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Modes of Expression in Artworks Involving Computational Processes

with an Emphasis on Neural Networks

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by

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1. Introduction: Creating Images Through Computation

Humans have always made marks to express themselves. From stone carvings and cave paintings to brush and pigment on paper, tools are instrumental in producing marks. *Oracle bone script*, one of the earliest forms of written language, is a pictographic language often carved onto turtle plastrons. During the Shang dynasty in China, it was often used for divination purposes. Aboriginal people used painting as a way to pass down the knowledge of their land and their beliefs to their descendants. Aforementioned marks served as mediums for the communication of one's thoughts and feelings. While they also served practical functions as records, the marks can be considered a type of expression.

Computational media are recent additions to the historical collection of expressive tools. *Sketchpad*, created in 1962 by Ivan Sutherland, is one of the earliest examples of dedicated systems for computer-aided drawing.[1] The prime innovation of *Sketchpad* is its ability to use drawing as an interface to communicate with the computer. Sutherland states in "Sketch Pad a Man-machine Graphical Communication System" that Sketchpad made it possible to "converse rapidly through the medium of line drawings."[2] It eliminated the need for "typed statements"[3] in favor of the *light pen* for generating electric circuit diagrams, mechanical drawings, and even animations. Much like with modern drawing tablets, the user was able to hold up the light pen to the screen

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[1] Ivan E, Sutherland. "Sketch Pad a Man-machine Graphical Communication System." *Proceedings of the SHARE Design Automation Workshop on - DAC 64*, 1964. doi:10.1145/800265.810742.

[2] Ibid, 329.

[3] Ibid.

to input position coordinates. The “instant facility” of *Sketchpad* also enabled “one to draw any symbol and duplicate its appearance anywhere on an object drawing at the push of a button.”[4] This feature is a good example of the advantages computational drawing methods may have over earlier technical drawing methods. In this calculation-based environment drawing perfectly regular geometric shapes has a very low cost. The repetition of shapes which can take countless human hours to draw is no longer a daunting task[5] when performed with the computer. In the paper which introduced *Sketchpad*, Sutherland put the efficiency and advantages of drawing in this mode into perspective: “It took about one half hour to generate 900 hexagons, including the time taken to figure out how to do it. Plotting them takes about 25 minutes. The drafting department estimated it would take two days to produce a similar pattern.”[6] Unlike the faint smudge of pencil marks that remain after the eraser has been used, digitized drawing allows us to make perfectly clean changes an infinite number of times.

Sutherland’s *Sketchpad* was revolutionary at the time[7] but is commonplace for a contemporary reader. Many of its functionalities and advantages have been translated into digital drawing software such as *Autodesk AutoCAD* and *Adobe Illustrator*. By means of a drawing tablet, we are able to digitize the strokes of the hand and apply on them commands such as Ctrl+C (copy), Ctrl+V (paste) and Ctrl+Z (undo). Digital brushes, compared with their physical counterparts,

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[4] Ibid, 341.

[5] There is value in manually carrying out this daunting task too, as can be seen in works such as *Untitled (Ocean)* by Vija Celmins.

[6] Ibid, 341.

[7] It had been said that Sketchpad was influenced by interfaces used in radar and the S.A.G.E (*Semi-automatic Ground Environment)*.

generate marks that are more regular and less noisy. While it takes more effort to draw precisely rather than in free form in the physical world, the opposite is perhaps true in the virtual world. It takes a smaller amount of code to draw a perfectly straight line compared with the amount needed to draw an irregular curve. The scratch patterns that accumulate on the desk as it is used and the dust that falls on the floor as time passes are independent of the user's intensions. However, to represent the same through a painting software or a 3D modeling software, the artist chooses to draw in the individual scratch marks and grains of dust. It can be said that the default level of entropy in the computational space is much lower than in the physical world. However, despite the differences in the process of drawing and painting, such as the freedom to make changes and the ease of repetition, many of the resulting visuals are not significantly different from those produced by earlier modes of creation. Their function and value is primarily based on expediting the drawing process and increasing the possibilities of integrating the results into other software.

There are other ways in which computers have had an impact on drawing and painting. Manfred Mohr, a pioneer of digital art, describes his practice as using "computer as a PARTNER."[8] More specifically, he "accepts that creative work is an algorithm which represents a human behavior in a given situation."[9] By devising his "own aesthetic parameters"[10] and "relying on the computer to show [..] large variety of possibilities"[11] it generates results that are "lying [..] outside of nor-

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8 Manfred Mohr, "Statement," in Manfred Mohr, *Computer Graphics — Une Esthétique Programmée* (Paris: ARC/Musée d'art moderne de la Ville de Paris,1971), 36.

9 Ibid.

10 Ibid.

11 Ibid, 40.

mal behavior but not outside of the imposed logic."[12] Mohr also emphasizes that "since the most important point in applying a computer to solve aesthetic problems is the [..] use of this instrument, the research therefore should assume that old techniques of drawing and imagination are not to be imposed on the machine (although this would be possible), but should develop a priori a vocabulary which integrates the computer in the aesthetic system."[13]

What does it mean to "develop a priori a vocabulary which integrates the computer in the aesthetic system"?[14] In this paper I aim to investigate precisely this question and also ponder what insight may be gained by examining that 'vocabulary'. Before we embark on this journey, one important point should be made. While this paper compares and contrasts the human mind with computer processes, it does not equate them. In current popular culture, analogies between the human brain and the central processing unit of a computer are commonly made. This paper acknowledges that the biological and neurological processes that underlie the wonder of the human mind still remain largely unknown and unexplored. They are fundamentally different from the operations of electric circuits that comprise a computer. Humans invented computers, and human thinking has shaped the design and architecture of the computer. It is therefore difficult to talk of computers and their intelligence as an entity completely severed from human beings. While there may be benefits in viewing them as separate entities that can hold conflicting interests from us, this paper will consider computers as an extension of human perception and knowledge.

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[12] Ibid.

[13] Ibid, 36-40.

[14] Ibid.

There are four main parts in this paper. In "Human Perception and Machine-mediated Perception," links between human perception and machine-mediated perception are explored. It starts with a brief tour of human perception and its relationship to the human body, then explores the quality of associations possible through machine learning, followed by comparing and contrasting machine associations with processes of the human mind. In combination of that analysis, I clarify what we can learn from how our perception as active and mobile animals differ from that of a machine, and that machine-mediated perception can also act as a mirror that allows us to peer into the digitally integrated beings that we are starting to become.

"Surrealist Methods of Creation and their Connection to Machine Association" explores parallels between machine based operations and surrealist methods of creation. It starts with a short introduction of Surrealism, Surrealists methods and Freud. The rest of the chapter analyzes the similarity and differences of surrealist methods and machine based operations, posing the question, "what can be gained from considering machine based operations as an extension of human abilities and thoughts?"

"Traditional East Asian Painting and Image Classification Neural Networks" is devoted to forming parallels between traditional East Asian paintings and image classification neural networks. Scattered perspective is introduced as an example of a technique that shares similarities with the image processing methods of many common neural networks.

The last main part focuses on the author's work 石 *(Rock),* 财 *(Wealth),* 壶 *(Kettle),* 笔 *(Writing brush),* 松 *(Pine)*. This chapter is a documentation on the methods used to generate the work. Both conceptual and technical aspects of the work are documented in a loosely chronological order.

2. Human Perception and Machine-mediated Perception.

Machine-mediated perception involves perceiving through instruments that are not biologically integrated into our body. Some examples of machine-mediated visual perception include digital cameras, telescopes and infrared thermography. In order for humans to perceive the data, it has to go through processing of our biological senses. In that way, machine-mediated perceptions are secondary perception inputs. It converts information we cannot biologically detect into a type of information we already know how to process. This translation process determines how we perceive the data intuitively. Inversely, our perception and thought process can also be influenced by integration of the machine-mediated perception into our senses.

2.1 Human Perception and its Relationship to Human Body.

Human perception and machine-mediated perception are intricately linked and are capable of affecting each other. For a person who works with mechanical tools, it is difficult to clearly denote where the machine begins and human ends. However, one key difference is the latency involved and degree of separation from human biology. In *Action in perception*, Alva Noë argues that human perception requires motion, and it is reliant on our sensorimotor abilities: "Perceptual experience acquires content thanks to our possession of bodily skills. What we perceive is determined by what we do (or what we know how to do); it is determined by what we are ready to do. [..] we enact our perceptual experience; we act it out."[15] Noë gives a few examples of action as an essential part of our perception: "An object looms larger in the visual field as we approach it,

[15] Alva Noë. *Action in Perception*. Cambridge, MA: MIT Press, 2006, 1.

and its profile deforms as we move about it. A sound grows louder as we move nearer to its source. Movements of the hand over the surface of an object give rise to shifting sensations. As perceivers we are masters of this sort of pattern of sensorimotor dependence."[16]

Human vision, for example, is intricately linked with the human body and its sensorimotor ability. A photograph taken with a camera can remain the same regardless of the viewer's position. That is rarely true for biological human vision. It is near impossible to separate human vision from the human body without mechanical equipments. Furthermore, human vision relies on our ability to move. To illustrate his point Noë introduces the term "Perspectival Properties (or P-properties), which refers to "the apparent shape and size of objects."[17] P-properties is a snapshot of the visual stimulus perceived from a given point in space, akin to how a photograph may portray an object. He states:

> "To see a circular plate from an angle, for example, is to see something with an elliptical P-shape, and it is to understand how that perspectival shape would vary as a function of one's (possible or actual) movements with respect to the perceived object. We see its circularity *in* the fact that it looks elliptical from here. We can do this because we understand implicitly that circularity is given in the way *how things look with respect to shape* varies as a result of movement."[18]

Following that line of inquiry, Noë concludes that "To see the actual size of a thing is to see how its perspectival size varies as we move."[19] Furthermore, Noë argues that "If perception is in part constituted by our possession and exercise of bodily skills [..] then it may also depend on

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[16] Ibid.

[17] Ibid, 83.

[18] Ibid, 84.

[19] Ibid.

our possession of the sort of bodies that can encompass those skills, for only a creature with such a body could have those skills. To perceive like us, it follows, you must have a body like ours."[20]

2.2. Machine Learning as a Way of Perception

Consider machine learning algorithms as an extension of human abilities. How does perceiving the world through the lens of machine learning algorithms alter the quality of our perception? If we were to adopt Noë's theory of perception, then it follows that the sensorimotor ability of the perception unit shapes the quality of the information perceived. Most classification machine learning algorithms lack the ability to process sensorimotor abilities directly. While the images of the object it operates on are taken from varying angles and scales, and thus capture the numerous possible "P-shapes" of the object, information on the specific human bodily movement required to access that particular visual stimulus is not available to the algorithm. In other words, the knowledge that comes from experiencing the object at a certain scale relative to our body and processing the way the "P-shape" changes according to our movement is not considered by the algorithm.

Furthermore, machine learning algorithms lack access to information about our physical and biological interactions with the object. While "[f]or the active animal, the ground is directly perceived as walk-uponable, and the tree stump as sit-uponable[,]"[21] a computer cannot and does not take our experiential perception of "walk-uponable"-ness and "sit-uponable"-ness into account.

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[20] Ibid, 25.

[21] Alva, Noë. *Action in Perception*, 21.

Machine learning algorithms, lacking a sense of touch and a desire to forage for food, are not capable of incorporating the firmness and the juiciness into its definition of a tomato.

Observing the object through a machine learning algorithm, thus, can be interpreted as perceiving the object largely outside the shape and scale boundary set by the human body. It can also act as a way to observe an object in relative separation from our physical and biological relationship to it. Moreover, "[v]isual experiences do not present the scene in the way that a photograph does. In fact, seeing is much more like touching than it is like depicting."[22] Since sensorimotor ability and human perception are inseparably linked, it can be argued that the dimension of time is inherent in human vision. Furthermore, Noë states that "the nature of the camera-electrode system"[23] used, for example, to make the dataset for machine learning algorithms "is so different from that of the eyes-brain system that there must be tremendous low-level sensorimotor differences; that is, the effects of movement on low-level details of sensory stimulation is enormously different in the two cases."[24]

As we integrate an increasing number of digital devices and software into our daily lives, our perception of the world becomes more and more influenced by the architecture of the digital technologies. The proportion of time machine-mediated perception plays a more dominant role in our perception has increased dramatically. We are growing ever more accustomed to seeing the world through the lens of a digital camera mediated by light sensors. An increasing proportion of

[22] Ibid, 72.

[23] Ibid, 115.

[24] Ibid.

an average person's day involves looking at pixels of some type, whether on a computer screen or printed on a paper. Humans designed modern computer architecture to be able to depict a pragmatic representation of our world. However, through our interaction with the computer, it in turn affects our perception in ways that are both subtle and not so subtle. Whichever side a person is on in the debate about good or evil technology, it is hard to deny that digital technology has infiltrated our lives and is shaping how we interact with the world. Therefore, I propose that there is value in works that aim to intuitively express the digital-device mediated perception. As much as we can learn from how our perception as active and mobile animals differ from that of a machine, machine-mediated perception acts as a mirror that allows us to peer into the perception of the digitally integrated beings that we are starting to become.

3. Surrealist Methods of Creation and their Connections to Machine Learning Associations

3.1 Brief Introduction to Surrealism and Surrealist Methods

André Breton, the founding figure of Surrealism, states the following in his *Manifestoes of Surrealism* (1924): "I believe in the future resolution of these two states, dream and reality, which are seemingly so contradictory, into a kind of absolute reality, a surreality, if one may so speak."[25] Peering into the unconscious through dreams and automatic processes can be said to be the crux of surrealist practices. Literary critique Maurice Nadeau states in "The History of Surrealism" that Surrealism was a "literary-artistic activity that centered in Paris in the Twenties."[26] Its roots were in Dadaism. Dadaism aimed to present lack of logic and meaning as valid expression. Nadeau describes Dadaism as "an art movement formed during the First World War in Zurich in negative reaction to the horrors and folly of the war. The art, poetry and performance produced by dada artists is often satirical and nonsensical in nature."[27] Surrealism was also significantly influenced by the thoughts and methods of Sigmund Freud, the founder of psychoanalysis. Breton wrote: "Completely occupied as I still was with Freud at that time, and familiar as I was with his methods of examination [..] I resolved to obtain from myself what we were trying to obtain from [patients], namely, a monologue spoken as rapidly as possible, without any intervention on the part of the critical faculties [..] unencumbered by the slightest inhibition [..]."[28] This inves-

[25] André Breton. *Manifestoes of Surrealism*. (Ann Arbor, MI: Univ. of Michigan Press, 2012), 14.

[26] Maurice Nadeau. *The History of Surrealism*. Cambridge, MA: Belknap Press of Harvard University Press, 2000, 12.

[27] Tate. "Dada – Art Term." Tate. Accessed March 27, 2019. https://www.tate.org.uk/art/art-terms/d/dada.

[28] André Breton. Quoted by: Mark, Polizzotti. *Revolution of the Mind: The Life of André Breton*. Place of Publication Not Identified: Black Widow Press (Massachusetts), 2010, 104.

tigative method through automatism is the root of and the inspiration behind one of the most characteristic Surrealist method of creation—automatic writing.

However, as the interests of the central figures of Surrealism became dispersed through drama and politics, what surrealism came to represent became less clear. In *History of Surrealism* Nadeau states that “[e]x-members and competent critics cannot agree even whether the movement was essentially pessimistic or optimistic in the face of decaying values.”[29] Therefore it will be most useful here to focus on the parts of surrealism that form most fertile connections with the topic of computational processes.

3.2 Analysis on Surrealist Methods and Computational Processes

“The final goal” of surrealism is stated to have been “the reconciliation of two hitherto warring realms: man and the world.”[30] Do humans rule the world or are they ruled by it? Are humans part of the world or should they be considered to be a distinct and special entity? Similar questions can be asked about the relationship between humans and machines. As the abilities of machine intelligence increase at an unprecedented rate, the machine’s autonomy has become a topic of fervent debate in popular culture.[31]

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[29] Maurice Nadeau. *The History of Surrealism*. Cambridge, MA: Belknap Press of Harvard University Press, 2000, 12.

[30] Ibid, 80.

[31] Cadie Thompson. "Here's the Real Reason Artificial Intelligence Could Be a Threat." Business Insider. September 17, 2015. Accessed March 27, 2019. https://www.businessinsider.com/autonomous-artificial-intelligence-is-the-real-threat-2015-9.

Nadeau states that surrealist methods of investigation brought the creators "power that they did not know they had, an incomparable freedom, a liberation of the mind, an unprecedented production of images."[32] As explored in Chapter 2, machine-mediated perception such as machine vision and image processing can be said to give us freedom to see from a perspective distanced from the human body. As more technology becomes available, the more "unprecedented production of images" becomes possible. Surrealists believed that succumbing to processes of automatism gives us freedom to discover "continents which had not yet been systematically explored: the unconscious, the marvelous, the dream, madness, hallucinatory states,"[33] namely the "other side of the logical decor."[34] The same line of inquiry can be made for machine-mediated perception. What knowledge can be gained through observing the world through the information acquiring methods unique to the computational architecture?

Consider the surrealist object. Nadeau defines it as "any *alienated* object, one out of its habitual context, used for purposes different from those for which it was intended."[35] He gives the example of a banal bottle-rack, stating that it can "confer upon it artistic value by isolating it from its habitual context, oblige others to consider it in itself and to forget its purpose, and you have created a strange object, catalyst of a host of unconscious desires."[36] Then consider an image generating machine learning algorithm. Algorithms such as Deep Convolutional Generative Adversar-

[32] Maurice Nadeau. *The History of Surrealism*. Cambridge, MA: Belknap Press of Harvard University Press, 2000, 82.

[33] Ibid, 80.

[34] Ibid, 80.

[35] Ibid, 185.

[36] Ibid.

ial Networks (DCGANs) typically takes hundreds and thousands of images of certain types of selected objects and learns from them through a series of calculations. The algorithm itself does not have any clue as to what the "habitual context" of the object is. The "habitual context" is based on lived human interaction with the object, and the algorithm for the most part does not have access to it. Furthermore, the images that the algorithm uses to learn from flattens the three dimensional object into rows of pixelated color values. Qualities of these methods can be thought of as considering the object "in itself and [..] forget[ing] its purpose."[37] The images of the object, processed through the algorithm as collections of color values, become devoid of its human designated purpose. But a question remains. In place of "unconscious desires," what is revealed by this machine mediated process and what makes it important for humans to examine? As quoted from Nadeau earlier, object taken out of human context becomes a "catalyst of a host of unconscious desires." It can be considered that images generated by computational processes such as neural networks are pushing the capability to function as a "catalyst" even further along.

However, it is worth considering if computational methods are too far removed from the organic functions of human neurology to be able to spark in us the 'unconscious desires' as in Surrealist works.

In "Artistic Genesis and Perspective of Surrealism," Breton, lists four points as qualities of a surrealist work. The first is the 'absence of contradiction.'[38] Breton seems to be referring to "resolution of these two states, dream and reality, which are seemingly so contradictory, into a kind of

[37] Ibid, 185.

[38] André Breton, Watson Simon. Taylor, and Mark Polizzotti. *Surrealism and Painting*. Boston: MFA Publications, 2002.

absolute reality, a *surreality*."[39] A work which has this quality would be a blend of reality and dream, a world in which seemingly contradictory things can coexist in the external world. The architecture of software does not allow for contradiction. A set of rules dictated by mathematics, convention, and pragmatism define the value and legitimacy of each software statement. Concepts in the external world are redefined in code in a manner that reflects human perception of them. A computational object can hold two opposing descriptors such as 'hot' and 'cold' from the external world. However as long as the rule of the software allows for it, the contradiction in the computational world does not exist. The software does not fundamentally distinguish between the two polar concepts as does the external world. To the machine, all the encoded concepts are different combinations of 1's and 0's.

The lack of a sense of time is another important aspect of Surrealism according to Breton. Modern computers operate in a drastically different timescale than humans do. This causes humans to experience a disrupted sense of time akin to timelessness when operating in the computational realm. An average desktop-grade CPU in 2018 has a clock rate of about 3GHz. It can be roughly converted to handling about 3,000,000,000 instructions per second. These instructions can include addition, subtraction, multiplication, division, value comparison and moving information from one place in memory to another. Compared with arithmetic calculation performed by humans which occur on the scale of seconds, one computational instruction occurring at the scale of 0.000000001 seconds can be said to be atomic. Furthermore, the digitized information is not perishable as long as the hardware that supports that illusion of performance is maintained. The

[39] André Breton. *Manifestoes of Surrealism*, 14.

method of input and output of that data is subject to obsolescence but what the data is fundamentally, the 1's and 0's, are designed to exist indefinitely without any degradation.

Breton lists 'replacement of external reality by psychic reality obeying the pleasure principle'[40] as another quality of a surrealist work. In the computational world, the entities of the external world are replaced by their abstracted version that reflects human perception and desire. The act of creating a version of the external world that reflects almost only entirely human perception and desires then can be considered an egocentric, and as an extension, a narcissistic act. Freud states "human narcissism wants to believe we were predestined to succeed, shaped by a human-like god. Too many of our identities are based on the mistaken belief that we were somehow 'chosen'."[41] While this claim may not be applicable to all cultures, it without doubt is present in many. As 'many of our identities are based on'[42] these narcissistic beliefs, it can be inferred that human psychic reality in large part consists of those beliefs. Software, as many other human inventions, is a manifestation of the narcissistic desires. Being able to create and enforce a set of rules of one's choosing and manifesting in the physical world in some form can be considered as an exercise of the narcissistic belief. In other words, the computational world provides humans the ability to redefine the concepts in external reality according to one's own perception, desire, and need and enables one to operate in the space created by them.

[40] André Breton, Watson Simon. *Surrealism and Painting*, 2002, 68.

[41] Sigmund Freud, and William D. Robson-Scott. *The Future of an Illusion*. London: Hogarth Press, 1962, 100.

[42] Ibid.

The argument made above is certainly not without loopholes. Humans are by no means omnipotent in the computational playground. Computational worlds are still affected by the laws of mathematics and physics despite the insulation of abstraction. Hard drives can fail and data can be lost. One can also argue that data cannot be purely thought of as 1's and 0's without including method of input and output with the external world and as such data should perhaps be qualified as perishable.

Furthermore, Breton referred to the surrealists as 'dreaming philosophers'. Can one apply words such as "dream" and "the unconscious" to a computational system that is not sentient? Art critic and theorist Rosalind Krauss states in *The Optical Unconscious*: "Freud, [..] is clear that the world over which technical devices extend their power is not one that could, itself, have an unconscious."[43] If we strictly define conscious and unconscious as pertaining to humans or as compatible with human subjectivity then software cannot be surreal. However, in "The Work of Art in the Age of Mechanical Reproduction" (1936) Walter Benjamin provided an alternative, wider definition of the unconscious. Through the example of the camera, Benjamin suggested that techniques such as slow motion can reveal 'familiar qualities of movement but [also] reveal in them entirely unknown ones.'[44] He continues: "The camera introduces us to unconscious optics as does psychoanalysis to unconscious impulses."[45] What does 'unconscious' used in this manner entail? On the surface it can be explained as merely revealing information about the external

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[43] Rosalind E. Krauss. *The Optical Unconscious*. The MIT Press, 1994, 179.

[44] Benjamin, Walter, Harry Zohn, and Hannah Arendt. *Illuminations: Essays and Reflections*. Boston: Mariner Books, Houghton Mifflin Harcourt, 2019, 236.

[45] Ibid, 237.

world that we previously didn't have access to. In the specific case of software, because of its unique position as an extension of the human desire for categorization and reasoning, the information that it reveals can cast light onto human as creatures of logic.

When working with software, moments of surprise often happen. The effect is at all times deterministic and one can always trace the software line by line to find out the reason behind the effect. Yet, despite its deterministic and logical nature it still comes as a surprise to the human observer. The digital artist Manfred Mohr describes this mode of working as follows:

> The logic built into a program makes it possible to create a nearly infinite number of new situations. This is very important since the creation of a form is limited a priori by its author's characteristics, of which he may be conscious or unconscious. It means that the exploration of a new idea leads sooner or later to a repetition which can be avoided by resorting to a computer once the basic parameters have been formulated. As it is possible to conceive the logic of a construction but not all its consequences, it is nearly an imperative to rely on a computer to show this large variety of possibilities; a procedure which may lead to different and perhaps more interesting answers, lying of course outside of normal behavior but not outside of the imposed logic.[46]

The part of software generated outcomes that 'l[ie] [..] outside of normal behavior'[47] can be seen as a surprise to the human observer. This outcome, by the virtue of being software generated, is a part of the 'imposed logic'[48] composed by the artist. These effects can be seen as manifestation of human abstraction and logic amplified to an extreme beyond the point of intuitive understanding. Perhaps using these moments as mirrors, we are able to peer into parts of ourselves that are not governed by reasoning and logic.

[46] Manfred Mohr, "Statement," 38

[47] Ibid.

[48] Ibid.

Software use is certainly not the surrealism of the twenty first century. Software does not directly reveal the human unconscious and not all artworks involving software is intended as an intro-spection into human unconscious. However, I would like to claim that all software can be seen in the light of surrealism. Surrealist qualities are accentuated when an artist deliberately exposes and utilizes the aforementioned 'moments of surprise.' Of course, I am not claiming that all software utilizing these surprises is "surrealist." It is rather, software as a medium can be argued as surrealistic and it is up to the artist to choose or not to choose to accentuate these qualities.

4. Traditional East Asian Painting and Image Classification Neural Networks

4.1 Scattered Perspective

It is impossible to capture a picture such as *Along the River during the Qingming Festival*[49] with a single shot of a camera. The 25.5 cm high and 525 cm long (10.0 in x 207 in) painting has an incredible amount of details about the daily lives of peasants in the Song Dynasty. Traditionally, scroll paintings were viewed with each side of the scroll held in each hand, slowly rolled and unrolled so that only a smaller portion of it is viewable at a given time. The movement of the viewer's eyes relative to the painting distinguishes it from linear perspective that is dominant in Western paintings during and after the Renaissance period. The type of technique that is utilized in *Along the River during the Qingming Festival* is called "Scattered perspective". "Scattered perspective" was utilized as a way of visual depiction in paintings as early as the Wei and Jin dynasties (220-420A.D.) in China. Guo Wenwei, a pioneer in Chinese seascape paintings with Jiaomo technique, states in an article[50] that "[o]nly when 'linear perspective' of Western paintings was introduced into China it [scattered perspective] was given a name, to distinguish between the two."[51] From this we can infer that scattered perspective was normal in China before visual depiction was influenced by contacts with the West.

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[49] Zhang Zeduan, *Along the River during the Qingming Festival*. 1736, ink and color on silk, 25.5 cm x 525 cm (10.0 in x 207 in). Palace Museum, Beijing.

[50] Wenwei, Guo. 论散点透视的科学性 ("Regarding the Scientific Qualities of Scattered Perspective"). *Traditional Chinese Painter*, April 2015. Author's translation.

[51] Ibid. The original quoted passage reads: 直到西画"焦点透视"传入中国，为与其区别，方得其名。 Author's translation.

The prime characteristic of scattered perspective is in its dynamic perspectival quality. Guo states: “The term ‘scattered perspective’ aptly expresses and accentuates its characteristic feature—artist’s moving perspective and observation from all angles.”[52] As the name implies, paintings that utilize scattered perspective do not depict a scene seen from a fixed point towards a fixed direction. While the lines that are integral to linear perspective are intersecting, in scattered perspective parallel lines dominate: “Unit imagery’s perspectival lines in Chinese painting utilizing scattered perspective has a parallel quality.”[53] Therefore, scattered perspective paintings can be said to have an orthographic quality. However, unlike orthographic views, scattered perspective is able to convey a sense of depth. The section of *Along the River during the Qingming Festival* with a bridge is a good example (see fig. 1).

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[52] Ibid. The original quoted passage reads: “散点透视”这一术语命名，形象地体现了画家移动视点进行全方位观照的特点。 Author’s translation.

[53] Ibid. The original quoted passage reads: 中国画散点透视单元意象的透视光线具有平行性。Author’s translation.

Figure.1. Chen Mei, Sun Hu, Jin Kun, Dai Hong, and Cheng Zhidao, *Along the River during the Qingming Festival* (Rainbow bridge section). 1736, ink and color on silk, 35.6 cm x 1152.8 cm. National Palace Museum, Taipei. National Palace Museum, https://theme.npm.edu.tw/exh105/npm_anime/AlongtheRiver/en/index.html (accessed June 5, 2019)

This section is able to convey the impression that the houses and people on the other side of the shore are further away from the people on the bridge. Compared with how this scene would have been drawn with linear perspective, the ground on the other side seems to be slightly elevated. This decision to "elevate" can be interpreted as a deliberate attempt to minimize the distortion that is present in human vision while still preserving the sense of depth. It can also be seen as an attempt to capture as much detail as possible on a piece of paper. Precisely because the ground is depicted slightly elevated, we are able to peek into the yards of the houses and see the postures of the individuals on the road rather than an indistinguishable crowd. The decision also hints at the default mode of viewing for a painting such as *Along the River during the Qingming Festival*. Just as relative horizontal displacement of position of eyes and the scroll is required to appreciate the entire painting, the choice to "elevate" can be seen as an invitation for viewers to also displace vertically—to move the scroll up and down to change the line of sight. For an imaginary person standing from a hill top looking down at such a view, this section of *Along the River during the Qingming Festival* can be said to capture all the details that the person can see moving left to right, squatting down and standing on their toes, on one two-dimensional paper.

Of course, since the Wei and Jin dynasties there have been many art movements and styles that also incorporate a non-linear or moving perspective. The flattened sense of perspective of Impressionist paintings and the combined multiple perspectives of analytic Cubism are examples from the Western parts of the world.

4.2 Similarity and Differences Between the Modes of Vision in East Asian Painting and in Neural Networks

Machine learning neural networks that involve images as datasets accepts images taken from multiple perspectives and scale. Image classification neural networks for example, accept input photographs that are labeled by the content in the photograph, regardless of which angle and scale the photograph was taken of the object. As a result, the neural network learns the distinguishing features of the category without taking into account the perspectival or scalar properties of the features. Of course, the practice of scattered perspective dominant in traditional East Asian paintings does not take variance in perspective and scale to an extreme. However, such paintings have in common the possibility of capturing more information over linear perspective.

Another common feature that many neural networks that share with traditional East Asian paintings is the non-anthropocentric approach. “Unity of Universe and Human”[54] is a central philosophy in extended Chinese cultural circle with roots in both Taoism and Confucianism. It is a holistic view that considers humans as a part of nature rather than as separate from it. As the “Unity of Universe and Human” philosophy permeates East Asian culture as a whole, it has also influenced the philosophies of painting throughout the eras. Chinese landscape painting (“Shanshui” in China and “Sansui” in Japan) is a good example. Aesthetics theorist Ken-ichi Sasaki states in “Perspectives East and West” that, “*Sansui* means literally 'mountains and waters,’ i.e. nature” and “Landscape as *sansui* is characterized by its vitalistic conception: the cosmic space is filled with *ki* a vital and spiritual element.”[55] The focus of “Shanshui” paintings is to capture the *ki* of the natural scene, “the unique or holy place that enables man to transcend.”[56] Nature comes first and human follows. This non-anthropocentric philosophy is in contrast with anthropocentrism dominant in Western paintings. Sasaki states that “in modern Western paintings, either a natural landscape or an urban landscape was introduced as the

[54] Ibid. The original quoted passage reads: 天人合一。Author’s translation.

[55] Ken-ichi, Sasaki. "Perspectives East and West." *Contemporary Aesthetics*, July 1, 2013. Accessed June 5, 2019. https://contempaesthetics.org/newvolume/pages/article.php?articleID=670.

[56] Ibid.

scenery in which human activities should be portrayed. This conception is tightly linked to the hierarchy of genres that takes historical paintings as the paradigm and represents the anthropocentrism that would dominate modern Western civilization.” Scattered perspective also strives to emphasize the philosophy of “Unity of Universe and Human”. Guo states that:

> [i]n scattered perspective, the parallelism of the unit imagery’s virtual projection line, the ratio of line of sight being of the same length, and spontaneity and expandability of space and time expressed through scattered distribution all plays crucial roles in forming the painting’s visual composition. Those three qualities enable paintings utilizing scattered perspective to hold richer scenic details and also allows them (including long scrolls) to more completely exhibit the intentionality of ‘Unity of Universe and Human’[57].

The expandability of time and space in Scattered perspective enables it to capture more scenic content and more fully manifest the philosophy of “Unity of Universe and Human” within the painting.

Visual depiction through neural networks can be considered as a type of non-anthropocentric vision. As explored in chapter 2, neural network vision is distanced from the human body and its perception. The quality of its vision results from the architecture of the computer, the format of digital images as well as mathematics and statistics that comprise the neural network. While neural network vision does not portray the *ki* of nature, it certainly encourages and enables us to see the world through a lens that is separate from the bodily confines of the human.

[57] Wenwei, Guo. 论散点透视的科学性 (“Regarding the Scientific Qualities of Scattered Perspective”). *Traditional Chinese Painter*, April 2015. The original quoted passage reads: 因为散点透视单元意象的虚拟投影光线的平行性、视线长度比例的统一性、散点分布的随意性及其时间、空间的延展性，对画面意境构图均起着重要保证作用，所以能够容纳更丰富的景物内容，能够更全面地展示(包括长卷在内)天人合一 的意象性画面。 Author’s translation.

There is also an analogy that can be made between the training process of the neural network and the "training" and "learning" process that is considered to be required of the artist to capture the nature on a piece of Xuan paper. For example, in Chinese "Shanshui" painting tradition, the artist is required to go through the process of "walking ten thousand 'li'"[58] and "reading ten thousand books"[59] to make observations of the world through a dynamic process. The ultimate goal of the training process is to overcome the "distortion" of the linear perspective and fill in the artwork with their subjective thoughts and philosophies. Therefore, "Shanshui" paintings are a result of accumulated learning rather than portrayal of what can be seen through the naked eye at that moment. The truer state of the object (and what ought to be portrayed through the artwork according to the tradition) is considered to be the combination of vision over a longer period of time and the mental state and belief of the artist. Neural networks take in tens of thousands of images and go through them one by one and finds a statistical model that represents that object the best. Coincidentally, the process is called "training" and "learning".

However, there are discrepancies in the analogy between the practices of East Asian paintings and artworks made with neural networks. The images generated with neural networks do not reflect the emotion and philosophy of the artist as directly as traditional East Asian painting. Emphasis on the high moral quality of the artist as a prerequisite for an excellent painting is also absent. Because they are missing this central property of East Asian paintings as artworks done with neural networks, they can be interpreted as less personal and emotionless. However, from

[58] Ibid. The original quoted passage reads: 行万里路。Author's translation.

[59] Ibid. The original quoted passage reads: 读万卷书。 Author's translation.

another angle the less pronounced "I" can be seen as an exploration of what is outside of human perception, or as a sign of a force pushing the work further away from anthropocentrism. Perhaps it can even be interpreted as an expression of humility and humbleness and a way to cast a new perspective onto nature and redefine the human-nature relationship.

5. 石 *(Rock)*, 财 *(Wealth)*, 壶 *(Kettle)*, 笔 *(Writing brush)*, 松 *(Pine)*

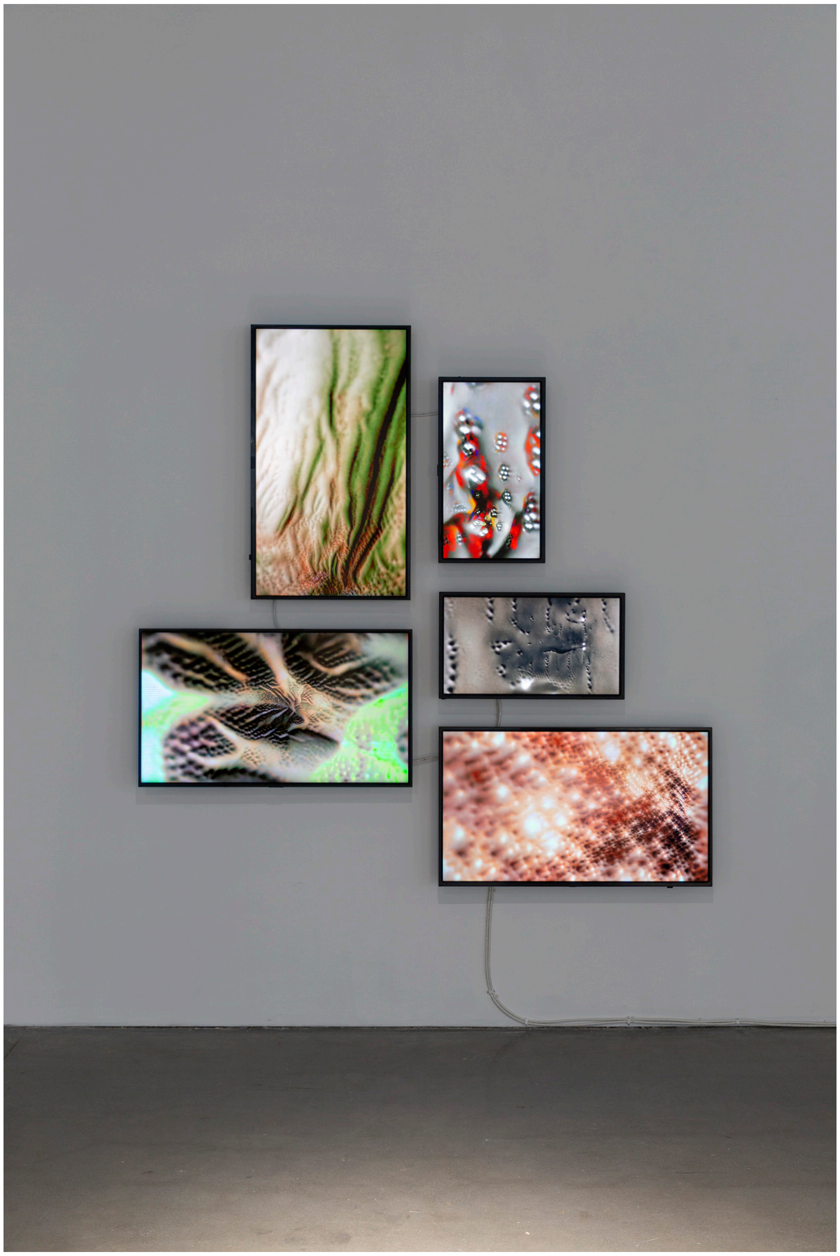

Fig. 2. 石 (Rock), 财 (Wealth), 壶 (Kettle), 笔 (Writing brush), 松 (Pine).

石 *(Rock)*, 财 *(Wealth)*, 壶 *(Kettle)*, 笔 *(Writing brush)*, 松 *(Pine)* is a video installation that references the tradition of East Asian 'still life' paintings. Five categories of objects and plants with symbolic significance in East Asian culture were depicted in the work. To create the video, thousands of photographs of the five objects and plants were taken. Those images were processed and trained on with an image classification neural network (VGGNet[60]). The resulting small images were combined through enlarging and blending to form a higher resolution image. The larger images are then recolored through Pix2pix, a Generative Adversarial Network (GAN). Finally, the recolored images were interpolated between frames to form the video.

5.1 Image Classification Network — VGGNet

VGGNet is an image classification neural network. It is typically applied to identify the content in a given image. Neural networks such as VGGNet requires a training phase to learn from the dataset provided. Through the training process, VGGNet learns the 'rules' that it can later on use to distinguish between the different objects in an image. VGGNet is most popularly trained with the 'Imagenet[61]' dataset, which is a 1,281,167 image dataset that contains photographs of 1000 classes of common objects and life-forms, including 'desk', 'bow', 'vulture' and many breeds of dogs. The 'Imagenet' dataset consists of images sourced from the internet. Each of the photograph corresponds to one category features different instances of the object. For example, the category "bow", contains 1111 images of 1111 different bows all taken from different angle, scale and lighting conditions. The objective of training VGGNet on this dataset is to learn the

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60 Very Deep CNNS for Large-Scale Visual Recognition. Accessed May 27, 2019. http://www.robot-s.ox.ac.uk/~vgg/research/very_deep.

61 "ImageNet." ImageNet. Accessed May 27, 2019. http://www.image-net.org.

visual cues that are unique to each category from information that are accessible through their digital photographs.

5.1.1 Generating Images From Image Classification Neural Network

After the training process is complete, the resulting model of the network can be used to classify images. The model trained with Imagenet will be able to take in a new image and predict which of the 1000 classes the content of the image belongs in. This process can also be run in reverse to generate new images. Instead of making a prediction about the input image, it can be slightly altered to more closely resemble the chosen class. This technique was originally developed to understand the neural network's internal process better. A post on the Google AI blog states the following regarding neural networks: "even though these are very useful tools based on well-known mathematical methods, we actually understand surprisingly little of why certain models work and others don't."[62] This technique, pioneered by the algorithm 'Deepdream'[63] is the first and one of the popular examples of these processes. The end of the article hints at the possibility of it becoming a way for artists to utilize neural networks in their artworks. Indeed, this technique has become revolutionary to artists working with neural networks. Each time the process is run, the input image is updated to better resemble the features the network learned to be specific to that class. Given enough iterations, we start to see the features emerge from the original image (see fig. 3).

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62 "Inceptionism: Going Deeper into Neural Networks." Google AI Blog. June 17, 2015. Accessed June 13, 2019. https://ai.googleblog.com/2015/06/inceptionism-going-deeper-into-neural.html.

63 Google. "Google/deepdream." GitHub. August 12, 2015. Accessed May 27, 2019. https://github.com/google/deepdream.

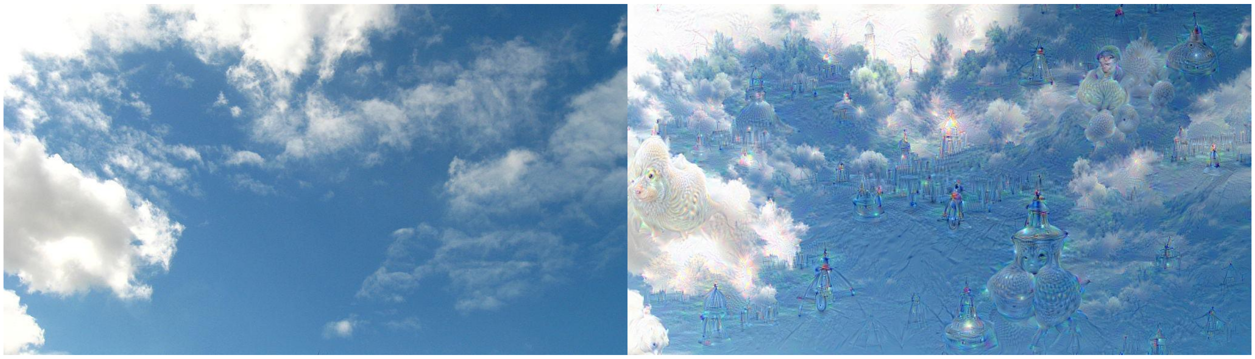

Figure 3. Example Deepdream input image (left), result image (right). Github, Inc. Accessed May 26, 2019. https://github.com/google/deepdream/blob/master/dream.ipynb

5.1.2 Dataset for 石 ***(Rock),*** 财 ***(Wealth),*** 壶 ***(Kettle),*** 笔 ***(Writing brush),*** 松 ***(Pine)***

For 石 *(Rock),* 财 *(Wealth),* 壶 *(Kettle),* 笔 *(Writing brush),* 松 *(Pine)* five categories of objects and plants with symbolic significance in broad East Asian culture were selected. An analogy can be made between VGGNet's training processes and traditional painting practice in East Asian culture regarding perspective. In contrast to more dominant approach in Western painting, traditional East Asian paintings place heavier emphasis on capturing the essence of the object or a scene. Perspectively accurate depiction of space is often of lower priority. Thus, many objects in different perspectives and scale can be seen combined in one two-dimensional paper. It is typical for image classification neural networks to be trained with datasets containing images that are taken from many perspectives and scale. This enables the neural network to learn to identify objects of a class no matter which perspective or scale the new input photograph is taken in. As a result, the visual cues that the networks learn are not specific to a fixed point and direction of view. In other words, the network learns the most distinguishing visual features of that category without taking into account the image's corresponding perspective and scale.

The dataset of 石 *(Rock),* 财 *(Wealth),* 壶 *(Kettle),* 笔 *(Writing brush),* 松 *(Pine)* is distinct from typical datasets VGGNet is trained with because of the number of featured objects in a category. Unlike datasets such as 'Imagenet', 石 *(Rock),* 财 *(Wealth),* 壶 *(Kettle),* 笔 *(Writing brush),* 松 *(Pine)* dataset features only one or a group of objects per category that are photographed repeatedly. Framed in a different way, VGGNet trained with 'Imagenet' aims to learn the common features of all instances of objects in the category, including ones that are not captured in the dataset. 石 *(Rock),* 财 *(Wealth),* 壶 *(Kettle),* 笔 *(Writing brush),* 松 *(Pine)* dataset's focus is on the particular instance of the object the artist has chosen to photograph. The characterizing visual cues captured by the trained model, therefore, will be specific to that instance of the object rather than all possible objects in that category. The generated images of VGGNet trained on 石 *(Rock),* 财 *(Wealth),* 壶 *(Kettle),* 笔 *(Writing brush),* 松 *(Pine)* can be interpreted as a type of visual perception based on convolutional neural network. It is seeing through analyzing distribution in numbers corresponding to the pixels.

Typically, the higher the number of layers in the network, the more image data is needed to train a successful model. In order to create a dataset that will work well with the 19 layer version of VGGNet to generate images, the first step in the project involved taking around 1000 photographs for each of the objects (see Fig 4, 5, 6, 7 and 8).

Figure. 4. Example ‘Wealth’ photograph.

Figure.5. Example ‘Rock’ photograph.

Figure. 6. Example ‘Writing brush’ photograph.

Figure.7. Example ‘Pine’ photograph.

Figure. 8. Example ‘Kettle’ photograph.

Each of the 1000 photographs were in turn cropped into 50 256 x 256 pixel images with variable magnification (1x to 10x) (See fig. 9).

Figure. 9. Example cropped 256 x 256 pixel ‘Pine’ images.

5.1.3 Training the neural network

Each of the 250,000 images were labeled with their corresponding category. The neural network was trained for 90 epochs, meaning it learned from each of the images 90 times throughout the entire training phase. One of the first attempts in training was highly capable in distinguishing between categories given an image, having a near perfect training accuracy of 99.9%. However, when the image-generating reverse process was applied, it generated uninteresting images (See fig. 10).

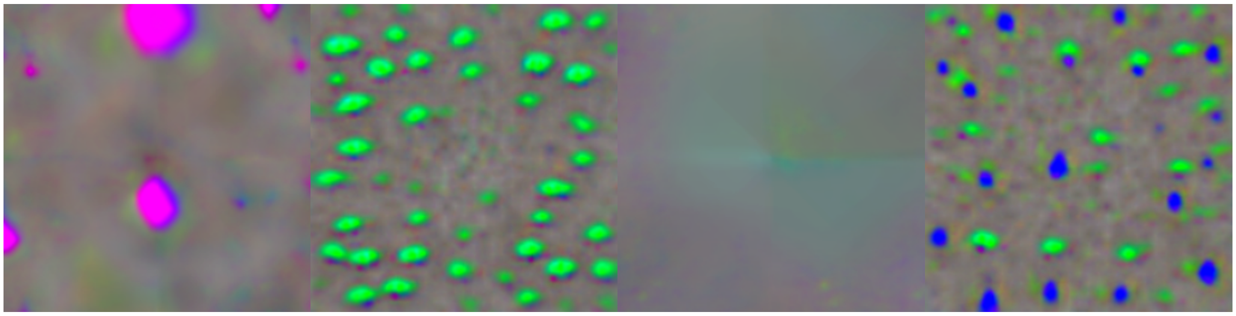

Figure. 10. Failed training generated images.

One of the most important features I wanted to capture from this process is the difference in synthesized texture of the distinct categories. Regarding this goal, these images are considered to be unsuccessful despite the high training accuracy. This unsuccessful attempt was perhaps due to the of number of categories. Since there are only 5 categories with relatively distinct color palette, the network only has to learn the color distribution differences in order to distinguish between them. A training with a hue shifted dataset was tried also, but the resulting images were similar in quality. It was only with grayscale input images that the network started to output distinct visuals for each category (See fig. 11).

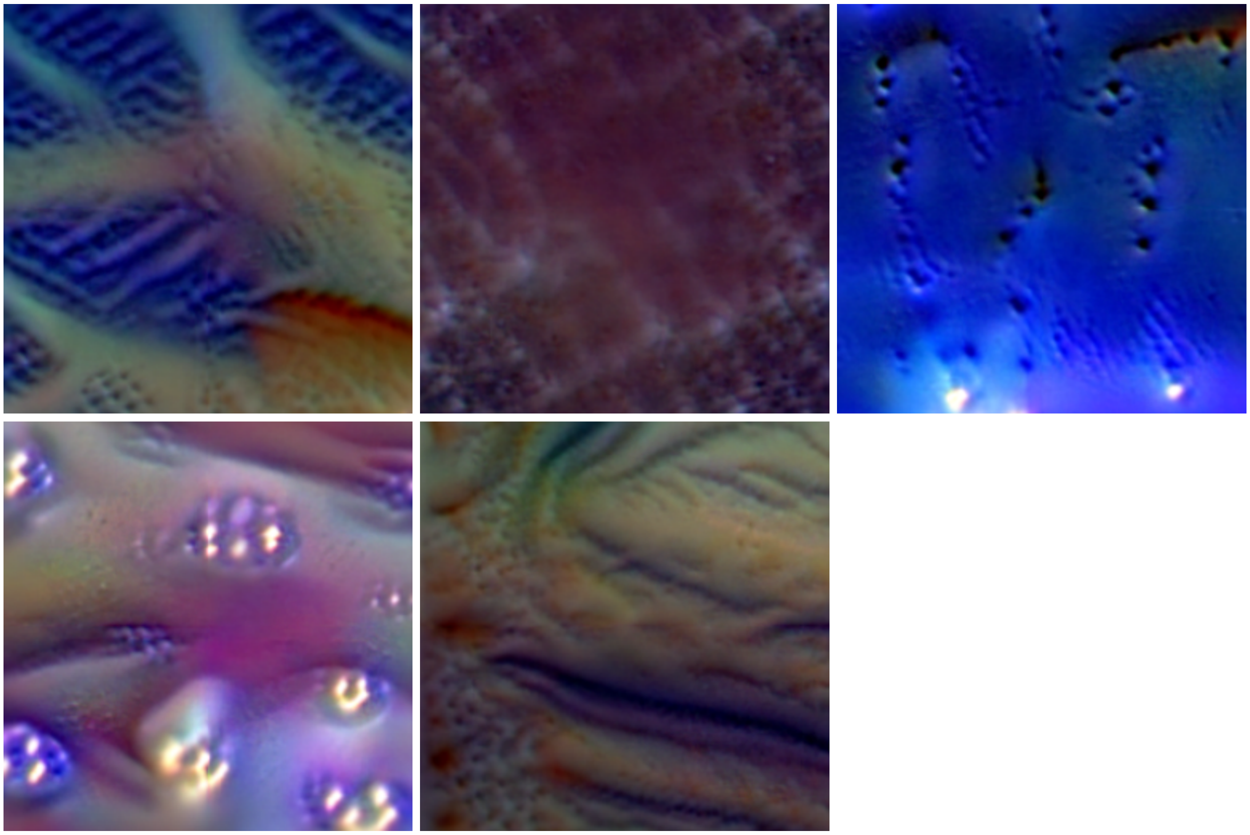

Figure. 11. Generated images from grayscale training for categories: wealth (top left), rock (top middle), kettle (top right), writing brush (bottom left), pine (bottom right).

5.1.4 Generating Higher Resolution Images From Trained VGGNet Model

In 'Deepdream', it is typical for the input image to be a photograph, as shown in the example of Figure 2. For 石 *(Rock),* 财 *(Wealth),* 壶 *(Kettle),* 笔 *(Writing brush),* 松 *(Pine)*, a 224 x 224 pixel image with randomly colored pixel was used as the starting input image. It enabled the features of the trained model to manifest without the original input image dominating the visual (see fig. 12).

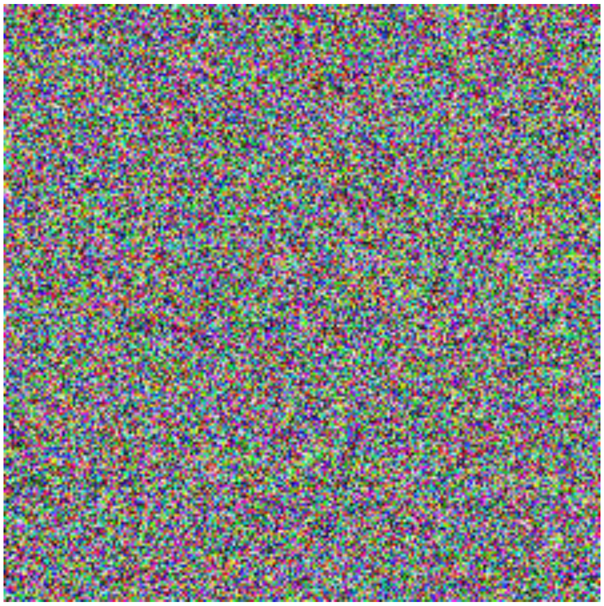

Figure. 12. Randomly colored pixel image.

The more times the process is run on the image, the more the image is altered to resemble the selected category. However, as byproduct of the process, the resulting image also comes to emphasize some strong saturated colors such as neon green, cyan, and magenta. The same emphasis in color can be seen in the majority of images generated through ‘Deepdream’. Lack of larger structure is another undesirable trait for the work that deprives the images from having a differentiated composition. Both can be remedied to an extent through enlarging and zooming in on the center portion of the image every iteration of calculation (see fig. 13, 14).

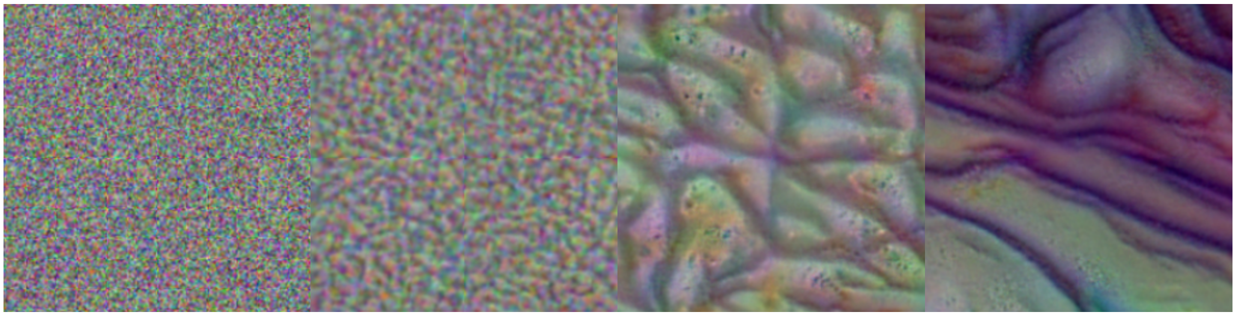

Figure. 13. Category Pine. Iteration 1, 5, 30 and 100.

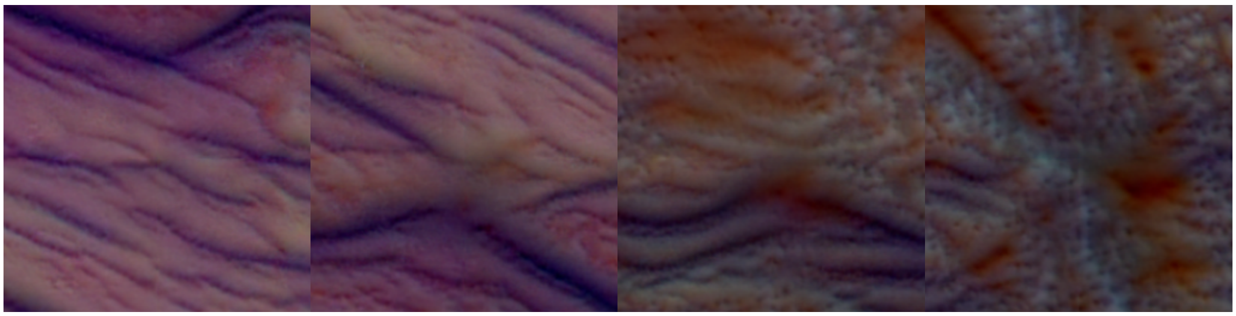

Figure. 14. Category Pine. Iteration 150, 200, 300 and 400.

Without modifying the structure of the algorithm, the output images from VGGNet are restricted to be 224 x 224 pixel. Since the change in images are not drastic from one iteration to the next, the sequence of images can be enlarged and combined into a continuous higher resolution image through help of alpha blending (see fig. 15, 16, 17, 18 and 19).

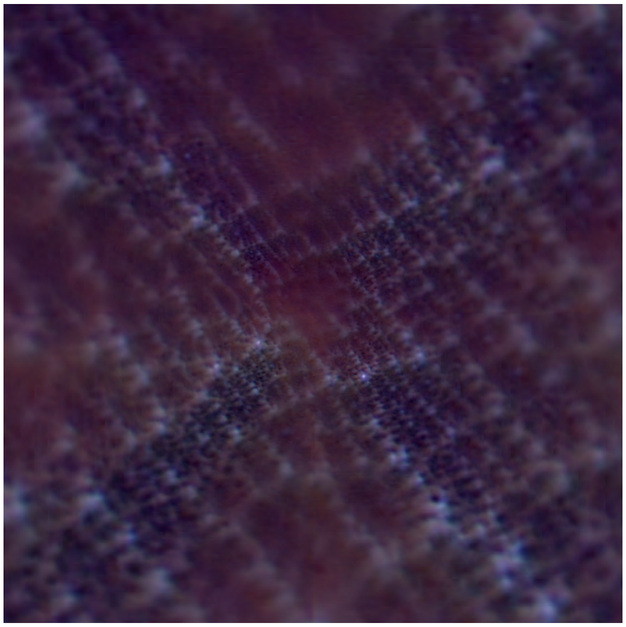

Figure. 15. Combined image of ‘Rock’.

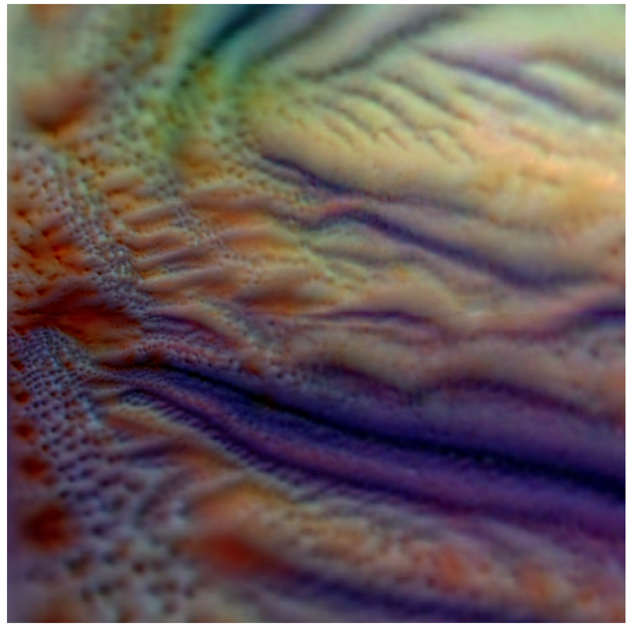

Figure.16. Combined image of ‘Pine’.

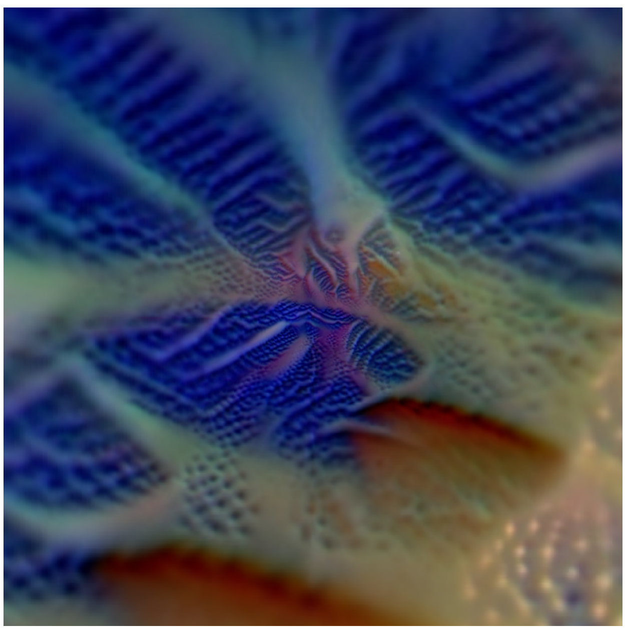

Figure. 17. Combined image of ‘Wealth’.

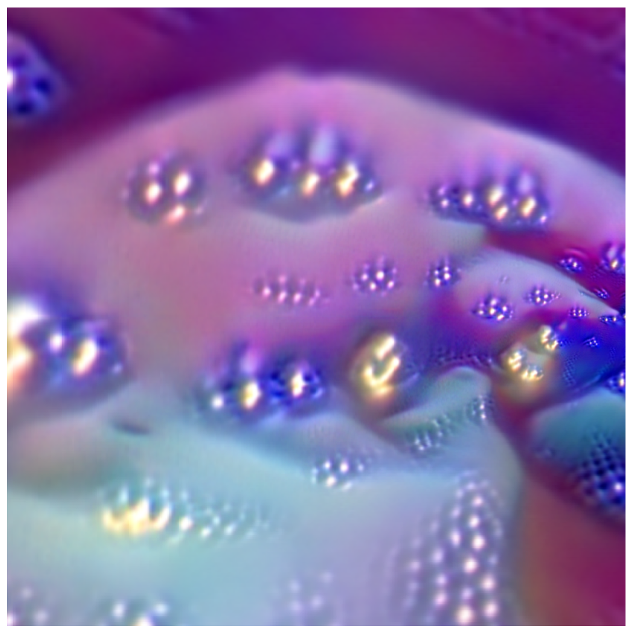

Figure. 18. Combined image of ‘Writing brush’.

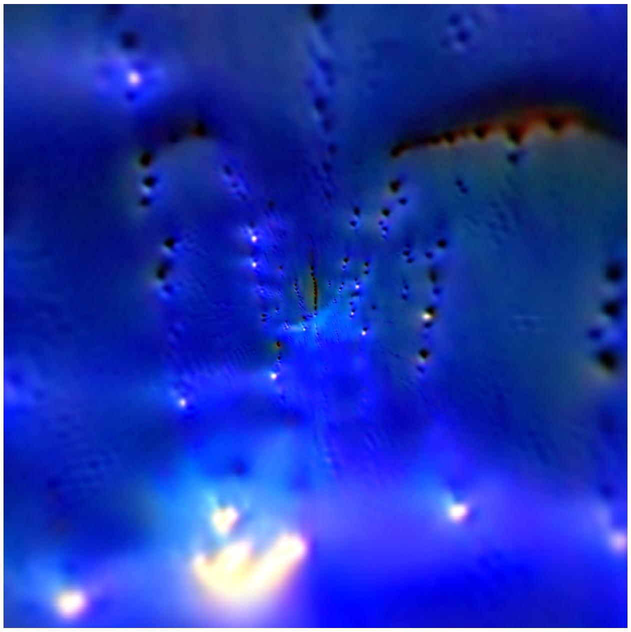

Figure. 19. Combined image of ‘Kettle’.

Due to enlarging the images of the same size into varying scale, the combined image has different amount of detail in different areas. This in turn generates an effect that is akin to having a focal point in a photograph, adding a sense of depth to the image.

Although the sharp neon colored outlines that are characteristic of many ‘Deepdream’-generated images are remedied through this enlarging technique, the varied color palette of the generated images can be considered to be taking more from the starting randomly colored image rather than from object themselves. Since VGGNet for 石 *(Rock),* 财 *(Wealth),* 壶 *(Kettle),* 笔 *(Writing brush),* 松 *(Pine)* was trained on a grayscale image dataset, it is clear that the color palette is not coming from the photographs in the dataset.

5.2 Pix2pix

To give the generated images a meaningful color scheme, the pix2pix machine learning algorithm is used. Pix2pix is a Generative Adversarial Network (GAN) that takes in a dataset of pairs of images. Like many GANs, there are two main parts to Pix2pix called 'Generator' and 'Discriminator'. Pix2pix, as name implies, is primarily used to convert an input image from one style to another. For example, pix2pix can be trained on a dataset of pairs of day and night scenery images to generate a night image given a daytime one. Pix2pix can also be used for learning variety of other relationships such as 'edges to photograph' and 'grayscale to color' (see fig. 20).

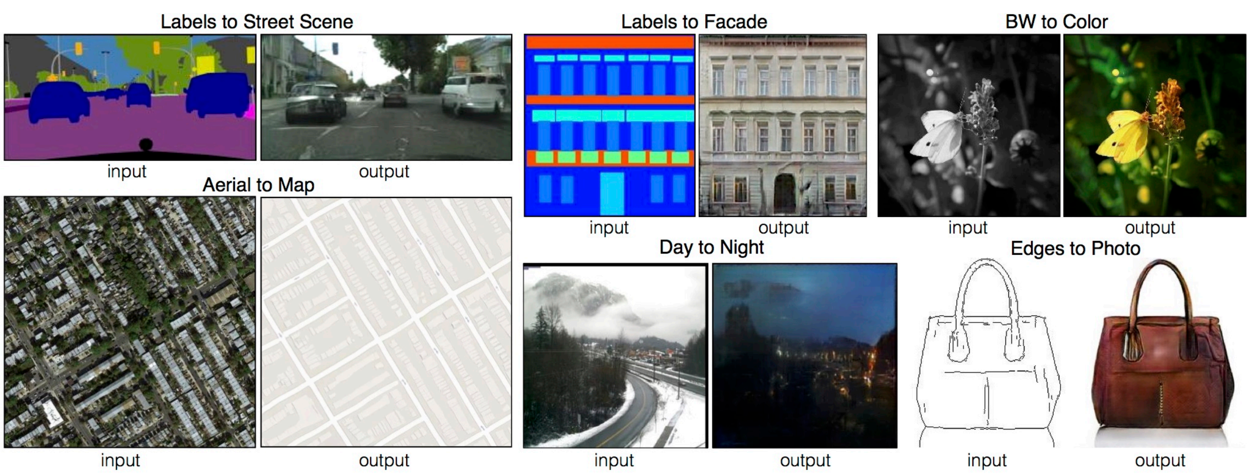

Figure. 20. Example results on several image-to-image translation problems. "In each case we use the same architecture and objective, simply training on different data". Github, inc. Accessed May 26, 1029. https://phillipi.github.io/pix2pix/

One training iteration of pix2pix can be summarized as follows. The generator takes in an image and modifies it to the target style. Then the discriminator takes in both the original target image and generator outputted 'fake' image and makes a prediction about which one is the original image. Finally, a small update is made to the model according to the correctness of the discriminator's prediction. Generator and discriminator plays a guessing game each iteration, each trying to 'outsmart' the other. The generator aims to generate better 'fake' images to fool the discriminator while discriminator evolves to be better at distinguishing the 'fake' image from the original.

In the case of 石 *(Rock),* 财 *(Wealth),* 壶 *(Kettle),* 笔 *(Writing brush),* 松 *(Pine)* grayscale to color image pair were inputted to the algorithm (see fig. 21, 22).

Figure. 21. Example grayscale, color input image pair for 'Rock'.

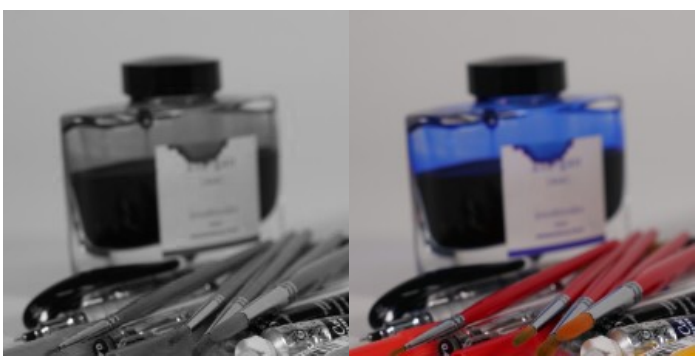

Figure. 22. Example grayscale, color input image pair for 'Writing brush'.

Pix2pix was trained five times in total, once per each of the 5 objects. In each case, pix2pix learned to accurately colorize grayscale photographs compared with their original colored photographs (see fig. 23, 24).

Figure. 23. Pine generated ‘fake’ color (left), original grayscale (mid) and original color (right).

Figure. 24. Wealth generated ‘fake’ color (left), original grayscale (mid) and original color (right).

The combined higher resolution images from VGGNet were changed into grayscale and inputted into their corresponding pix2pix trained models. Fortunately, there was no input size restriction with pix2pix which enabled me to input combined higher resolution image as big as 1920 x 1920 pixel (see fig. 25, 26, 27, 28 and 29).

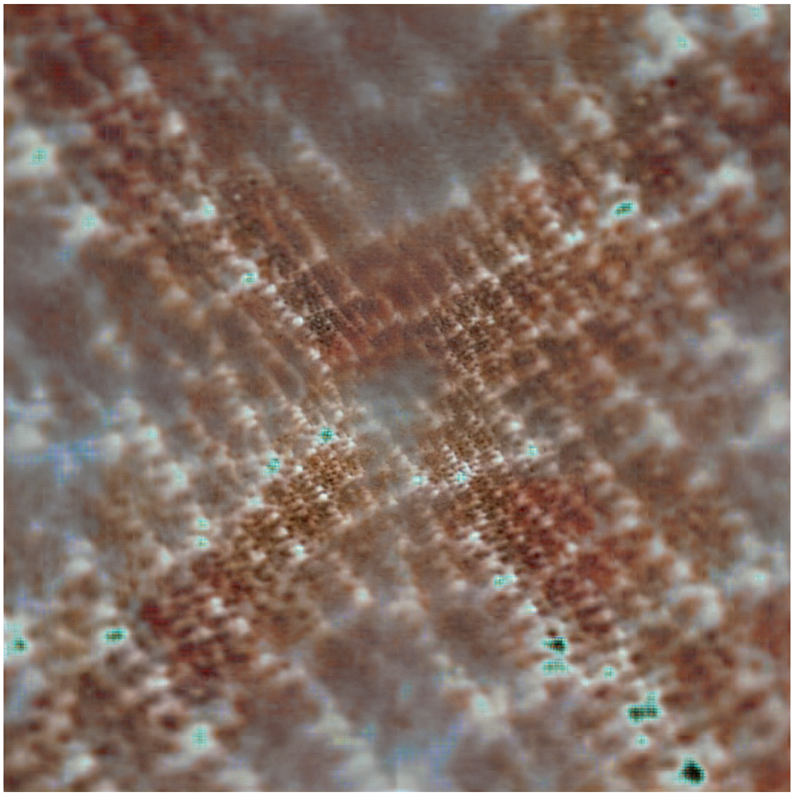

Figure. 25. Recolorized ‘Rock’

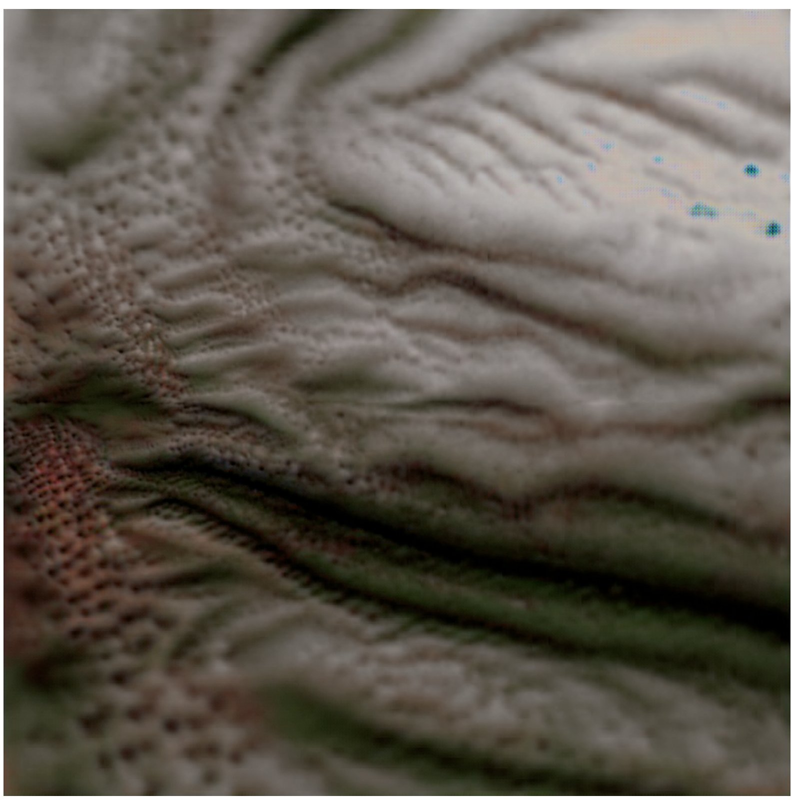

Figure. 26. Recolorized ‘Pine’

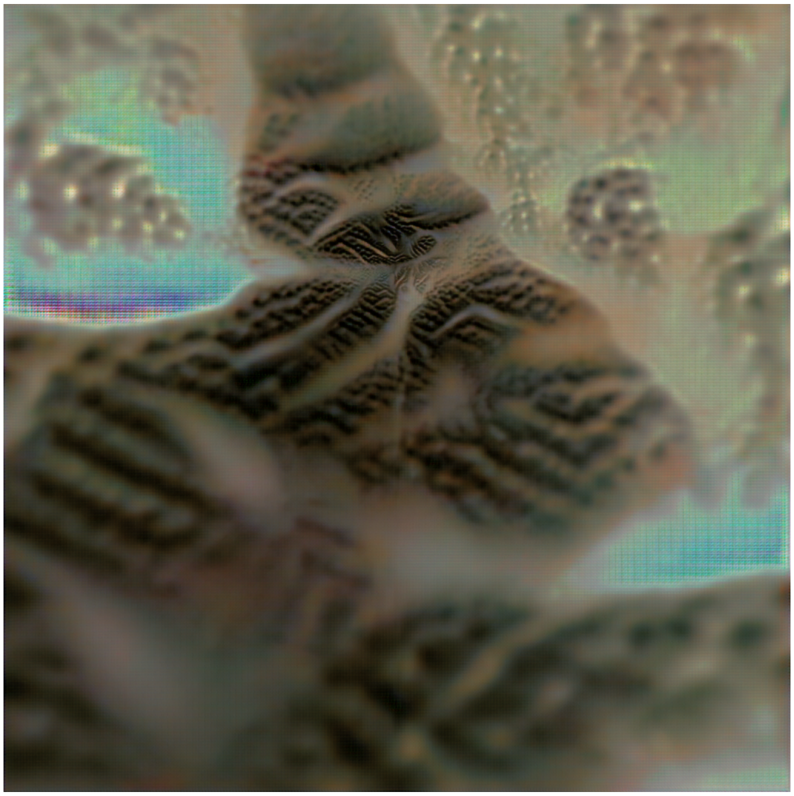
Figure. 27. Recolorized ‘Wealth’.

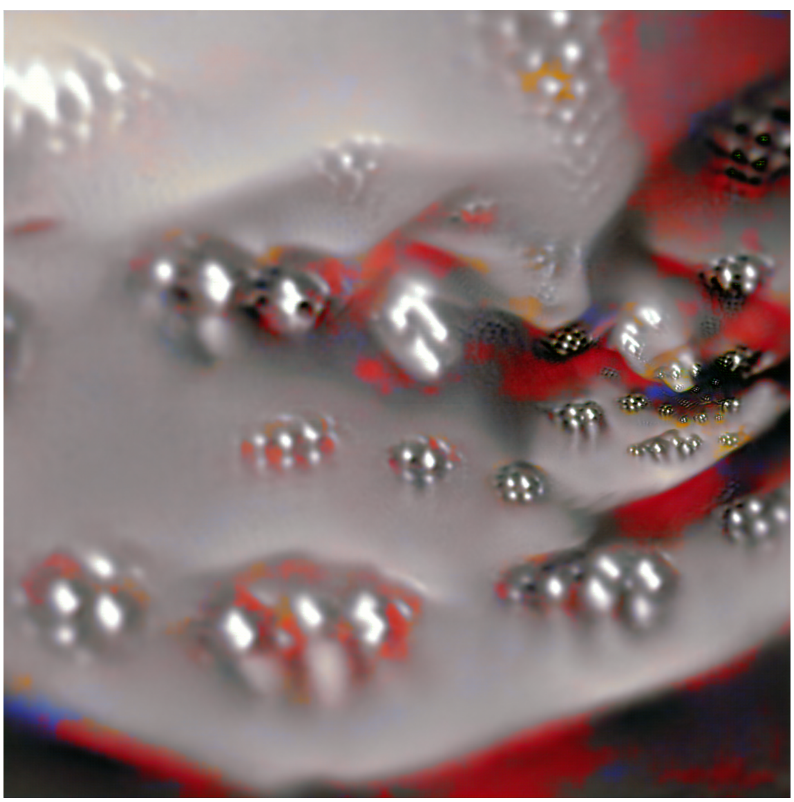
Figure. 28. Recolorized ‘Writing brush’.

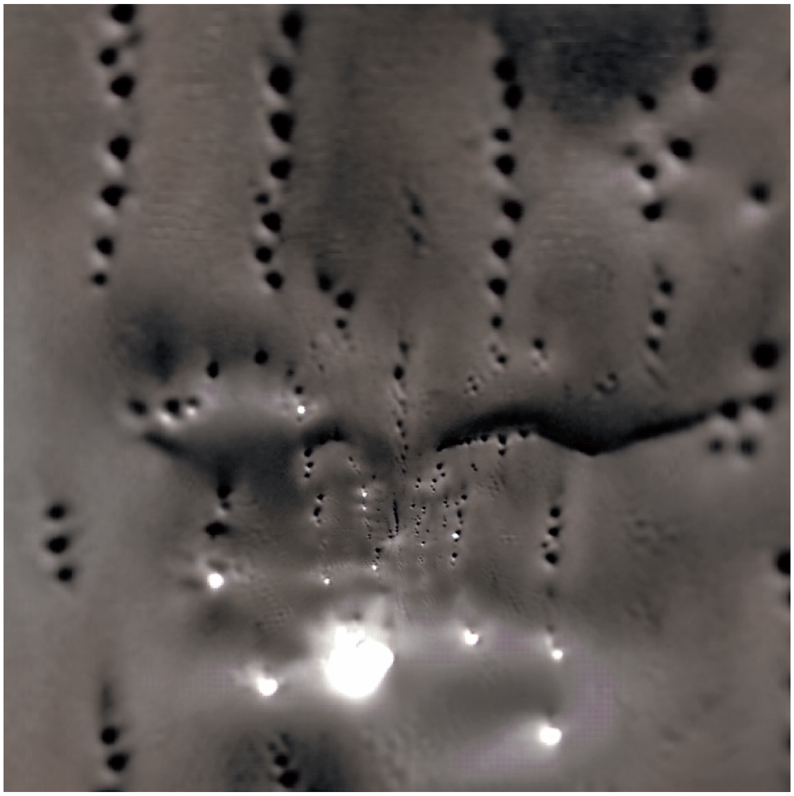

Figure. 29. Recolorized ‘Kettle’.

5.3 Animation

Infinite zoom is one of the typical animation that are used to animate images generated with machine learning algorithms that are similar in architecture with VGGNet.[64] My aim was to develop an animation style that deviates from the norm and emphasizes the concept of shifting perspective in reference to East Asian painting. I decided to change the pivot of enlargement in VGGNet generation process to include those that are off-centered. Specifically, the ‘focus’ was

[64] Jason Bailey. "DeepDream Creator Unveils Very First Images After Three Years." Artnome. January 02, 2019. Accessed May 27, 2019. https://www.artnome.com/news/2018/12/30/deepdream-creator-unveils-very-first-images-after-three-years.

swept across the midsection of the square images to accentuate the illusion of shifting focal point (see fig. 30, 31, 32, 33 and 34).

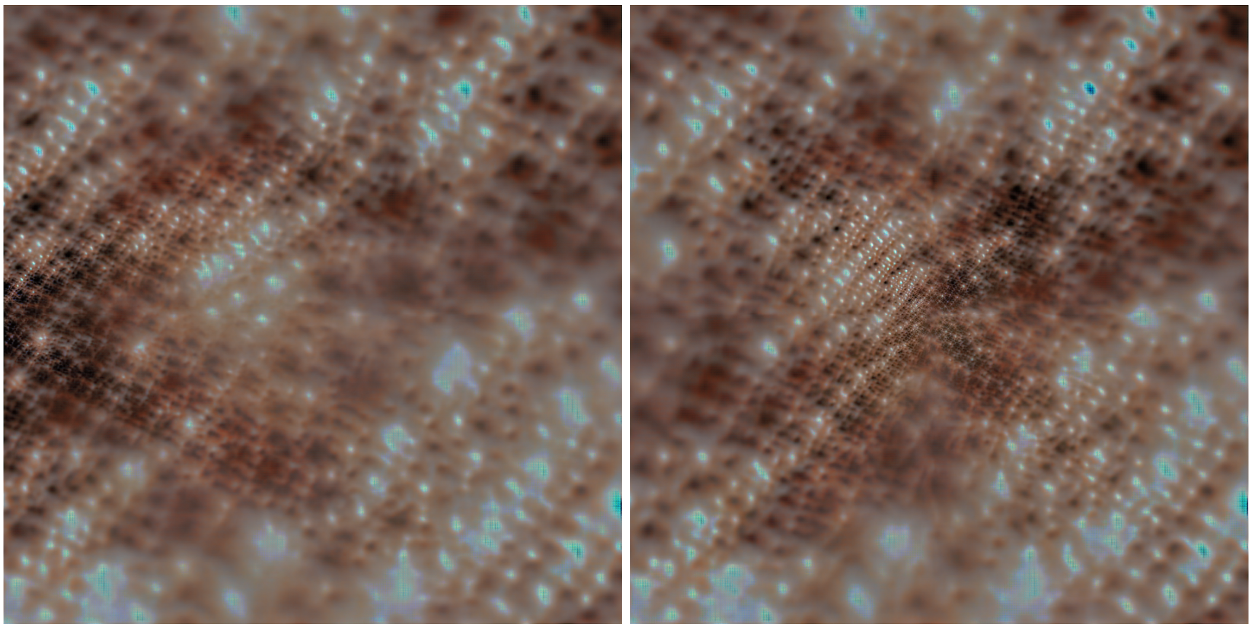

Figure. 30. ‘Rock’ with focus on left and middle.

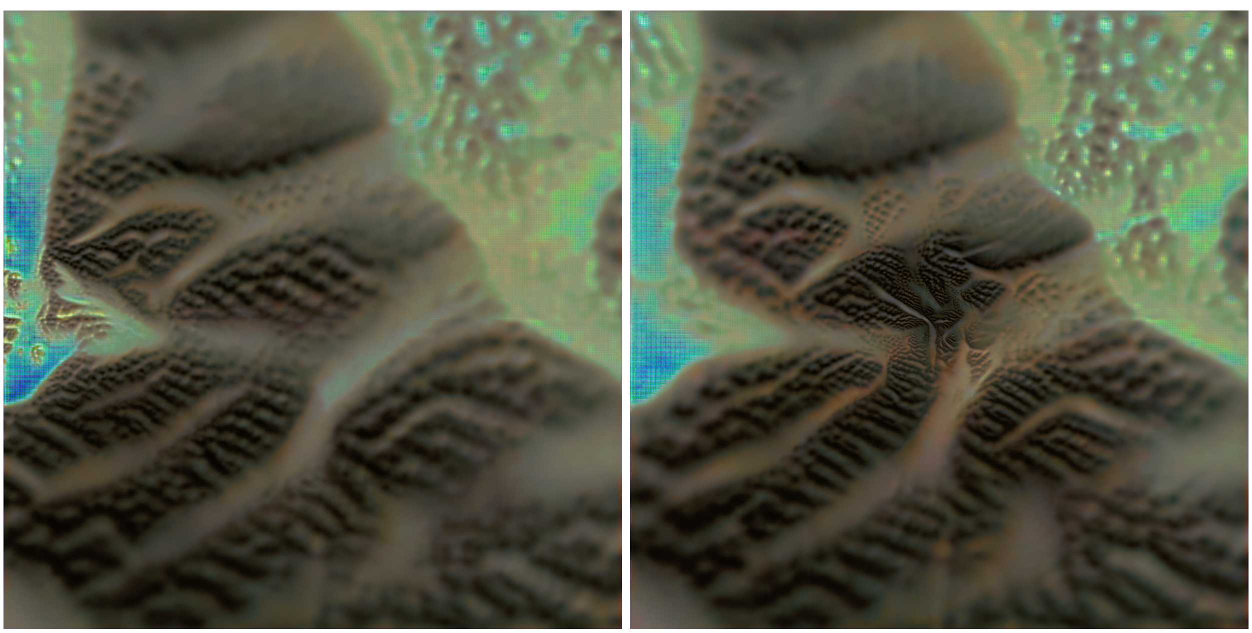

Figure. 31. ‘Wealth’ with focus on left and middle.

Figure. 32. ‘Kettle’ with focus on left and middle.

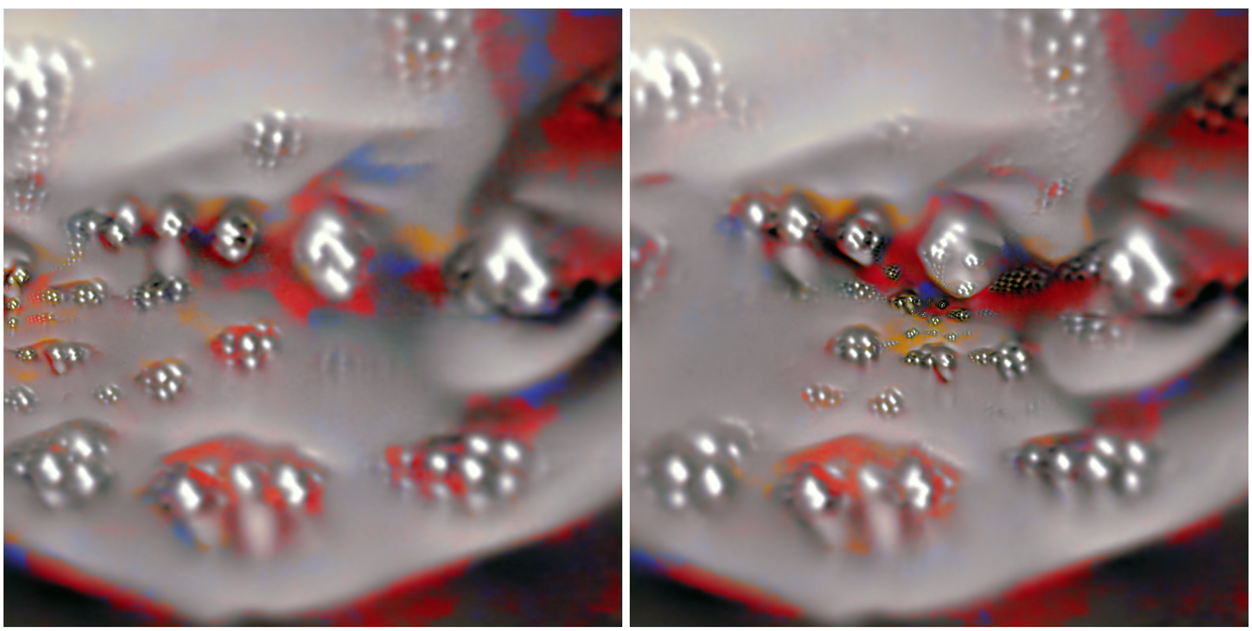

Figure. 33. ‘Writing brush’ with focus on left and middle.

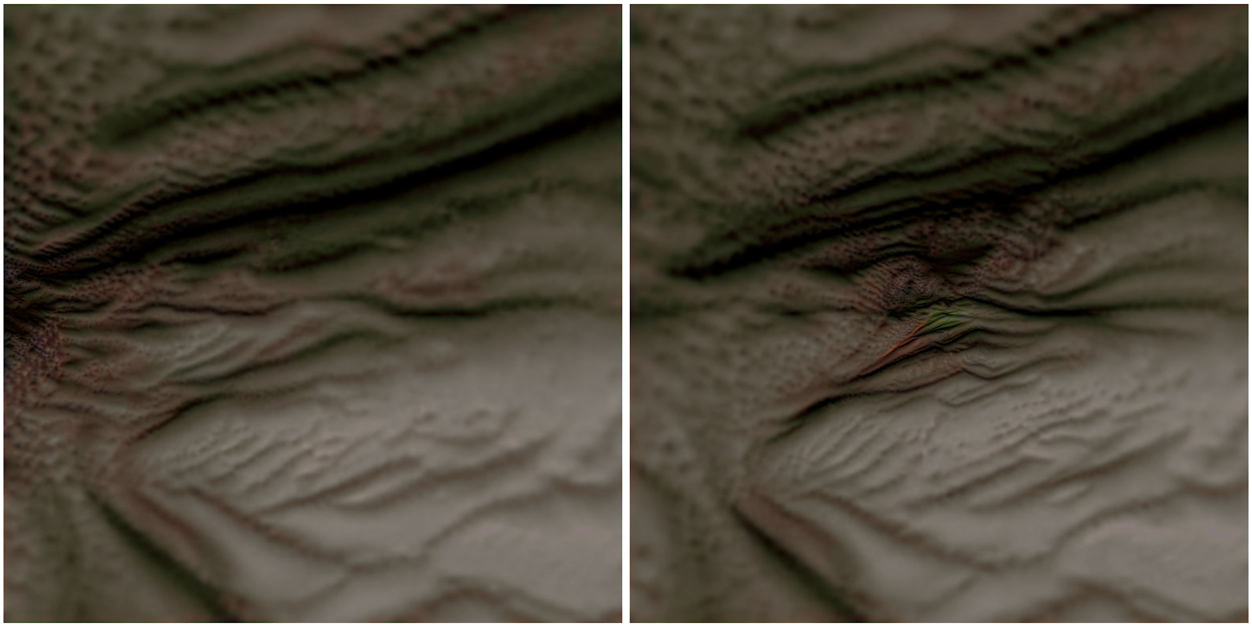

Figure. 34. ‘Pine’ with focus on left and middle.

Originally I expected the images to be continuous with respect to focal point position. In other words, I expected each composed image with very small difference in focal point position to be very similar to each other. However, that was not the case. Position difference of 1/200 of the image width changed the content of the focus area so drastically, that the constructed animation from those images as frames failed to be continuous (see fig. 35).

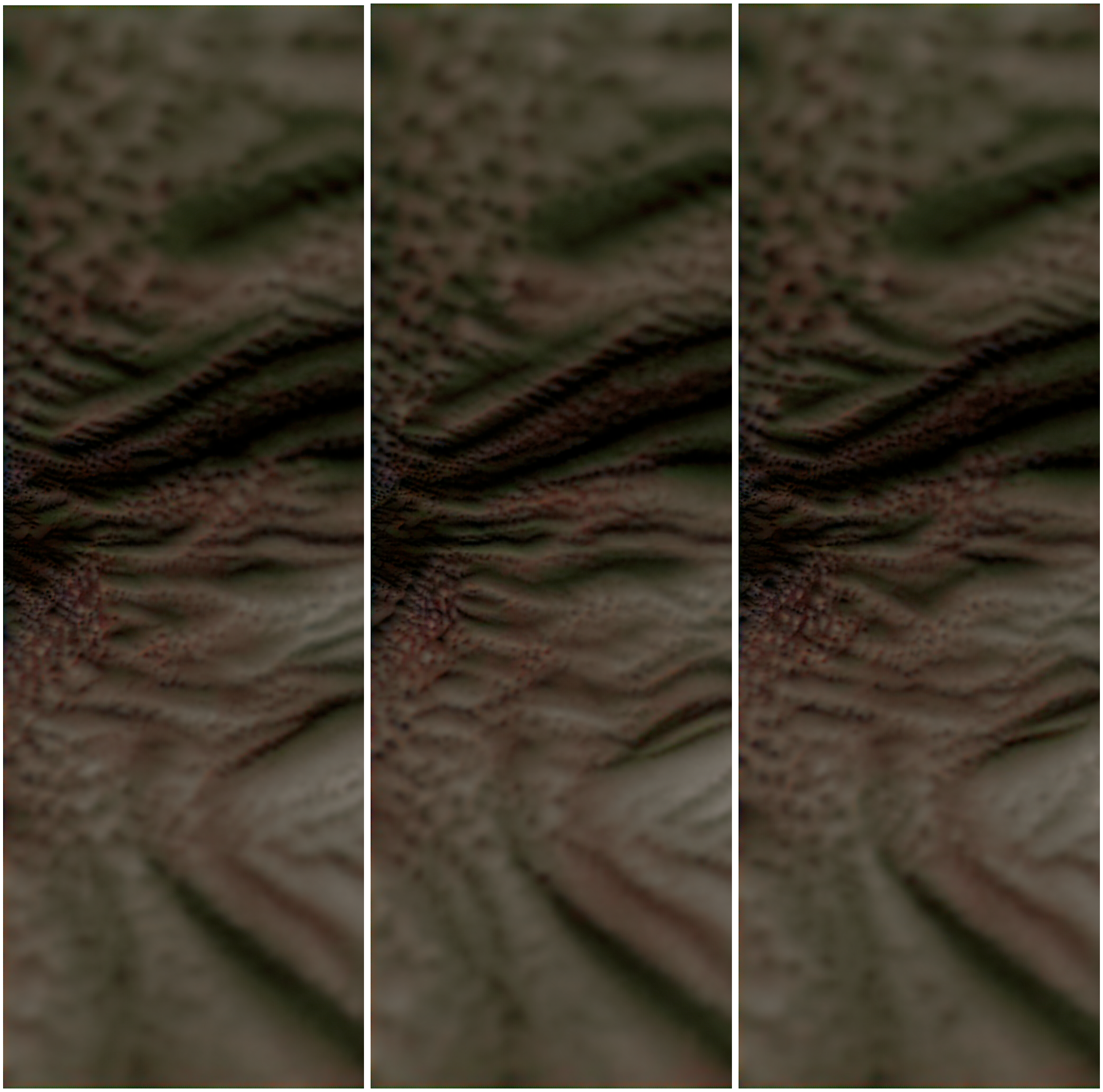

Figure. 35. ‘Pine’ with focus position at 0/200 (left), 1/200 (mid), 2/200 (right).

Therefore, I decided to adopt an interpolative approach with these images, using them as ‘key frames’ rather than as individual frames themselves. For the center where the images are highly variable key frame by key frame, the variability was embraced and the area was linearly interpolated. As for the ‘out of focus’ peripheral parts, a spherical linear interpolation was used to make the animation more smooth and organic compared to parts ‘in focus.’

6. Conclusion: Humanity in machine based processes.

Throughout this text, I compared computational methods of creation (with an emphasis on neural networks) with three other types of image making processes: human visual perception, Surrealist methods, and traditional East Asian paintings. There are several similarities that computational methods share with the three processes. Computational methods, as a product and extension of human capacity to reason and categorize, can translate information that is not directly available to human sensory organs into ones that we can process. Surrealist methods of creation are also a way of exploring subjects that are out of their habitual context. Software can be used in an artwork to emphasize these three Surrealist qualities: freedom from contradiction, absence of sense of time, and replacement of external reality with psychic reality. Neural networks with image input are able to convey the spatial and temporal expandability that is characteristic of scattered perspective in traditional East Asian paintings.

The difference between computational methods and the three more traditional image making process is its deviation from anthropocentrism. Computational methods, by the virtue of its architecture, is able to take inputs that are separate from human sensorimotor abilities. This allows the artists utilizing computational methods as part of their process to take the objects of depiction out of their habitual context. Regarding Surrealism, computational methods do not directly reveal the human unconscious. Neither does it convey thoughts and emotions of the artist in traditional East Asian paintings.

As we see more artworks created with neural networks or computational processes in general, it is important to ponder what can be conveyed and gained through these works. Works such as 石 *(Rock),* 财 *(Wealth),* 壶 *(Kettle),* 笔 *(Writing brush),* 松 *(Pine)* is an expression of the quality of the neural network's vision— a machine architecture based vision that is becoming an increasingly integral part of our daily life whether in the form of tagging feature in social media hosted pictures or pedestrian detection in self-driving cars. While it is a quality that is less anthropocentric in a biological sense, it is also reflective of the machine-mediated beings we are starting to become. As we integrate more instruments into our lives, we become more reliant on secondary perception methods. Machine-mediated perception and neural network vision are a few examples of recent additions to those methods. However, humans have always been creatures of tools. In this sense, the "deviations" from anthropocentrism that we see from artworks involving computational processes can be considered to be expressions of one of the qualities that makes us the most human. Perhaps, these artworks are as honest an expression of humanity as any type of artworks that came before.

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