea that can be repeated

in many different ways, and the version that is presented here is only one of many possible variations. The *Adversarially Evolved Hallucinations* are therefore opening up to see images as something different than as always being singular entities. An image is just one depiction that with the contingencies of the various agents that are producing it always could have looked differently. The hallucination is here based on the information that the computer is operating on. *Rainbow* is an image that is consisting of data, of large quantities of information that are stored and processed in the computer. As an image, it is solid and permanent as a material object, but it is a result of continuous and ongoing computations that are ever-changing, as are most of the digital images surrounding us today.

3.2 Image as interface

This correlation between information and the visible images in these works characterizes many of the images in our digital media culture. Through computation, the world is quantified into numbers and statistics as information for machines to operate on. The world is technologically mediated through the language of computers as data, which is recorded, stored, and operated on. Information defines many of the central defining activities of today but is largely invisible, and imperceptible to humans as data if not translated to visual forms. Still, it shapes many of the crucial processes in the world, like economics, communication, warfare, and culture. According to artist and writer Hito Steyerl, human vision is losing its importance in the connection to images, where issues of calculation such as filtering, decryption and pattern recognition, scan large quantities of information which we cannot perceive unless it's translated to a human form.[51] Digital images are not stored as an image in a way perceivable for humans, but rather as numerical code in the apparatus, and are only later presented to its human users in a translated form that is perceivable for our sensory apparatus.

Laura Marks has offered an important contribution to how digital images work in her book *Enfoldment and Infinity*. Through her investigation of the aesthetic parallels between new media art and Islamic architecture, illustrations and decoration, she demonstrates that the main link between the two seemingly different visual forms of expression are that both can be characterized as aniconic. That means that instead of being literal representations of things or

[51] Steyerl, *Duty Free Art*, 47-48.

ideas in the world, they are rather symbolic or suggestive. As with the Islamic principle of not depicting god and their prophets, she argues that the aesthetics of new media also works in ways opposite of being icons. In new media, the underlying processes of the images, what is not seen, becomes more significant than what is seen. Marks notes that what we see and hear in today's contemporary media culture often is the result of the processing of information, stored in databases and activated by the code of algorithms.[52] Although the information is invisible to us, it is crucial in shaping our perceptible world. Marks argues that when dealing with this type of images we are to a greater extent reading information rather than looking at pictures and that contemporary visual culture therefore now is information culture.[53] This means that a lot of images in the form of data are circulating between computers through operations that are independent of humans. Here images are read and written by machines, produced only for other machines, and are thus becoming invisible for humans. The automatization of images and the operations of non-human actants demand a shift in the focus on images and visuality that implies a decentering of the human. This involves acknowledging the limitations of human vision and the recognition of other forms of vision and images. There are many aspects of images that are invisible to human spectators, and there are other beings in this world that operate in the world in visual ways that diverge from the human, as *Rainbow* exemplifies.

Paglen`s images cannot be said to be completely aniconic as they are so connected to our world of human images, building on a corpus of digital images. The images in the dataset are representations of objects that exist in the world, and an image like *Rainbow*, therefore, has some connection to the visible world. What we see in the series is the visual outcome that our senses are open to. This visible surface is made up by the invisible processes and the vast amount of data constituting the image and unfolds as strange and uncanny depictions. This data that pervades the image must be said to be aniconic as it does not represent anything in itself, but has to be activated and displayed before being able to become visible to us. It cannot be perceived by us directly, but lies latent, or operates only as data from machine to machine. Stereotypes of objects in our visible world are transformed into data in machines that use this information to carry out tasks. From the data that the computer operates on, the image unfolds through the activation of the algorithms. The visual depiction we see when

[52] Marks, *Enfoldment and Infinity*, 2.

[53] Ibid., 2-3.

looking at *Rainbow* comes secondary to that of information and algorithms. The image is here no longer only a visible representation, but also an unfixed, latent force that is virtual and has to be actualized to be perceived by us. *Rainbow* is one of many possible outcomes, or hallucinations, that the computer can produce. Paglen instructed the computer to make several images of every category, and then chose the ones he wanted to exhibit. This means that the underlying data is unstable in that it can be reactivated in different forms, where every calculation brings forth something new, and where every image is distinct from the previous ones. The image itself is therefore in a way becoming subordinate to the invisible information and algorithms that generate it. The single image cannot fully account for the whole computational system, as it is ever-changing and could always have had a different visual appearance. What we are looking at is one version of how the computer has visualized the underlying data, and because only a small part of the data is actualized, what we do not see is more significant than what is visible.

The image therefore acts more like an interface, as a limited surface where the operation of the computer and human perception meet. Instead of being representations of the actual things it portrays, it functions as a symbol for the computational process, the data, and the algorithms. If understanding representation as a human concept of communication and interpretation, *Rainbow* does not have the likeness of what we perceive of a rainbow to be instantly recognizable. It is an abstract depiction that is not identifiable and then becomes more symbolic in that it does not directly point to a rainbow. The images in the dataset that is presented to the computer are connected to the real world as representations of objects. In the depictions made by the computer, these icons are coming back into the visual field after being analyzed by the network. The landscape, the sky, the bow, and the colors are disassembled and presented in bits and pieces in distorted ways in the work. We are receiving an aesthetic manifestation and visual expression of the process of its generation. This aesthetic of the machinic operations defines the image, as there is a reassembly of the digital images visible to humans into collages of these made by the computer, where the icons are barely recognizable to us.

This is where Marks' theories become important in her account of the appearance of images. She expands on Deleuze and Guattari's theories of how certain images emerges into our visible world from the infinite, what she refers to as the "universe of all images".[54] The

[54] Marks, *Enfoldment and Infinity*, 5.

infinite is here incorporating "all that has existed, will exist, has never existed, and will never exist, in a virtual state".[55] It is encompassing of everything on both a material and an abstract level, known or unknown, as ideas or other things that exist in a non-material way. Only some aspects of the infinite unfold and become actual in the form of information or as images.[56] To Deleuze and Guattari's focus on the relation between the infinite and the image, Marks adds the layer of information, which constitutes the most of the images that surround us today. In her account, information becomes a way to express the infinite so that it can be graspable for humans, where fragments of the infinite needs to be transformed to information before it can be approached by us. It then acts as a mediator between us and the world, where parts of the infinite are included in the form of information, while other things are left out and excluded.[57] Through information, the world is measured in terms of data. This, Marks claims, is not direct representations, but symbols of the infinite. Symbols that have entered the sphere of human signifying and meaning, and which is therefore severely transformed from the infinite.[58] In Paglen`s images, information is crucial as it is the underlying structure that unfolds the image through the algorithms. The image layer is then a way in which we can experience the inaccessible infinite, where the image becomes an actualization and materialization of the virtual. From the abstracted information, a world is brought into existence through the algorithms and the creation of the image. Based on quantifications of the world in the form of information and data from the digital images of rainbows, the image is hallucinated into existence.

In *Rainbow,* the visible image is what is presented to us, but the underlying information and the infinite is of larger importance. The information that is presented through the datasets only make up fractions of the infinite, as selected and unsystematic pieces of the world expressed in the form of data. This data is then further processed by the computer and in its own active selection and exclusions is then processed into an image that is perceivable for the human sensory apparatus. As Marks points out, we are today to such an extent relying on our eyes to

[55] Marks, *Enfoldment and Infinity*, 5.

[56] Marks, *Enfoldment and Infinity*, 6.

[57] Marks, *Enfoldment and Infinity*, 10-11.

[58] Marks, *Enfoldment and Infinity*, 6.

understand the world, but she characterizes perception as more like reading information than to experience sensuous material.[59] This new form of images of which Paglen's works are a part of, is then not an opening to the directly perceptible or sensible, but to what is readable through information and data.[60] In his images, like *Rainbow*, there is an interplay between these different levels. Parts of the infinite is actualized as information in the machines, largely invisible to humans, and bits and pieces of the information is visualized in the hallucination of the images. Where the infinite can be said to be the realm of possible images of the world, it is translated into information through the recording of cameras. These are depictions of rainbows in various settings, conditions, and perspectives, where the visible world of humans is mediated through the digital apparatus. Vast amounts of images are read by the computer as data and are sorted into categories. The depictions of the phenomena of rainbows are then further processed by the computer to produce an image. The resulting outcome that Paglen is exhibiting is therefore not a direct copy of the world such as analog photographs, but is more like a projection or a model based on statistics and information. It is based on abstract ideas constructed by Paglen, which are then computed to make an image which acts as a visualization of these concepts. From the algorithms in the computer, a world is brought into existence based on the information from the given input. What unfolds is a world that is altered from the reality we experience. The image is a result of the performative computer which unfolds the data in new arrangements. The machinic operations are in the image, visible as gaps between the layer of information and the image. Here only parts of the information is actualized in a visible form, where other parts are excluded and left in a virtual state. The machine is selective in regards to what aspects of the information it operates on, and the contingency of the algorithms that actualizes the image visualizes the information only in certain ways. Out of all the information that is stored and operated on in the machine, only some of it is made visible.

In *Rainbow*, information is made visible as an image. It shows how only a fraction of the infinite is actualized as visible entities or phenomena in our world. The works display that there is more to the world than what we see and sense. The visual is not all there is. Most remains virtual, which is still real, but not actualized. In this machinic assemblage of humans

[59] Marks, *Enfoldment and Infinity*, 2-3.

[60] Ibid., 3.

and non-humans, what is actualized is affected by power structures. The selections of the datasets in the input and learning-process is crucial to determine what is made visible. Other things that are not able to be photographed or rendered digitally are excluded, and therefore not actualized. This also applies to things that are not represented in the datasets. Images and visuality are pervaded by power structures, and so are many of the invisible processes as well. *Rainbow* shows how this new visual depiction unfolds from the information it has been given, and that the gaps between the information and what is actualized as an image are characterizing the outcome. In this form of image, representation is replaced by performativity. The work exhibits the machines translation of information into an image, where what remains virtual is more important than what is visualized. *Rainbow* highlights the invisible, showing that human perception can only sense a small part of the infinite world where the invisible processes of information and data are increasingly operating in significant domains. Information is crucial in shaping both the visible world, as images, and the invisible operations that structure the world. What we cannot see is in computer vision more important than what we can see.

This implies that *Rainbow*, as a computational and algorithmic image, is so radically different from traditional images that we cannot interpret it as such. There is an invisible layer of code and data behind the image that we cannot access and that abstracts the visible image away from what we usually see. This is one answer to why these images appear as so unfamiliar to us. There is a new layer of data between us and the world that becomes so prominent in this image. The resemblance to the depicted things is lost to us in the translation of the code, and because of this, the image cannot be approached fully by our human perception. We miss out on the most important aspect of the image, and that makes it appear very strange. So to experience this work as a human being, to rely simply on what is visible will not make much sense. This view correlates to Vilém Flusser's early ideas of the shift from what he calls traditional images to technical images. He characterizes traditional images as mirrors, in that they are direct representations or imprints of the world, and technical images as "projections that code the meaningless particles that it records of the world to give them a meaning."[61] In a similar manner to Marks aesthetics of enfoldment and unfoldment, he notes that technical images are "drawn from the inside toward the outside", and that they must be understood not

[61] Flusser, *Into the Universe of Technical Images*, 48.

by what the image show, but of how it is programmed.[62] He claims that technical images are visualizations rather than depictions and that they are more like symptoms of chemical or electronic processes than traditional images.[63] Based on this he notes that "the image itself is the message".[64] This is a paraphrase of Marshall McLuhan's famous statement that the medium is the message, and by proclaiming this, Flusser emphasizes that the medium that has produced the image is of larger significance than the meaning or content of the visible image. The meaning is rather in the specific abilities of the medium to render the world. To Flusser, one of the most important aspects of technical images is that they don't signify the real directly but through models. He argues that they rather indicate the operations and data that conditions the image, and how the medium is actualizing it through the instructional programs.[65] Flusser traces the shift in how images are transformed from having a direct connection to the world to become something that is structured by digital information that unfolds through programs and algorithms. This requires us to understand images in new ways where what is visible to us is often not enough to understand an image. There is much more to images than what we see. The images circulating in computer vision systems are invisible to us, and when asked to produce an image visible to humans it is not there to represent something to us. The images in Paglen's series are instead results of operations by machines that operate on images in ways that diverge from our use of them. These are machines that use images to make decisions, to recognize, and to analyze. We therefore have to abandon the idea of images being solely for humans and to understand that a large portion of images today are accustomed to other machines in processes that are invisible to us.

This idea is very prominent in Trevor Paglen's works, where the computers usually operate in ways that are imperceptible to humans. These computational technologies have different applications than to be visible for humans as static images. Instead, they are part of complex machinic networks that operates and acts based on the information they can extract from images and other visual input. It then turns more into what pictures do than what they mean.

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[62] Flusser, *Into the Universe of Technical Images*, 48.

[63] Ibid., 34.

[64] Ibid., 49.

[65] Ibid.,. 50.

Rainbow is an example of a picture that has left the traditional status as a representation and a signifying system and is more a result of a complex calculation. It is revealing a small section of the underlying code and algorithms and is a selective, both human and nonhuman, way of perceiving the infinite world where only some parts of it is actualized, whilst everything else remains virtual. It is an artwork that shows that images have become something that largely operate in machinic networks and that humans cannot perceive. In the creation of this image, Paglen has only affected the input level by providing images for the system to process. Humans are supplying images that the machines are reading as information and then operating on in a translated form. These images are not for us, but now the computer has produced an image that is visible for humans, but far from being understandable or representational. This generated image shifts the focus of images away from meaning and towards the underlying processes that go on in the background of the technologies that we use in our daily lives. In this way, it is also about the imperceptible forces that conditions perception, the algorithms, and calculation that shapes how and what of much of what we see. *Rainbow* reminds us of the ways in which human vision is not neutral, that we do not see exclusively with our eyes, and that nonhuman forces are crucial in producing images. Humans have partly constructed these systems, but the machines are largely operating by themselves.

3.3 Nonhuman vision

Jonathan Crary, an art historian, theorist, and critic, who has written extensively on the role of human vision in a wider historical perspective, points out that what have traditionally been seen as the most important functions of the human eye are now being replaced by technical apparatuses that turns visual images into something that no longer references the optically perceived world or any human observer.[66] Rather, they refer to mathematical data and code. Crary predicts that traditional forms of perception will persist, but that the new technologies of image production are taking their place as the dominant models of visualization. This will in turn impact how and what we see and understand about the world, but also how social processes and institutions function. Following the relocation of vision into the domain of technical systems and code, Crary sees the formation of new networks of consumption, circulation, and exchange.[67] Rooted in the physical, mental and cultural functioning of the

[66] Crary, *Techniques of the Observer, 2.*

[67] Ibid., *1-2.*

human eye and ocular apparatuses, he understands that there is a coming shift that is altering something fundamental about the human body and the role of our eyes, and vision. As Paglen's works show, it can certainly be stated that there exists a transformation of images and vision into something increasingly non-human.

These images provide a glimpse into the mode of vision found in the new computer technology. In Paglen's exhibition, the images from the *Adversarially Evolved Hallucinations* are presented in a way that is visible to humans, but they are still alien and unpleasant. That the images show things we are used to seeing in our world is not comforting, but rather uncomfortable. We can recognize most of the things they depict, but they are reproduced in strange and alien ways. They are images made by a computer with a different visual apparatus than ourselves, in a world where we have seen ourselves as the only species able to produce images. To be able to see through the visual system of another being is an uncanny experience. When images are changing, we also have to adapt. These works give an opportunity to see differently. They declare that images are not the same as representations. Instead, they are pointing to the crucial fact that digital images today are not solely for us, but increasingly something that operates in machinic networks where images equal information and data. A work like *Rainbow* gives a visual impression of the state of digital images, which are unfixed entities whose main form is as data and that have to be generated every time they are visualized for a human observer. By its strange depictions, the work makes evident that what we can perceive with our human vision is not enough to grasp the processes that make up the image. What is visible to us is rather just a fraction of the information that is stored in the computer, where the resulting image is not able to in a traditional way convey any meaning to a human. *Rainbow* calls attention to the calculation that is constantly happening around us, but that is invisible, and that has transformed our visual culture. Images like these are not stable, but something that is more unfamiliar than we have previously thought. Paglens works are an exploration of what is possible to visualize in these invisible systems. Images like *Rainbow* are not a window to the world, but an interface to something else. It shows us the limitations and the possibilities of the translation from information to image, and to visualize this is a strategy to create awareness of the invisible operations that structure the world and to help us see differently.

In *Rainbow*, there is a distinctly non-human form of vision that is operating. A machinic visual construction that can both identify objects and create new image-worlds by depicting

our surroundings in a different way. In these systems, the world is measured by the non-human, revealing that human vision is not superior, but one of many forms of perceiving. Computer vision is shaped by both human and non-human actants and is also shaping what and how we see. Arguing that we always have seen in largely nonhuman ways, Joanna Zylinska proposes the concept of nonhuman vision as an alternative way to understand ourselves and our relation to the nonhuman entanglements that make up the world.[68] Here human vision is positioned "as a part of a complex assemblage of perception in which various organic and machinic agents come together".[69] It is then a theory of images that goes beyond representation and which opens up to seeing beyond the scope of humanism and the human eyes and perception.[70] It stresses that human vision is entangled to material and nonhuman agents, that our point of view is not strictly ours. In this way we can learn to see differently, understanding the role of technological systems in shaping the visible world and our perception. Through this theory, she emphasizes that rather than representing something, the processes behind the images mediate the world. As earlier technologies through history have radically changed the way we see, we have become accustomed to them to a degree that they are now understood as a part of us. Image-making has also to an extent always been partly nonhuman in that it relies on material and technological features that shape and mediate the images we assume are being executed by humans. Be it painting, with pigments and brushes, or cameras, where the world is mediated through a lens and recording materials, nonhuman media is constantly shaping and producing our images and vision. The system Paglen uses makes it evident that also nonhuman actants can have perceptual abilities and a complex sense of visual understanding. Computer vision can be said to be exceptional in its capabilities, but it foregrounds that other technological and material entities are important in shaping our vision. *Rainbow* challenges our human perception by rendering visually how many of the forces that structure our perception are imperceptible to us.

[68] Zylinska, *Nonhuman Photography*, 15.

[69] Zylinska, *Nonhuman Photography*, 14.

[70] 1

4 Alien Vision

The works in the *Adversarially Evolved Hallucinations* raise pressing questions of ontology, non-human agency, and what it means to be human. When seeing the images displayed in the series, we are confronted with a visual outcome of a complex computational operation which simulates a form of images that we are familiar with, but which in appearance reveals strange signs of alien operations. The series is based on images that are connected to human culture, ideas, and constructions, but are seen through a computer that has been trained with images through machine learning. What we think of as very human imagery is in Paglens works conveyed as a different way of depicting the world, one where what we know is measured by the non-human. This alien perspective characterizing the whole series, but is especially prominent in the work called *A Man* (fig. 3), which conveys a different understanding of the human, media relations and images.

A Man depicts what looks like a foreign species that is stretching out a diffuse arm, looking in the viewer's direction with a face that is more reminiscent of a dog rather than a human. It is a very incomplete face, but it is possible to identify something that has the appearance of a face, with eyes, ears, and a nose. The creature is melting into the eerie background consisting of hardly definable hues of colors ranging from grey-purple to black-blue and suddenly some fields of red, that blends into each other in a hazy scenery. The neutral and disinterested title establish a feeling of being watched by an alien species with another form of visual perception. My human brain has never visualized another human being in a similar way. Unfamiliar with the technology it might give associations to how a fly buzzing around the kitchen stares at us in the act of cooking, a bat locating us through our window, or what our dog imagines in its dreams. There are little to no traces of any linear perspective and illusion of depth, and the surface of the image seems rather two-dimensional. The image deploys a set of colors and relations of colors that departs from what the human eye is used to seeing. It surely is visualized by a non-human entity with a different set of eyes and modes of visual perception than the human.

For this work, Paglen has fed the computer with a dataset called *The Humans*, including different categories of human activities as androids, people licking ice cream, human eyes, and men.[71] From the latter dataset, presumably containing images of mainly white men, the

[71] Strecker, "An Urgent Look at How Artificial Intelligence Will See the World."

network has constructed an image of how it visualizes a man. There are undoubtedly issues at stake here concerning the limited conception and the narrow definition of what "a man" is. Instead of pushing the frameworks of what a man is by including a diverse selection of different types of men, Paglen seems to have chosen a corpus of images that reflects the limited and discriminatory stereotype that is often found in these systems. Questions of bias and power relations is not the main focus of this chapter, but it is worthwhile to be aware of how we are used to thinking of "a man" or "the human", and what these terms include and exclude. The focus here is instead oriented towards the depiction of a human being through this visual and intelligent system. The character in *A man* is depicted in a way that is very inhuman and strange, not portrayed in any familiar way or resembling human shapes as we are used to seeing them. Had it not been for the title it would not be clear from the image itself that this is a rendering of a human being. Aware of the title and the dataset that the work is based on, on the other hand, the strangeness of the machine is displayed through the work when it presents one of the things we are most accustomed to looking at, namely ourselves, the human.

We have some knowledge about how different animals that live alongside us perceive the world through their specific visual and non-visual perception, but there are no direct ways of experiencing the visual apparatus of a cat, a dog, or larvae. What would such an experience be like? Technological apparatuses have, on the other hand, an exceptional role in giving other perspectives on the world because they can reproduce it in their specific ways and still create images that are visible for humans. This is somewhat true for devices as cameras and mobile phones, but those depictions are highly familiar to us and are mainly built to capture and reproduce the world as we see it. Except for the odd glitches that can occur in these digital apparatuses, they are not usually unfolding the strangeness within them to a degree that makes us uncomfortable and forces us to shift our perspective. Mark B. N. Hansen notes that the media characterizing the twenty-first-century breaks with the earlier correlation of media and human experience, which primarily address human sense perception.[72] Computers that are operating with machine learning, artificial intelligence, and computer vision are on the other hand operating on scales that only can be accessed indirectly by humans. These forms of media are radically challenging the model of media where humans and media systems are

[72] Hansen, *Feed-Forward*, 38.

coupled to the human sensory apparatus.[73] There has certainly always been aspects of media and their operations that are distinctly different from the human, but the ways these twenty-first-century technologies are so significantly separated from human perception forces a shift in how we relate to our technological surroundings. If being accustomed to experiencing media as something that is operating on the level of our senses, and being exposed to only the sides of media that are familiar to our modes of perception, then this new media reality is characterized by its fundamentally non-human modes of sensing and being in the world. Because these machines are distinguished by operating with code, which is invisible to human perception, an encounter with this form of media can be disturbing, as it forces us to overturn the idea of media as prosthetics for humans. In *A man*, the computer has learned to sense and measure a human being, and we are faced with the strange presentation of an alien entity trying to make sense of us through our visual appearance.

Some researchers, as Benjamin Bratton, has termed this unpleasant experience as "the inverse uncanny valley".[74] The uncanny valley has since the 1970s been a concept for describing the negative reaction humans have when encountering non-humans as robots and dolls that have a high degree of human likeness, while at the same time is clearly artificial. A Japanese robotics professor found that people experience a sudden decrease of affinity towards a robot when the design becomes more human and less toy-like.[75] It is an unpleasant feeling of confronting something alien that attempts to appear human. The uncanny valley triggers some of the emotions we get when we recognize another human being, but then the encounter becomes uncomfortable when we realize that it is not. In the inverse uncanny valley, the situation is reversed, and one is confronted with oneself from a perspective that is somewhat human, but predominantly alien. It is a way of visualizing that which is somewhat similar to the human, but still strangely different and unpleasant. It is an opportunity to see oneself through the viewpoint of a partly autonomous system that observes and analyses us, and that provides a distinctly different way of perceiving and visualizing the world. This inverse uncanny valley is a technological alienation that disrupts how we are used to seeing ourselves, displaying the strangeness of the non-human other.

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[73] Hansen, Feed-Forward, 37.

[74] Pepi and Jordan, "Machine Vision."

[75] Mori, "The Uncanny Valley", 98-99.

This ontological destabilization is a central theme in Paglen's series, and *A man* works as a manifestation of this idea. Computer vision is a form of vision that we cannot fully access or understand every step of, but that interfere in our world, and that even use the human as one of its subjects. By depicting a human being, the work points to the invisible operations where our images and behavior is closely observed by machines that gathers all the information it can about us. Here, humans are labeled and put into categories. This is an important aspect of today's media culture, characterizing the technological systems we interact with. These are not simply for us, but are also used to gather data about us through our images and activities. We are not the only ones looking at the world. Even though the computer vision network operates in code and through computation, it has the ability to produce an image that we can see in a way we are accustomed to. However, its aesthetic is clearly not adapted to human modes of perception. It is a form of imaging that is largely non-human in that it emphasizes operations that are not directly referencing the human senses. In fact, the computer performs its task more efficiently by not being obliged to do so. Computer vision is a form of visual perception that can be seen as trying to mimic what we understand as human forms of images and capacities, but it is significantly dissimilar from human perception. As Bratton notes, "instead of being creeped out at how slightly inhuman the creature in the image appears, we are creeped out at how un-human we look through the creature's eyes".[76] These technologies are able to accomplish tasks that outperform the human exactly because they can operate in its specific way with code and algorithms, without having to conform to human ways of perceiving and thinking.

A Man then opens up to see ourselves from a different visual system. In the systems Paglen use to produce the works, the capacity to analyze and calculate data far exceeds the capacity of the human brain in many tasks. It is a machine tasked with a high degree of autonomy which accelerates its operations to a degree to which we no longer can access or understand. When this machine produces images of us that are so different from what we are used to seeing, then we are forced to imagine things from another perspective. Humans are simply seen as information that is stored and recognized in the computer in the same way everything else is understood and valued. To recognize and reproduce the visual features of a man is no more important than recognizing the other things the computer has learned to identify, like rainbows and vampires. The human is perceived through its basic visual characteristics

[76] Pepi and Jordan, "Machine Vision."

without being ascribed any exalting attributes that elevate it to a position at the top of any hierarchy. The figure of a man is rather seen as information to be analyzed and processed. The human is not prioritized any differently than other objects and things in the world, alive or inanimate, and from the perspective of this computer, no entity is placed in the center.

4.1 A Post-Human Media Ecology

This work serves as a visual and artistic exploration of contemporary questions about how we relate to the world around us, and the relationship between humans and technology. It makes it evident that the human perspective is not the only one, and that there are other forms of intelligence around us other than the one we possess. The human and human vision is decentered in order to try to understand the world from the perspective of the machine. In an attempt to understand the visual organization of these sight-technologies, the idea of the human is inevitably understood differently. In these machines, what is understood as "human" becomes something unpleasantly different to how we are used to looking at ourselves. To rethink the traditional notion of what the human subject is has been the principal occupation of the philosophical movement of posthumanism, which has become a significant branch of the Humanities in recent years. The human has long been considered as having a unique form of intelligence and agency which surpasses all other forms. We have seen ourselves as the dominant subject of the world, measuring all other things in their relationship to us. Nature, other beings, technology, and things has been understood through human perception and the purpose we attribute them. Posthumanism argues that this is a misconception of the complex networks of the world that prevents us from understanding our role in an interconnected and dynamic world where we are living alongside other entities. It declares that we cannot continue to think of the human in the traditional, humanist way, as it results in misconceptions of the relations between actants in the world.

One of the most prominent voices of this philosophical field is Rosi Braidotti, who advocates for what she calls a critical posthumanism. This is a form of thinking in the intersection of post-humanism and post-anthropocentrism. Both of these philosophical branches seeks to move away from the western ideal of 'man', and away from the idea of the human as inherently exceptional and on top of the hierarchy of beings.[77] Her view corresponds to Levi

[77] Braidotti, "Posthuman Critical Theory", 339.

Bryant and Ian Bogost's concepts of Onto-Cartography and Alien Phenomenology. Bryant's machine-ontology is a post-human media ecology in that it rejects an anthropocentric view of media by understanding all things as machines which afford and constrain possibilities of other entities in the world.[78] It sees things, objects, animals, and humans as constantly modifying each other. Instead of a hierarchy of beings, it presents a flat ontology where the machines are seen as operating on input, transforming it to produced outputs.[79] As Bryant puts it, a posthumanist ontology is one in which "humans are no longer monarchs of being, but are instead among beings, entangled in beings, and implicated in other beings".[80]

A Man introduces the possibility of artworks to speculate on other forms of existence, and on other forms of intelligence and perception. This work is a way of visually exploring the issues brought up by posthuman philosophy, both as an engagement with how this entity interacts with the world, and as a material manifestation of its operations. As a visual entity, it has a different effect that is more immediate than theoretical speculation. It shows that other forms of beings existing and share a network with us and other non-human beings. Encountering this alien perspective provides us with an opportunity to be aware that the human is not the sole master of the universe. There are other ways of being and operating in the world which affect and are interrelated with human life. The anthropocentric understanding of the relationship between humans and technology is alienating us from the technological processes and agencies that are increasingly determining the way in which we live our lives. This perception misses a lot of critical aspects by failing to consider the technological agency and the processes that exceed the human senses. The *Adversarially Evolved Hallucinations* show us that the operations of computer vision and artificial intelligence is very different from human processes and that technology is something we cannot understand fully. We cannot have direct access to its operations or its way of being, sensing and making decisions, but that does not mean that we should only understand it as it appears to us. The digital images Paglen has exhibited can work as a common denominator which both humans and machines understand. This opens up for active speculation into the inner workings of the computer engaging in these processes. By decentering the human and trying to see like the machine, the works show that we are not alone in the universe, and that we are not the only sensing and

[78] Bryant, *Onto-Cartography*, 9.

[79] Ibid., 38.

[80] Bogost, *Alien Phenomenology*, 16-17.

intelligent beings.

A Man gives visual evidence that there are other actants operating in the world that have their very own way of perceiving the distinctly non-human world. This way of visually operating with things and concepts has some similarities to how humans function, but cannot be deciphered by a human framework as the differences exceed the resemblance. To see oneself from the perspective of a computer-vision system opens us up to decenter the human and understand the world differently. The world is made up of different beings with different forms of existence and specific qualities that cannot be measured solely by the human. Most of the activities in the world are performed by non-human beings that are autonomous from humans. Although these processes might be imperceptible to us, these assemblages of machines are affected by and affecting other entities in their specific ways of openness and closure. One reason why *A man* causes such an uncanny feeling is because it so radically confronts the idea of human superiority. It forces us to leave our modes of thinking and our perceptions in order to see reality from a different perspective. It reminds us that the world is full of actants which have the ability to sense and exist in the world outside the human mind. This work makes evident that the human is only one form of being among many, with its limited way of perceiving and acting in the world which is not necessarily universal. We have a specific set of visual perception, and the machine has another one. This shift of perception and agency questions our division of subjects and objects, where the human has been seen as the subject and its surroundings, as objects. In *A man* this hierarchy is destabilized and reversed. A human male is interpreted and visualized by the sensing system of a computer. Here the human is more of an object, a thing to be observed, lacking any agency. The character in the image is looking in the direction of the one portraying him, as if he was suddenly frightened by the fact that there is another being in the room.

It is urgent today to envision the human as part of a larger network of other beings that we constantly interact with and live among. This mode of thinking that the works relate to is important in facing the challenges posed by the Anthropocene, the current geological period of the Earth marked by the omnipresence of homo sapiens. We have through our relatively short time span - compared to the deep time of the Earth - affected the planet to such a degree that our species has become a geological force, leaving traces of ourselves not only in cities, but also in the Earth's surface, atmosphere, oceans, and in the most remote places some still think of as nature. In the failures of the anthropocentric organization of the planet, another

ontology seems to be inevitable. Through the processes in the *Adversarially Evolved Hallucinations*, from the input to the hallucination of images and the computer's use of humans as information, it becomes evident that the world is composed by a broad range of different machines, where humans are one of them. We are one type of entity that interact with other machines and remake the world together with them. Our activities are in different ways affecting the other beings that we are living amongst. At the same time, our species is conditioned by all the other entities that surround us. *A man* displays how the human is also itself serving as input in feedback loops with other machines. As N. Katherine Hayles put it, we are «Enmeshed in networks of social, economic, and technological relations, some of which are human, some nonhuman".[81] This is also highly crucial to acknowledge in order to develop a more accurate relationship to the technologies we live with. We are both interacting with a vast amount of different media, and we are ourselves serving as media for other machines Instead of understanding them as neutral, Paglens works presents computer-vision as a complex assemblage of human and non-human actants. In the project, there is an emphasis on the human involvement in the construction of the systems, but the autonomy of the machines is also highlighted to a degree that pervades the works. They are acting in very specific ways that determine their possible use. Rosi Braidotti argues that because robots and other partly autonomous machines have made it possible to circumvent human decision making, humans are now increasingly operating not `in the loop`, but as observers `on the loop`.[82] In this scenario there is a need to understand the world from a perspective where humans are not in the position as subjects. In this image and from the computer's perspective, we are more like objects, and the situation is turned around.

To be able to speculate how the world looks from different perspectives is important in order to form an idea of how other entities sense and operate in the world, what needs different machines have to fulfill in order to interact or operate in different situations. It is to try to understand how the world better can be suited to non-humans, instead of thinking about how other beings can be used by us. To understand the human as interrelated to the rest of the world is to see it as a more complex form of being. In this way we can reduce the pain we inflict on other beings through our activities on the planet, ultimately creating better ways of living together. This holds for human relations to non-humans and to other humans as well

[81] Hayles, *How we think*, 13.

[82] Braidotti, *The posthuman*, 44.

which has important ethical and political consequences. A lot of the suffering in the world can be partly ascribed to the lack of understanding of a situation from the perspective of the other. Bryant notes how this is pervading the colonization of other cultures, of sexism that is not customized to the specific need of women, and in how animals are treated.[83]

4.2 Mediation

This work is therefore telling of important aspects of how we are entangled with other beings, and also more specifically to the technologies around us. When the computer is the active agent, observing and analyzing, and the human is unable to affect the process, the view of media as simply a tool for humans falls short. Johanna Zylinska and Sarah Kember argue that our relationship to technology is one that is closely linked to the human body. They see technology as a kind of prosthetic for the human body, but in a way that diverges from the anthropocentric understanding advocated by McLuhan, where technology are mere tools or extensions of the human body. Instead, they imagine the human as a form of cyborg, where the capacities of our bodies are conditioned by various technologies. It is a view that proclaims that the human condition is one that has always been mediated.[84] By understanding the relationship between humans and our surroundings in this way, they argue that this radically alters our conception of the human as "master of the universe to which all beings are inferior". Their view rather poses an understanding of the human as a being that has always been connected to an innumerable range of non-human entities, and that has developed in interaction with the available technologies. Zylinska and Kember argue that this view is a more fertile approach to understand media relations and media environments in that it's a more critical and responsible relationship to the world.[85] Here, mediation and life are closely connected, and mediation becomes an essential concept for understanding the human and our realization in the world.[86] Different technologies have always existed together with us, and

[83] Bryant, *Onto-Cartography*, 71.

[84] Kember and Zylinska, *Life After New Media*, 194.

[85] Ibid. 193-194.

[86] Ibid.,, xv.

shaped our lives to a degree that technology and media are precisely what makes us human.[87] Media is internal in us, and part of our bodies and minds.

In *A man*, this is expressed through the encounter with a machine's perception of a human, which requires a shift in our perspective in order to understand ourselves in a different way. By seeing ourselves through the machinic vision, we are up against an alternative comprehension of the human. One in which we are surrounded by other forms of sensing and operating entities that destabilizes the idea of the human as the center of things. This might be the reason why the encounter is so uncanny. The human is seen as being no more important than rainbows, vampires, and octopuses. It is this worldview of another entity which acts as a reminder that we are not alone in the universe, and not the only form of being that can make decisions, visualize, and sense the things around us. We know that other beings have forms of vision and modes of thinking and feeling, but these tend to either be suppressed as inferior to human functioning or viewed from a human-centered perspective. Vision and intelligence in this computer vision-system cannot be comprehended in its similarities to humans. Rather, it functions in ways that are ungraspable for humans, and that are completely different from how we work, thus questioning our ontological thinking.

Computer-vision is just one of the technologies we are living amongst, which is not exclusively for us, but that does affect us and shape our activities and our experience in the world. As with human vision, machinic vision is also an assemblage of different actants, materials. and technologies. Computer vision is as a technology suddenly possible at this moment in time because of the level of computational power able to analyze vast amounts of information at a speed hitherto unprecedented. As an infrastructure, it transforms the world through its new ways of organizing it, and the computational logic it holds. It brings a lot of possibilities in how it can be used, but it is largely in the hands of the ones in power and with resources to work with it. It is therefore easy to understand these technologies as simply a tool made for and by the more powerful actants in human society, designed to fit their needs and wishes. If we instead follow Levi Bryants account of machines as structurally coupled to other machines, modifying the activity and becoming of each other, these systems become something very different.[88] In Bryant's view, social relations are modified by relations of

[87] Kember and Zylinska, *Life After New Media*, 194.

[88] Bryant, *Onto-Cartography*, 33.

power, but this understanding of power also includes physical and discursive machines, many of them non-human or material.[89] This means that human social relations, and power relations are conditioned by all the machines, or media, around us. It cannot then be understood simply through human meaning and signification. This view of media also challenges the conception of technology as designed for and by humans. Instead, Bryant sees it more as a negotiation between human ideas and the already existing machines and materials, which contribute to the design as much as human intentions and plans.[90] That means that technologies are not made solely from human ideas, but by the existing materials and configurations that shape the outcome through their limitations and possibilities, creating something that diverges from the strictly human purposes.

Computer-vision is facilitated by numerous technologies. Some of them include the powerful computers and their components, servers that can store enormous amounts of data, the widespread infrastructure of fiber optic cables, and other wireless transmitters such as satellites and base stations. The assemblages of these technologies make certain operations more feasible. First of all, computer vision and machine learning needs large amounts of data in order to be able to learn from the material satisfactorily. This connects the technology to the field of big data, and those who are able to gather and store large and complex amounts of data. In the case of images, some global companies, the military, and governmental institutions are in an exceptional position in their abilities to accumulate data. The technologies then open up possibility for finding ways of feeding it data, and in this way it forms us as well. As a machine, it "does not have a purpose or use in itself, but takes on a purpose when it is structurally coupled to other machines".[91] Computer vision and machine learning have a lot of possibilities in its uses, but some of its main particularities make it appealing for the ones with resources to manage it. The technology is therefore also in its construction and development not only shaped by human agency, but by an assemblage of different machines and materials already established.

As Paglens works shows, humans are responsible for impacting some of the crucial steps like feeding the machine with large datasets of images. The computer then works with the data

[89] Bryant, *Onto-Cartography*, 7.

[90] Ibid., 17-22.

[91] Ibid., 24.

largely independently, making itself ready to work with new and unknown images, which is what its main task is. Paglens system can be connected to a camera that records live footage for the computer to analyze based on what it knows. Similar couplings of machines are characterizing the technology at large. The computational systems have been connected to devices that can gather constant streams of data to feed and adjust the network to the outside world. In a sense it wants to gather information about us, and so does their guardians in order to improve their systems, making it even more encompassing in new spheres of the world. Our digital images, faces, online activities, and physical movements are constantly analyzed and regarded by these systems. With the absence of human intervention, these machines are observing us without us being aware of it, and *A man* is a way of seeing things from the perspective of this alien spectator that we share the world with. It is to see ourselves from the viewpoint of the processes going on in the background around us, the algorithms and calculations that analyzes our activities and images but that we cannot see.

The work displays that the technology cannot be seen as simply prosthetics for humans. It challenges the anthropocentric view of media, and attempts to broaden our understanding of the non-human operations that characterize the technology. We have so little understanding of the non-human machinic operations that they can easily be used to exploit us, thinking that they are objective and purely machinic. These are technologies that are impacting our lives both individually and socially, and it would be naive to think of these technologies as inherently neutral. Instead, the works encourage us to understand the operations and logic behind the system, not to take it for granted. The algorithms and processes that operate in the background of our devices are invisible to us, but nevertheless shape our perception and understanding of our power structures social relations, and interactions.

A man gives insight into the amount of power and the capacity that computers and complex technological systems. These machines are able to all these things, and they are using us as information to operate on and improve their knowledge. These are technologies that are increasingly impacting our lives through things like robots, computers, self-driving cars, and all the connected devices in our smart homes and cities. All these technologies involve aspects of machine learning and computer vision, and provide big changes that challenge our perception of technology. This kind of technology makes it evident that computers are intelligent and powerful in their capacity and forces us to realize that the media we interact with has, to a certain degree, always been like that, alien and with agency outside of the

human. The concept of the uncanny valley was used to design robots that humans wanted to interact with. The inverse uncanny valley rather declares that the technological other is distinctly non-human. Instead, we have to face that there are things that we are used to thinking of as characterizing the human, like intelligence, creativity, language, image-making, and the ability to analyze information, is also found in a multitude of ways in other beings. This has for long been suppressed, but the level of autonomy in these technologies makes it evident that technology is something composed of both humans and machines simultaneously. Paglen's work manages to make visible the essential aspect that media is not coupled directly to the human senses, but can be independent and only open for some specific flows of input that it operates on, with particularities that are distinctively non-human. Humans, as one kind of machine with one way of sensing and experiencing the world, are just one of numerous other machines that act in the world in their specific ways. We cannot control or access these operations, but we are part of complex, constant processes with other entities that also forms our bodies and our activities. This is a more complex account of the human than to understand it as the center of being which everything else is perceived through. *A man* displays something essential about what it means to be human, namely that our bodies are subject to a plethora of other machines that form our way of being and becoming on this planet. We are media for other machines to the same degree that other machines are media for us as well as to other non-human machines, in operations we can only access indirectly. This is true for the technologies involved in Paglens project as well as all the other non-human activities happening around us.

4.3 Postimages

It follows that this shift in perspective is also needed for images. New media theorist Ingrid Hoelzl propose that we think of the digital image of today as a postimage. She argues, as Paglens images are examples of, that many of today's images are operations and processes based on data and algorithms, rather than representations. She therefore insists that we have to see images from a posthumanist perspective where we realize there are more forms of vision than only the human, and that there are other aspects of images than what we are used to. The term therefore needs to be expanded.[92] She sees the postimage as a result of a collaboration between humans and machines. The idea of the postimage abandons the humanist conception

[92] Hoelzl, "From Softimage to Postimage", 72-73.

of images where vision and representation are seen as largely inseparable and breaks away from the image as only the perspectival image, which sees the world from the standpoint of the human, which is placed in the center of things. Rather, it thinks the image as something that is made in cooperation of humans, technology, and nature, which is co-evolving and co-operating. She argues that vision is something collaborative, that it is distributed between machines. The postimage is then defined as "the collaboration of visioning humans/animals, data/algorithms and, increasingly, autonomous machines".[93] This is describing of the processes Paglen is involved in, where the human intervenes in the early phase of providing input to the computer, and where the computers are operating on the data in a way inaccessible to humans.

In both Paglen's case, and in the larger applications of computer vision, the technology is characterized by machines operating with other machines. In Paglen's case this holds for the learning process of the generative adversarial network, where the two computers, the generator and the discriminator, are trying to outsmart each other by either convincing the other that they are showing an image from a dataset or to disprove an image as generated. Machine to machine operations are also defining other uses of the technology. These digital, algorithmic images are not solely for us. In many instances, they are particularly characterized by the absence of humans in the loop, with operations which humans cannot directly access. This proclaims that human vision is not outstanding or exceptional, but one of many forms of perceiving the world visually. What we think of as human vision is as well largely shaped by non-human actants and technologies, but that we have been accustomed to seeing with. There are forces beneath our perception constantly impacting how we see, and shaping the images both visible and invisible to us. Paglen's series gives a visible account of how the technologies characterizing the twenty-first-century in some ways adheres to the human senses. There are parts of the operations of the non-human machines that we can impact in the form of providing input that is translated by the machine, and there are other aspects of media that we cannot control or access. An important lesson of media is that it always has constraints in what we can experience and control, but that in turn is impacting our perception.

[93] Hoelzl, "From Softimage to Postimage", 73.

As with our vision and modes of being, the images that surround us is as well are the result of both human and non-human operations, and it has always been that way. In traditional artistic mediums such as painting and sculpture, the materials are acting in specific ways. They change with different temperatures and conditions, and they deteriorate in different ways over time, in ways we only can partly observe. Working with materials like these force one to take the perspective of the matter into consideration in order to collaborate together with it. This holds for engaging in operations with computer vision as well, but in this case, the inaccessibility and closure of the machine becomes more evident. The images living amongst us today are therefore even more evident as collaborations between different machines, where humans are only one of them. Paglen's series shows how images can be constructed by non-human machines to the degree that they become highly strange and uncanny to us. Images are increasingly marked by this non-human creativity, learning from other images in order to create something new and hitherto unseen and unthought by the human.

5 Concluding remarks

Through the different works in the *Adversarially Evolved Hallucinations*, Trevor Paglen displays some of the ways in which computer vision systems perceive the world. These systems are assemblages of human and non-human machines composed of different materials, ideas, technologies, and actants. *Vampire* shows that computer vision sees in collaboration with humans that feed them the datasets necessary for the network to learn to recognize objects. In this work, it becomes evident that the provided input has great importance in shaping how and what the computer sees. In the formative process of selecting what to feed the computer, human values and bias are involved when ordering the world into categories. The infinitely complex world is quantified into datasets and taxonomies which the computers are operating on. To be able to decide what the computer can know of the world is to have the power over the interpretations of the machines and the meaning of its images. It is, therefore, reason to believe that these systems have a distinctly different way of seeing than humans. Computer vision perceives the world through strict categories constructed by humans, where ambiguity is nonexistent. Their vision is one of calculations and statistics, where the average is becoming the norm which things are measured in relation to. For humans, on the other hand, the meaning of images is something unstable that is open to change and different interpretations. Meanings do not have to be fixed but are rather fluid. In a work like *Vampire*, the computers insistence of what it depicts becomes absurd for a human spectator. The network strives to make an image that fit the category of vampires, measured by the blueprint that is the images in the dataset. These systems do probably not possess the abilities to understand more creative and imaginative visual concepts, as allegories, metaphors, and emotions. Computer vision has neither the same abilities to understand contexts. They are instead seeing through pattern recognition and calculation where they can identify individual objects, but not the larger whole. This must be said to be a limited form of vision compared to humans, as these systems do not have the same particular visual capacities of advanced interpretation of what we see. Instead, the network has to make assumptions of what is statistically most likely to fit the category based on the datasets that include human values and bias.

At the same time, computer vision has powerful abilities to interpret large amounts of input of categories it knows, that by far precedes that of humans. It can store enormous quantities of information in a database and process an immense number of images. Computer vision can

also distinguish patterns that we cannot see, by comparing numerous images to each other at a scale unmanageable for humans. Terms like artificial intelligence and neural networks then become rather obscuring, as it implies an understanding of the systems through the human. It is clearly a form of vision and intelligence, but one that is distinct from humans. Computer vision reminds us that human vision is not the only form of vision, and to simply measure it in terms of the human will not give a sufficient understanding of it. The non-anthropocentric and speculative machine-theory of Levi Bryant has proven to be a helpful tool to explore these works. It has allowed understanding the systems on their own terms, where its technological specificities are structurally open and operationally closed to various inputs. Through the work *Rainbow*, this thesis has explored how these systems operate with images in a form that is invisible to humans. The networks are relying on information in the form of data, where images are only translated to a human form if it's asked to do so. *Rainbow*, and the other works in the *Adversarially Evolved Hallucinations* are investigations in what can be made visible of these otherwise invisible systems. This image shows how such a hallucination of the computer that is generating an image visible to humans is creating a limited interface to the underlying machinic operations. This is an image that we can not fully comprehend as a traditional image. Here, the direct relation to the world is obscured by being analyzed and operated on as information in the computer. *Rainbow* is thus not a representation of the world as we are used to, but is closer to a statistical model, where only bits and pieces of the information of the computer is actualized into an image. By visualizing these operations, Paglen shows how these are completely different forms of images and vision than we are used to, but that we can see a fraction of the processes of the machines. This implies a shift in how we understand images, from representations to calculations. *Rainbow* is a way of showing how computer vision sees and to what degree its operations can be visualized.

In *A man*, the computer is observing us, the human. This forces us to try to see from the perspective of the computer looking at us. This demands that we see ourselves from the outside, through the perception of the computer. The work displays how the human is not understood any different than other objects and phenomena in the world. Instead, the human is perceived in the same way as everything else, as information that the system observes and tries to make sense of. The work implies an understanding of media that correlates to contemporary non-anthropocentric philosophies that seek to understand the human and the relations between things in the world in new ways. It opens up to look into what the technologies, beings, and things, wants and needs, and how it operates differently according

to various input. *A man* sees the human in a similar way, as a machine, a medium that exists at the line as everything else. It exhibits how we are not the primary actant in the world, but that we also are watched and affected by other machines. The work shows us a glimpse of the world from the perspective of the sensing systems that surround us. These systems monitor us and want to gather as much information as possible about us. As *Vampire* indicate, the technologies open up for many new uses in the domain of our private lives. These systems are most effective when they operate on large scales, which favors only some corporations and institutions that are able to use these systems at a planetary scale. This means that the technological particularities shape how humans apply the systems as well as we are affecting it. Through its operations, computer vision is are impacting an increasing part of our lives and societies. By being normative, predictive, observing, and controlling systems, they condition our behavior, perception, sight, and societies.

These implications cannot be explained simply through human ideology and power structures but must be assigned to the combination of many different machines. The distribution of human power is indeed affecting these systems through the input and some of the applications. As technological media that operates in our societies, computer vision govern human experience and understanding. By instead understanding the systems in a non-anthropocentric way, it becomes possible to see that the machines have some agency themselves, and are affecting the system and its uses. By constructing a computer vision system, Trevor Paglen is showing how there is possible to make such systems also for smaller actors that can use it in new and alternative ways. The *Adversarially Evolved Hallucinations* also exhibits some of the problems of computer vision. It has a long history of development and is seemingly working at a high level, and is applied in an increasing amount of areas that are impacting our societies. Paglen's project points out in various ways that there are social consequences of these systems that have not been thought of and that has to be taken into account. Computer vision has been launched at a large scale, but Paglen's series shows that it still is a form of an experiment that we really don't know the outcome of. Paglen shows how human selections are inherent to this system and that the selection of which images to give the computers and what classes the images are put in. We trust the people that make these systems, but the systems are not neutral but constructed. Through the series, he brings attention to this, and by visualizing how computer vision sees, what it looks like, how it is structured and how it functions, Paglen gives us an opportunity to see the world we live in and how it might be different. In opposition to the actors that are using these technologies for the

accumulation of capital or surveillance, Paglen's project is democratic and informative, and not in the interest of seeking profit. The works open up a small visible space of computer vision which we can interact with and that can help us speculate in how these systems can be applied to be for the best of society, and what can be done to make computer vision more fair and ethical.

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Illustrations

Fig.1: Paglen, Trevor. *Vampire* (Corpus: Monsters of Capitalism). Dye sublimation metal print. 152.4 x 121.9 cm. 2017.

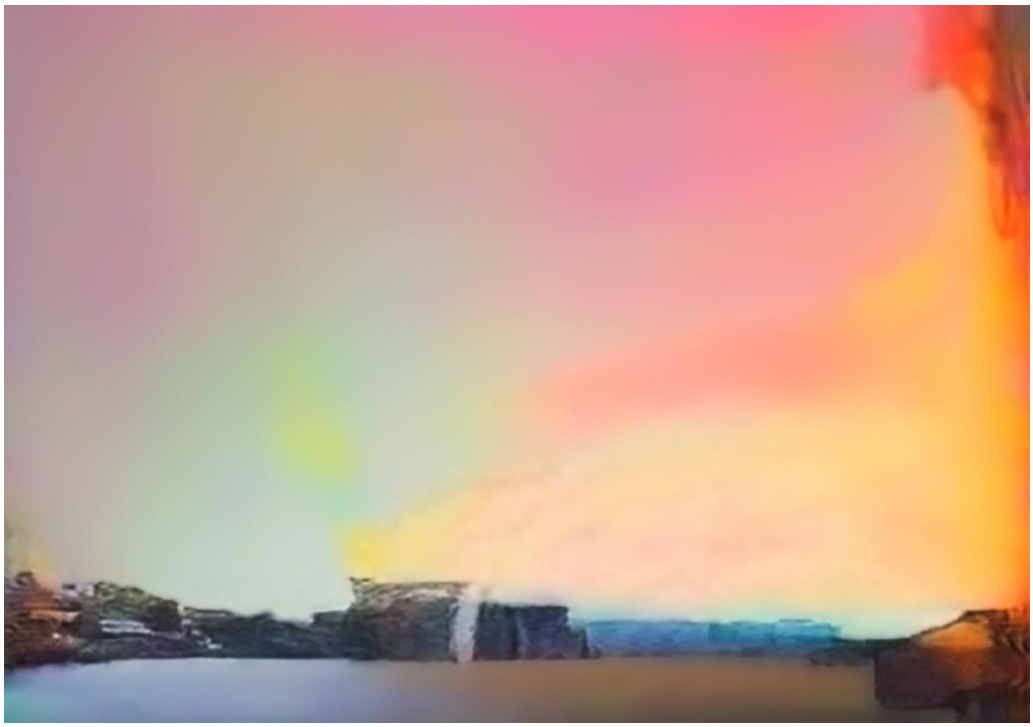

Fig. 2: Paglen, Trevor. *Rainbow* (Corpus: Omens and Portents). Dye sublimation metal print. 54.6 x 68.3 cm. 2017.

Fig: 3. Paglen, Trevor. *A Man* (Corpus: The Humans). Dye sublimation metal print. 121.9 x 152.4 cm. 2017.