Virtual photography: artificial Intelligence, in-game, and extended reality

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VIRTUAL PHOTOGRAPHY

Artificial Intelligence, In-game, and Extended Reality

[transcript] Image

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Virtual Photography

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Contents

Part III: Extended and Limited Realities

Appendix

Introduction

Ali Shobeiri

> "The virtual is fully real in so far as it is virtual."
> (Gilles Deleuze, *Difference and Repetition*)

> "Virtualization fluidizes existing distinctions, augments the degrees of freedom involved, and hollows out a compelling vacuum."
> (Pierre Lévy, *Becoming Virtual*)

The term "virtual photography," which gives this book its title, is simultaneously axiomatic and obfuscating as it conveys an idea that is both banal and novel. It refers to a kind of photography that is practiced ubiquitously but is defined only elusively—everybody seems to know about the virtualization of photography, but nobody knows what a virtual photograph actually is. Virtual photography has already found its place in common parlance; however, its conceptual territory is still uncharted for researchers and practitioners of photography. Obviously, as isolated terms, "virtual" and "photography" have their histories, theories, and discourses. Their combination, though, causes indecision that oscillates between immanent orthodoxy and imminent heresy because it stitches a *virtuality-inducing* crux onto the *reality-infusing* medium of photography. In other words, due to the reluctance of photography to be virtualized and the resistance of the virtual to be realized, the term "virtual photography" appears to be oxymoronic. Thus, one might ask: What is virtual photography? And what can be considered a virtual photograph? To answer these questions, we first need to take a brief detour to the early days of the medium, long before photography was included under its contemporary virtual disguise. Doing so will show that photography has arrived at its present virtual condition after enduring many deaths and rebirths over the past decades.

The Birth and Death(s) of Photography

Since its conception around two centuries ago,[1] photography has been frequently defined etymologically as "drawing/writing with/in light." This drawing or writing happens when the camera shutter opens and the light rays that have been reflected off the photographed subject penetrate the lens and are inscribed on a photosensitive surface. For the photography enthusiasts of the early nineteenth century, more, it was the transposition of light from the physical world to the photograph that was amusing and amazing, rather than what the first photographs showed. During this period, photography was replete with luminous metaphors, such as reflection, inflection, deflection, and refraction, for without light there could be no photography—their existence was codependent. William Henry Fox Talbot, an early inventor of photographic technology, underscored this aspect in the title of his 1844 book *The Pencil of Nature*.[2] For him, it was as if light could inscribe itself without any technological mediation or human intervention, thereby turning the photograph into its double. What Talbot understood as "nature," which was later to be called the "referent," became the defining agent of photography for several decades to come.

Unlike Talbot, who was fascinated by the mystifying inscription of light, other thinkers declared the camera to be the main operator of photography between the mid- and late-twentieth century. For them, the camera was a

1 Historians have debated the exact year in which photography was invented. In 1814, Joseph Nicephore Niépce, the French inventor of photography, started actively pursuing the process of making a permanent camera image. In 1816, he temporarily fixed a photographic print for the first time. For a detailed discussion of the invention of photography, see Robert Hirsch, *Seizing the Light: A History of Photography* (New York: McGraw-Hill, 2000).

2 William Henry Fox Talbot, *The Pencil of Nature* (London: Longman, Brown, Green, and Longmans, 1977).

"mold machine"[3] that could "mummify"[4] time and "freeze"[5] space into the form of a photograph. During this period, the camera was not simply an omniscient device; it was an omnipotent machine—a prosthetic gateway to the "optical unconscious" where temporality and spatiality were intertwined.[6] However, the shift of perception from the quasi-seamless inscription of light to the semi-mechanical production of the photograph did not last long. In 1980, literary theorist Roland Barthes situated the locus of photography in the photograph itself, calling it "that-has-been"[7]—the indexical and spectral presence of the physical reality (i.e., the referent) entombed in the photograph.[8] Finally, the early twenty-first century has foregrounded the role of yet another operator of photography, the spectator, without whom the photographed event/person/place would vanish in time and space.[9] Consequently, for nearly

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3 Stanley Cavell, *The World Viewed: Reflections on the Ontology of Film* (Cambridge, MA: Harvard University, 1979).

4 André Bazin, "Ontology of the Photographic Image," in *What Is Cinema?*, trans. Hugh Gray (Berkeley/Los Angeles, CA: University of California Press, 1967).

5 Susan Sontag, *On Photography* (London: Penguin Books, 1977).

6 Walter Benjamin, "A Small History of Photography," in *One-Way Street and Other Writings*, trans. E. Jephcott and K. Shorter (London: Lowe and Brydone, 1979), 243.

7 Roland Barthes, *Camera Lucida*, trans. Richard Howard (London: Vintage Books, 2000).

8 In the history of photography, there has been an ongoing debate about whether the photographic image can be deemed a sign of the reality it represents, particularly whether it is an iconic or indexical sign. The indexical sign implies that the photo has a causal relationship to its referent (e.g., smoke is an index of fire), while the iconic sign suggests that the photograph conveys what it represents only by means of imitation and likeness (e.g., a painting of a fire is an icon of a real fire). However, as film theorist Tom Gunning argues, the indexicality and iconicity of photographs have always been intertwined, since our evaluation of a photograph as accurate depends not only on its indexical basis but also "on our recognition of it as looking like its subject." Therefore, Gunning contends that "the photograph exceeds the function of a sign" precisely because its "truth value" always depends on its "visual accuracy" (indexicality) to the same extent that it does on its "recognizability" (iconicity). See Tom Gunning, "What's the Point of an Index? Or, Faking Photographs," *Nordicom Review* 25, no. 1–2 (2004), 41–48. Literary theorist Walter Benn Michaels offers a similar critique of seeing the photograph merely as a sign when he argues that the indexicality of photographs is not a one-to-one relationship with the reality they represent; rather, it is "the bypassing of the artist's intentionality." See Walter Benn Michaels, "Photography and Fossils," in *Photography Theory: The Art Seminar*, ed. James Elkins (New York: Routledge, 2007), 441.

9 For a detailed discussion of the role of the spectator in photography, see Ariella Azoulay, *The Civil Contract of Photography*, trans. Rela Mazeli and Ruvik Daieli (New York: Zone Books, 2008) and Abigail Solomon-Godeau, *Photography at the Dock: Essays on Pho-*

two hundred years, theories of photography have been continually changing the defining agent of photography: from light to camera, from camera to photograph, and from photograph to spectator. However, while historians and theoreticians were debating who the dominant agent of photography was—the agent who could define its medium-specific qualities—photography suddenly lost its agency and was quickly pronounced dead in 1992.[10]

Between 1990 and 1995, the digitization of photographic images and the expansion of the World Wide Web brought photography to its unexpected demise. Temporarily, all discussions concerning its autonomy as a medium were suspended. Due to the digital computation and online transmission of photographic images across the globe, it was now the task of "digital culture" to investigate the dissipating ontology of photography.[11] This period was epitomized by the instantaneous massification and circulation of images on the internet, and it was hailed as the "post-photographic era"—the era when "the computer-processed digital image superseded the image fixed on silver-based photographic emulsions."[12] Suddenly, what we had once known as "the photograph," which allegedly had a causal/indexical relationship with its represented reality, ceased to exist. Having been converted into data, it was no longer the photograph but the screen that was at the center of theoretical debates. This paradigm shift was accelerated after the development of Web 2.0, the rapid growth of social networks, the enormous accumulation of photos in online databases, and the mass availability of a new hybrid communication device—the camera phone. Thanks to the omnipresence of smartphones, it seemed that photography was simultaneously "everywhere" and "nowhere."[13] As a technology, photography was dead, but as a practice, it was fully alive. It was as if photography had become "undead."[14]

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tographic History, Institutions, and Practices (Minneapolis, MN: University of Minnesota Press, 1991).

10 William J. Mitchell, *The Reconfigured Eye* (Cambridge, MA: MIT Press, 1992).

11 Martin Lister, *The Photographic Image in Digital Culture*, 1st edition (London: Routledge, 1995).

12 Mitchell, *The Reconfigured Eye*, 120.

13 Martin Lister, *The Photographic Image in Digital Culture*, 2nd edition (London: Routledge, 2013), 5.

14 Nina Lager Vestberg, in *The Photographic Image in Digital Culture*, ed. Martin Lister (London: Routledge, 2013), 113–131.

Over the past two decades, photography has repeatedly and obstinately avoided its hasty demise.[15] By immediately adapting to the technological transformations and innovations of the early twenty-first century, it has proven that it is not dead; rather, it has been resurrected and reincarnated. Seemingly disinterested in prefixes such as "post,"[16] "after,"[17] and "non,"[18] photography has outlived its indexical past and entered the present dematerialized, cybernetic, and algorithmic era. Still, there has been a persistent reluctance to refer to highly technological imagery as "photographs," which is something that *Virtual Photography* intends to break free from.

Not (Only) the Image, but (Also) the Photograph

In media and image studies, it is common knowledge that the family of images is extensive and expanding, ranging from optical, graphic, perceptual, mental, verbal, and psychological images[19] to industrial, transparent, opaque, spatial, and temporal ones.[20] Clearly, a photograph is an image, one that came into existence during the transition from "traditional images" (e.g., paintings and drawings) to "technological images" (i.e., images made with mechanical and computational devices).[21] However, referring to nascent manifestations of

15 See Lev Manovich, "The Paradoxes of Digital Photography," in *Photography after Photography: Memory and Representation in the Digital Age*, eds. S. Iglhaut and H. Amelunxen (London: Art Stock, 1997), 57–65; Martha Rosler, "Image Simulations, Computer Manipulations," in *Decoys and Disruptions: Selected Writings* (Cambridge, MA: MIT Press, 2004), 259–317.

16 Geoffrey Batchen, "Post-Photography," in *Each Wild Idea: Writing, Photography, History* (Cambridge, MA: MIT Press, 2000).

17 Fred Ritchin, *After Photography* (New York: W. W. Norton & Company, 2009).

18 François Laruelle, *The Concept of Non-Photography* (Cambridge, MA: MIT Press, 2011).

19 See W. J. T. Mitchell, *Iconology: Image, Text, Ideology* (Chicago/London: The University of Chicago Press, 1986).

20 See John Lechte, *Genealogy and Ontology of the Western Image and its Digital Future* (New York: Routledge, 2012).

21 Vilém Flusser organized different media into three categories—traditional images, texts, and technical images—and he considered photography to be the epitome of the third kind due to its chemical and/or electronic basis (45). In his words, "The difference between traditional images and technical images, then, would be this: the first are observations of objects, the second computations of concepts. The first arises through depiction, the second through a peculiar hallucinatory power that has lost its faith in

photography *only* as images means depriving them of their evolutionary trajectories and photographic historicity. For example, if photo-like pictures generated in computer games are just images,[22] then exploring their photographic genealogies is pointless. To be clear, this is not a lexical matter but an ontological one. As soon as there is a new modality of photographic making/thinking, the grand family of images exerts its supremacy on photography. That is precisely why referring to recent AI-generated images as photographs seems inappropriate to some. This is a tendency, as well as a hesitancy, which has been ongoing for the past two decades—to refer to technologically produced pictures that have caused a paradigm shift in art theory and history as *images* rather than *photographs*.

Many examples of this trend can be found. Nonreflective and desocialized photos from logistic and military actions are called "operational images."[23] Excessively downloaded, reformatted, reedited, and alienated photos are "poor images."[24] Computational photos that continually multiply in cyberspace are defined as "algorithmic images."[25] Programmable and synchronizable photos become "soft images."[26] Dematerialized and malleable digital photos are called "versatile images."[27] Oversaturated, intertwined, and atmospheric online pho-

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rules." Vilém Flusser, *Into the Universe of Technological Images* (Minneapolis, MN: University of Minnesota Press, 2011).

22 For art historian Hans Belting, the distinction between images and pictures is a crucial one. An image, he proposes, "may live in the work of art, but does not necessarily coincide with the work of art"; a picture is where an image "may reside." See Hans Belting, *An Anthropology of Images*, trans. Thomas Dunlap (Princeton, NJ: Princeton University, 2011), 2.

23 In 2000, filmmaker Harun Farocki coined the term "operational image" in the first part of his three-part audiovisual installation called *Eye/Machine*. For a recent account of this concept, see Jussi Parrika, *Operational Images: From the Visual to the Invisual* (Minnesota, MN: University of Minnesota Press, 2023).

24 Hito Steyerl, "In Defense of the Poor Image," *E-flux Journal*, no. 10 (2009), 1–9.

25 Daniel Rubinstein and Katrina Sluis, "The Digital Image in Photographic Culture," in *The Photographic Image in Digital Culture*, ed. Martin Lister, 2nd edition (London: Routledge, 2013), 22–40.

26 Ingrid Hoelzl and Rémi Marie, *Softimage: Towards a New Theory of the Digital Image* (Chicago: University of Chicago Press, 2015).

27 Alexandra Moschovi, Carol McKay, and Arabella Plouviez, eds. *The Versatile Image: Photography, Digital Technologies and the Internet* (Leuven: Leuven University Press, 2013).

tos are "ambient images."[28] Photos that travel and circulate are described as "unfettered images."[29] Photographs whose existence is inherently tied to the screen have been termed "screen images."[30] Regardless of these neologisms, if the photos in question *retained* and *conveyed* photographic "functions",[31] they could also be referred to as photographs. In other words, if some of these images were made through *photographic means* and for *photographic ends*—through what has been called "photomediation"[32]—they can be seen as photographs. This is precisely the intention of *Virtual Photography*: to salvage the photograph from the depthless family of images thanks to the conceptual strength and vitality of the notion of the virtual.

Accordingly, instead of succumbing to the grand family of images, to cohesively account for the most recent photographic practices and technologies, this book proposes the term "virtual photography" as a unifying theoretical and methodological framework. This term has so far been loosely applied only to in-game photos, but this volume aims to consider any photographic technology that has a virtual core as an example of virtual photography.

What Is Virtual Photography?

The adjective "virtual" comes from the Latin *virtus*, which means "having the virtue of." Therefore, when we refer to, say, a "virtual desk," we mean that that object has all the qualities (i.e., the virtues) of a desk even though it is not a real desk. Based on this, the definition of "virtual" can be "not in actual fact."[33] Because it intrinsically evades facticity, dealing with the term "virtual" is difficult.

Notable thinkers of the twentieth century have shown that the concept of virtuality is difficult to understand because its definition is contingent upon

28 Sean Cubitt et al. "Ambient Images," *The Nordic Journal of Aesthetics*, no. 61–62 (2021), 68–77.

29 Michelle Henning, *Photography: The Unfettered Image* (New York: Routledge, 2022).

30 Winfried Gerling, Sebastian Möring, and Marco De Mutiis, eds. *Screen Images: Screenshot, Screencast, In-game Photography* (Berlin: Kadmos Verlag, 2023).

31 See Vilém Flusser, *Into the Universe of Technological Images*; Vilém Flusser, *Towards a Philosophy of Photography* (London: Reaktion Books, 2000).

32 Joanna Zylinska, "Photomediations: An Introduction," in *Photomediations: A Reader*, eds. Kamila Kuc and Joanna Zylinska (Online: Open Humanities Press, 2016), 1–17.

33 Denis Berthier, "Artificial Agents and their Ontological Status," *International Conference on Computers and Philosophy* (2006), 4.

other ideas. Henri Bergson[34] in philosophy and Marcel Proust[35] in literature initially broached the concept, thus planting the seed of virtuality. Later, other thinkers fleshed out its philosophical aspects. The list of such thinkers includes, but is not limited to, cultural theorist Paul Virilio, who opposed the terms "virtual" and "factual";[36] philosopher Jean Baudrillard, who equated the virtual with "the computerized";[37] sociologist Rob Shields, who saw the opposite of the virtual in "the material";[38] epistemologist Denis Berthier, who equated the virtual with "the ideal";[39] philosopher Brian Massumi, who ontologized the virtual as "the potential";[40] essayist Philippe Quéau, who associated the virtual with "the liminal";[41] and theorist Simon O'Sullivan, who situated the virtual into the realm of "affect."[42] Despite their differences, these authors agree that the virtual does *not* oppose the real, nor does it coincide with it, since it has a reality of its own. The alleged tension between the virtual and the real manifests itself in the syntagma of "virtual reality," which, in everyday language, suggests that there is an implied opposition between the virtual and the real. However, if that were the case, we could not speak of virtual reality as a distinct entity as we do today—that is, as one being.[43]

To eliminate the friction between the virtual and the real, the philosopher Gilles Deleuze postulated separate ontological doubles for these concepts: the virtual vs. the actual and the possible vs. the real. This point is clarified in *Difference and Repetition*, where Deleuze lucidly distinguishes between the two processes undergone by the virtual and the possible. He outlines the difference in question as follows:

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34 See Henri Bergson, *Creative Evolution*, trans. A. Mitchell (New York: Random House, 1944) and *Matter and Memory*, trans. N. M. Paul and W. S. Palmer (New York: Zone, 1991).

35 See Marcel Proust, *The Captive and the Fugitive*, the fifth volume of *In Search of Lost Time*, ed. William C. Carter (Connecticut/London: Yale University Press, 2023).

36 Paul Virilio, *The Vision Machine* (London: Indiana University Press, 1994), 60.

37 Jean Baudrillard, "The Virtual Illusion: Or the Automatic Writing of the World," *Theory, Culture & Society*, vol. 19 (1995), 97–107.

38 Rob Shields, *The Virtual* (London/New York: Routledge, 2003).

39 Berthier Denis, "Intentionality and the Virtual," *Intellectica*, no. 40 (2005), 91–108.

40 Brian Massumi, *Parables for the Virtual: Movement, Affect, Sensation* (Durham, NC: Duke University Press, 2002).

41 Philippe Quéau, "Virtual Multiplicities," *Diogenes*, vol. 46, no. 183 (1998), 107–116.

42 Simon O'Sullivan, "The Aesthetics of Affect: Thinking beyond Representation," *Angelaki*, vol. 6, no. 3 (2001), 125–135.

43 See Roberto Diodato, "Virtual Reality and Aesthetics Experience," *Philosophies*, vol. 7, no. 29 (2022), 1–8.

> The only danger in all this is that the virtual could be confused with the possible. The possible is opposed to the real; the process undergone by the possible is therefore "realization." By contrast, the virtual is not opposed to the real; it possesses a full reality by itself. The process it undergoes is that of actualization. It would be wrong to see only a verbal dispute here; it is a question of existence itself.[44]

Having a full reality of its own, the virtual is never a *realized* but an *actualizing* entity for Deleuze. Unlike the possible, which irreversibly enters existence via realization, the virtual sustains its existence through endless actualization. The following example can help clarify the vital distinction between realization and actualization. During its existence, a seed may become a tree or a desk. The difference here is that the process undergone by the tree is the *realization* of the seed while the process undergone by the desk is the *actualization* of the seed. While the former is determined and constituted (realization), the latter is indeterminate and constituting (actualization). In other words, if the realization of the possible is a means toward an end (i.e., the real), the actualization of the virtual is a means without an end. *The end of actualization is the sustenance of the virtual*. This, however, does not mean that a virtualized entity (e.g., photography) is devoid of reality; the perpetual and permeable modality of the virtual is what constitutes its very reality. Therefore, as the philosopher Pierre Lévy proposed, "Virtualization is not a derealization (the transformation of a reality into a collection of possibles) but a change of identity, a displacement of the center of ontological gravity of the object considered."[45]

Following Deleuze's idea that the virtual is not opposed to the real, Lévy argued that the process of virtualization is by no means a "derealization"—an emptying out of reality. During its actualization, the virtual constitutes its self-contained reality, which runs parallel to, but never collides with, the reality of the possible. According to the philosopher Grant Tavinor, placing too much emphasis on the distinction between the virtual and the real is the principal mistake we make when trying to understand the virtual, whereas something virtual can be fully real. Hence, a virtual x is almost or nearly an x, but not actually so. "[The] virtual retains the efficiency or function of a real x, while mani-

44 Gilles Deleuze, *Difference and Repetition* (New York: Columbia University Press, 1994), 211.

45 Pierre Lévy, *Becoming Virtual: Reality in the Digital Age* (New York/London: Plenum Press, 1998), 26.

festing these in an unfamiliar or noncustomary form."[46] As Deleuze would have put it, unlike the possible, which undergoes an *irreversible realization*, thus becoming a destined real, the virtual undergoes an *incessant actualization*, which reflects the becoming of virtualization.

The concept of virtual photography follows a similar logic; it refers to a kind of photography that retains the efficiency and function of real photography (made with or without a camera) while manifesting these in an unfamiliar or noncustomary form. Camera-based/camera-less photography underwent its *intended realization* in the past two centuries. In contrast, virtual photography manifests the *unbounded actualization* of photography in our dematerialized, cybernetic, and algorithmic era. In other words, while analog photography and digital photography were born out of the realization of the *possible* (*light*), virtual photography has come into existence through the constant actualization of the *virtual* (*data*)—the fabric of reality in the age of gamification, artificial intelligence, and extended reality. Having evolved and revolutionized itself over the past 200 years, the reality of photography is no longer dependent on the alleged indexicality or causality of camera-based/camera-less photography. Instead, it is now the never-ending and ever-changing actualization of the virtual that constitutes the reality of photography. This means that virtual photography is "real" photography and virtual photos are "real" photos only if we admit that in a time when computer-generated imagery is proliferating rapidly, our sense of reality is being incrementally and irrevocably infused with virtuality. Hence, at present, the virtualization of photography does not amount to the derealization of the medium—a hallowing out of reality from the kernel of its ontological gravity. Conversely, it is precisely the *data-perfused* and *algorithm-infused* actualization of photography that gives it its sense of reality today. To put it concisely, *virtual photographs are real photographs undergoing indeterminate and indefinite actualizations*. This is how the pliability and perpetuity of the virtual creates a reality that runs parallel to, and never clashes with, the conventional reality of photography.

Therefore, by focusing on the concept of the virtual and the medium of photography, this book asks the following question: What are the ontological and epistemological modalities of virtual photography in contemporary culture and how can they enable us to view memory, identity, and subjectivity anew? To answer this question, the book reflects on the most recent resurrections and reincarnations of photography.

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46 Grant Tavinor, *The Aesthetics of Virtual Reality* (New York: Routledge, 2022).

Virtual Resurrections/Reincarnations of Photography

Having technologically and ontologically transmuted itself, photography has now managed to find its way into every corner of our lives, from urban spaces to cyberspace, from criminology to cosmology, and from war weaponry to love wizardry.[47] Stealthily permeating our emotional, social, and political lives, the latest manifestations of photographic technology have altered our perceptions of individuality and communality as well as private ipseity and public illeity. Thus, they have changed our very grip on reality. Traditionally, photography has been seen as a means of documenting an external reality or expressing an internal feeling; today, though, photography is capable of actualizing nonexistent pasts and never-lived experiences. For instance, recent developments in computational photography allow us not only to adjust the size, focus, tone, color, and scale of a photograph but also to create omnipictures—that is, multiple-capture single images that aspire to better resonate with the intricacies of our lived experiences.[48] Whereas photography once was limited to the inscription of (visible) light, the emerging field of phasmagraphy expands the "boundaries of the visible photographic spectrum to the adjacent wavelengths," such as radiography, thermography, ultraviolet, data clouds, electron microscopy, and functional magnetic-resonance imaging.[49] Thanks to recent advancements in laser imaging, detection, and ranging, free-floating Wi-Fi transmissions in cities can now be turned into photographs, which reminds us that "everything that exists in [a] signal can also exist as an image."[50] Some see these changes as the creation of a "new visual regime,"[51] while others view

47 See Mervin Heiferman, ed. *Photography Changes Everything* (New York: Aperture, 2012).

48 Ramesh Raskar, "Computational Photography: Epsilon to Coded Photography," in *LIX Fall Colloquium on Emerging Trends in Visual Computing* (Berlin: Springer, 2008), 238–253.

49 Elke Reinhuber, "Phasmagraphy: A Potential Future for Artistic Imaging," *Technoetic Arts: A Journal of Speculative Research*, vol. 15, no. 3 (2017), 261–274.

50 Jussi Parikka, "On Seeing Where There's Nothing to See: Practices of Light Beyond Photography," in *Photography off the Scale: Technologies and Theories of the Mass Image*, eds. Jussi Parikka and Tomáš Dvořák (Edinburgh: Edinburgh University Press, 2021), 185–201.

51 Daniel Rubenstein, Johnny Golding, and Andy Fisher, *On the Verge of Photography: Imaging Beyond Representation* (Birmingham: Article Press, 2013).

them as the promise of still-to-come subjectivities.[52] Regardless of this, the question is no longer whether photography is an "expanded field"[53] or still an "expanding form,"[54] but in which direction it is transmuting.

At present, the most prevalent and contentious examples of these photographic transformations are extended reality (ER), artificial intelligence (AI), and in-game photography. Over the past decade, the latter has been gaining momentum on social networks and in virtual art galleries. Initially, the practice of in-game photography referred to the act of taking screenshots during gameplay by so-called virtual tourists both offline and online. One of the earliest instances of this practice was a digital portrait series entitled *Thirteen Most Beautiful Avatars* by the artists Eva and Franco Mattes, which was shot in *Second Life* (2006).[55] Originally, in-game photos were effectively screenshots; however, the video game industry extended the screenshot function by introducing the photo mode and camera mode. These features were first embedded in *Gran Turismo 4* (2005), and they were later expanded by popular games such as *The Elder Scrolls V: Skyrim* (2011), *Grand Theft Auto* (2013), *The Last of Us Remastered* (2014), and *Fall Out 4* (2015). Depending on the video game, in-game photography generally allows players to capture photos in four different ways: 1) taking screenshots, 2) modifying and/or hacking the game, 3) simulating the action of taking a photo, and 4) simulating camera technology.[56] As a result, in video games, photographic mediation operates along two main axes: diegetic (e.g., access to a photographic device or prompt to take a photo) and nondiegetic (e.g., hacking/modding and photo mode/replay).[57] While for some these technological

52 David Bate, "The Emancipation of Photography," in *The Versatile Image: Photography, Digital Technologies and the Internet*, eds. Alexandra Moschovi, Carol McKay, and Arabella Plouviez (Leuven: Leuven University Press, 2013).

53 George Baker, "Photography's Expanded Field," *October*, no. 114 (2005), 114–120. Geoffrey Batchen, "Post-Photography," in *Each Wild Idea: Writing, Photography, History* (Cambridge, MA: MIT Press, 2000).

54 Sandra Plummer, "Photography as Expanding Form," *Photographies*, vol. 8, no. 2 (2015), 137–153.

55 See the virtual gallery here: https://0100101110101101.org/show-13-most-beautiful-avatars/.

56 Sebastian Möring and Marco De Mutiis, "Camera Lucida: Reflections on Photography in Video Games", in *Intermedia Games—Games Inter Media: Video Games ad Intermediality*, eds. Michael Fuchs and Jeff Thoss (New York: Bloomsbury Publishing, 2019), 69–93.

57 Vladimir Rizov, "PlayStation Photography: Towards an Understanding of Video Game Photography," in *Game | World | Architectonics: Transdisciplinary Approaches on Structures*

transformations lay bare the intrinsic ludic nature of photography,[58] others view them as thrilling ontological shifts in the history of aesthetics.[59] During the past decade, in-game photography was a niche, a trend, or an optional feature; today, there are games entirely dedicated to photographic shooting (*Umurangi Generation*, 2020), perceiving (*Viewfinder*, 2023), and exploring (*Lushfoil Photography Sim*, 2024).

The technological and aesthetic implications of in-game photography are still being debated. In contrast, the sociocultural and ethical-political ramifications of AI photography are yet to be explored. Over the past couple of years (2022–2024), AI platforms such as DALL-E 2, Midjourney, DreamStudio, Craiyon, and DeepAI have become increasingly popular. As a result, AI photography is transforming various creative industries.[60] AI photography refers to the practice of generating entirely new photos, or enhancing existing ones, through AI or machine learning. The most common method for creating AI photos has been dubbed "promtography," a portmanteau that combines the word "prompt" (i.e., a textual mode of interaction between a human and AI) with "photography." This method allows users to feed the AI any kind of text (e.g., a question, information, or coding), which may or may not be supplemented with an image, in order to elicit a desired synthetic image, which may or may not be called a photograph. The results can be glamorous and astonishing, or unsettling and desensitizing, depending on how skillfully the promtographer has instructed the machine. While text-to-image photo production is a new trend in photography, the use of AI in the field is not. Over the past decade, AI has been steadily, though imperceptibly, (re)shaping photography through (among others) facial recognition, advanced image restoration, image synthesis, noise reduction, automated enhancement, object-detection autofocus, and object removal.[61] The current use of AI in photography, however, extends far beyond these gradual and unobtrusive developments, and

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*and Mechanics, Levels and Spaces, Aesthetics and Perception, ed. Marc Bonner (*Heidelberg: Heidelberg University Publishing, 2021), 50–62.

58 Cindy Poremba, "Point and Shoot: Remediating Photography in Gamespace," *Games and Culture*, vol. 2, no. 1 (2007), 49–58.

59 Jon Robson and Grant Tavinor, *The Aesthetics of Videogames* (New York: Routledge, 2018).

60 For example, see how Adobe is using AI and machine learning to produce photographs: https://blog.adobe.com/en/publish/2021/11/12/how-is-machine-learning-transforming-modern-photography (accessed January 22, 2024).

61 See Joanna Zylinska, *The Perceptive Machine: On Photographic Future between the Eye and AI* (Cambridge, MA: MIT Press, 2023).

it presents us with a somewhat super photography—a kind of photography that is fully entwined with the photographic even though it surpasses its ontological boundaries.[62] In 2023, by utilizing the visual language of the 1940s, the artist Boris Eldagsen won the Sony World Photography Award with his AI-generated image called *The Electrician*—a world's first. Eldagsen refused to accept the prize, thereby calling into question the artistic legitimacy of AI photography. Evidently, AI photography requires digital authorship and documentary veracity;[63] it also demands that we formulate new ways of thinking about individuality, collectivity, and subjectivity at large.

Slowly but surely, photography is also becoming part of ER platforms in the form of virtual reality, augmented reality, mixed reality, and cross reality.[64] ER photography became mainstream thanks to Adobe's 3D models of virtualized objects.[65] At present, it is generating promising results across other platforms and disciplines. For instance, in ecological psychology, visual post-occupancy evaluation is used to restore and revitalize the mental and physical health of individuals.[66] This is a multimethod approach employed by environmental psychologists to assess design outcomes from the users' perspectives. To move in the world from multiple perspectives, VR designers have developed the intricate method of viewpoint-free photography, which enables users to interactively control the viewpoint of a photograph after capture, either in a sedentary or ambulatory position.[67] ER photography has also found its place among behavioral and information scientists exploring the possibility of enhancing spatial memory through the use of panoramic photography.[68] If ER photography was once limited to object design and 3D modeling, it has now become a promising tool in psychology, architecture, and memory studies.

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62 Michael Peter Schofield, "Camera Phantasma: Reframing Virtual Photographies in the Age of AI," *Convergence*, vol. 0, no.1 (2023), 1–23.

63 Deutsche Fotografische Akademie (2023). See https://dfa.photography/.

64 Samuel Greengard, *Virtual Reality* (London: MIT Press, 2019).

65 See https://www.adobe.com/products/substance3d/discover/virtual-photography.html (accessed January 16, 2024).

66 Marco Boffi, et al. "Visual Post-occupancy Evaluation of a Restorative Garden Using Virtual Reality Photography: Restoration, and Behavior in Older and Younger People," *Environmental Psychology*, vol. 13, no. 1 (2022), 1–20.

67 Peter Hedman, *Viewpoint-Free Photography for Virtual Reality* (London: University College London, 2019).

68 M. Carmen Juan, et al. "A Virtual Reality Photography Application to Assess Spatial Memory," *Behaviour & Information Technology*, vol. 42, no. 6 (2022), 1–14.

Having changed dramatically over the past few decades, photography has become integral to video games, AI, and ER platforms. Currently, these are the most common manifestations of virtual photography, but this book considers any photographic practice that originates from a virtual core as virtual photography. Doing so allows us not only to welcome expansions of the medium but also to embrace its future realities.

Structure of the Book

To classify the current manifestations of virtual photography, this book is divided into three thematic parts, each focusing on a particular aspect of the virtualization of the medium. Part I, "Artificial Intelligence and the Algorithm," focuses on the current applications and ramifications of AI, CGI, and deep learning for photography. In chapter 1, drawing on Baudrillard's concepts of simulation, generation, and models, Amanda Wasielewski investigates the historically fraught connection between photography and the real and its implications for the photographic image after the advent of generative AI. Like photography, which is supposed to reveal the latent objective world, Wasielewski suggests that AI-generated photography reveals the hidden facets of the data used to produce it—the objective world of the dataset. In chapter 2, David Bate examines the status of AI photography and the photographic image by distinguishing between fantasy and fiction vis-à-vis photographic image making. He suggests that a great deal of contemporary generative-AI photography can be seen through the conceptual lens of speculative fiction. To highlight this, he explores the evolution of the CGI images produced by IKEA, showing how they have managed to retain a semblance of realism by referring to tangible objects in the experiential world of the viewer. In chapter 3, Ali Shobeiri explores the conjunction of memory and AI photography through Generative Adversarial Networks, asking whether these synthetic photographs can actualize a memory that has never existed factually. By drawing on Henry Bergson's idea of the virtual and Jacques Derrida's notion of the spectral, Shobeiri examines the virtuality of memory and the spectrality of the photograph. In doing so, he proposes the term "larval memory" as a conceptual framework for the ontological status of the memories that have been summoned through AI photography.

Part II, "In-Game Photography and Virtual Adventurism," concentrates on the evolution of photography and photographic functionalities in computer games. In chapter 4, Marco De Mutiis offers an overview of the relationship between photography and computer games from the 1950s to the present, and he investigates how picture taking in games has been evolving in tandem with the development of game hardware and software. In doing so, he suggests the term “playable imaging” to highlight the agency of play in relation to the act of taking pictures and to counter the traditional understanding of photography as a medium that is merely mediated in ludic spaces. In chapter 5, Natasha Chuk examines how the development of photography and the practice of in-game photography reflect our changing relationship with the landscape by both retaining and reimagining aspects of traditional landscape photography. By introducing the idea of the player-game-camera triangle in computer games, Chuk shows how photorealist environments can reflect on the idea of the technological sublime. In chapter 6, Martin Charvát focuses on the photographic representation of the landscape and looks at the transformations of the subgenre of the picturesque in computer games. He proposes that the photographic embodiment of the picturesque is not only an expression of pleasure in the virtualized world but also an index of the existence of the player, which functions as a unique marker of identity across social media communities. In chapter 7, Paula Gortázar shows how the logic of in-game photography is in part driven by the spirit of adventurism—a thrill induced by a range of psychological and biological reactions generated by the accomplishments of different objectives in the game. Gortázar suggests that this sense of adventure is not always derived from confronting risky situations; it is mostly a product of challenging the gameplay’s rules and disrupting its behaviors.

Part III, “Extended and Limited Realities,” investigates how photography can both define and limit our conceptions of reality and virtuality. In chapter 8, Jens Schröter shows that image modeling and simulation have a much longer history than statistical images, and he explores the photographic technology that long preceded and heavily influenced contemporary virtual photography—photorealist computer graphics. By tracing its roots in the 1970s, Schröter argues that early photorealist computer graphics not only formed the basis of computer simulation but also shaped our contemporary understanding of virtual objects, which can be photographed with a virtual camera. In chapter 9, Francesco Giarrusso examines the transformative impact of virtual photography on scientific exploration. He discusses how the visualization of supermassive black holes with the Event Horizon Telescope has redefined contemporary photography. By investigating the methodologies used to create the images of M87, a supergiant elliptical galaxy in the constellation of Virgo containing trillions of stars, Giarrusso shows that virtual photography expands the visual representation of astronomical phenomena and shifts our ontological and epistemological perspectives. In chapter 10, Kris Belden-Adams discusses the role of photography as a lithophane in geological exploration, or as source material for 3D printing and data visualization, thus showing how it can be used to monitor volcanoes for clues of imminent eruptions. Belden-Adams proposes that the highly technological photographs in question are not merely data visualizations; they reveal how virtual photography can insert a hypothetical core into our very understanding of reality. In chapter 11, Dominik Lengyel and Catherine Toulouse demonstrate how photography is employed to represent abstract architectural hypotheses that lead to uncertain, and at times contradictory, assumptions. They argue that the use of virtual photography in architecture can give this uncertainty a concrete shape through spatial projection, thereby creating measurable criteria that serve the unambiguous interpretation of architectural space. Finally, in chapter 12, Helen Westgeest looks into the increasing awareness of the limitations of human vision by exploring what lies just beyond it. Using comparison, she shows that near-infrared photography does not simply virtualize what humans cannot see with their eyes; it also actualizes a world beyond our visual limitations. Westgeest suggests that these virtual photographs invite humans into a contact zone where they can meet nonhumans halfway.

Despite their different approaches and disciplinary backgrounds, the chapters of *Virtual Photography* are meant to serve as historical, theoretical, and methodological examinations of the growing interdisciplinary field of virtual photography, of which this book is an example.

Part I:

Artificial Intelligence and the Algorithm

1. The Latent Objective World

Photography and the Real after Generative AI

Amanda Wasielewski

When OpenAI presented DALL-E 2 on 6 April 2022, one of the sample images they used across social media and in the press was "A photo of an astronaut riding a horse." DALL-E was one of the first visual generative artificial intelligence (AI) platforms to make generating AI-produced images easy and accessible to the general public. The company's release of images such as this was designed to show the range of subject matter and style combinations that could be achieved. And the technology did not disappoint, as evidenced by the ensuing hype that surrounded it. In many of the sample images produced, two incongruous elements—in this case, the astronaut and the horse—are shown pictured together in a seamless way. This is made possible by combining a multimodal text/image model, which builds semantic links between these two "modes" of data using an artificial neural network, and a diffusion model, which is trained to produce new images from noise through a process of adding noise to training images.[1] Together, these models are a powerful engine for image creation.

The launch of DALL-E was not the first time that space exploration had been used to signal the start of an innovative new media platform.[2] The hook in this case, however, is not merely the presence of the astronaut doing something groundbreaking but the strange and fantastical juxtaposition of that astronaut doing something *impossible*, i.e., riding a horse in space. The fact that

1 This work is supported by a grant from the Artists + Machine Intelligence (AMI) research program at Google. Alec Radford et al., "Learning Transferable Visual Models From Natural Language Supervision" (arXiv, February 26, 2021), https://doi.org/10.48550/arXiv.2103.00020; Jonathan Ho, Ajay Jain, and Pieter Abbeel, "Denoising Diffusion Probabilistic Models" (arXiv, December 16, 2020).

2 MTV also famously used the image of the astronaut at its inception.

it is rendered like a photograph aligns this impossible scenario with photography's historic ties to the real.[3] Thus, a new frontier is opened up by this image—but what kind of frontier? The juxtaposition is, on one hand, reminiscent of the Comte de Lautréamont's famous "chance encounter of a sewing machine and an umbrella on an operating table" that was popular among the Surrealists of the 1920s.[4] On the other hand, it is also reminiscent of Jean Baudrillard's definition of simulation as "the generation by models of a real without origin or reality" and his attendant concept of the hyperreal (the etymological cousin of the surreal).[5]

This chapter explores the fraught connection to the real presented by AI-generated images rendered in a photographic style—what I call, simply, AI-generated photographs. Framed by Baudrillard's theory of objects, I argue that AI-generated photographs are defined by the elision of the photographic medium for the task of object recognition. This elision is complicated by photography's virtuality, which is defined by art historian David Summers as a surface with the appearance of "forms in real space."[6] Without the real space or origin presumed to underpin it, however, "The Virtual is no longer the potentially real, as it once was," according to Baudrillard.[7] AI-generated photographs embody precisely this loss of potential for the virtual in photography, i.e., the loss of real space.

Objects and Images on the Operating Table

Like the sewing machine and the umbrella on the operating table, the meeting of the astronaut and the horse is quite literally a chance encounter. It is the product of complex statistical weights in the AI model. Their coming together

3 Amanda Wasielewski, "Unnatural Images: On AI-Generated Photography," *Critical Inquiry*, Autumn 2024.

4 Comte de Lautréamont, *Les Chants de Maldoror* (Paris: Éditions de la sirène, 1920), 323; Shane McCorristine, "Lautréamont and the Haunting of Surrealism," in *Writing in Context: French Literature, Theory and the Avant Gardes*, ed. Tiina Arppe, Timo Kaitaro, and Kai Mikkonen (Helsinki: Helskinki Collegium for Advanced Studies, 2009), 31–49.

5 Jean Baudrillard, *Simulacra and Simulation*, trans. Sheila Faria Glaser (Ann Arbor: University of Michigan Press, 2014), 1.

6 David Summers, *Real Spaces: World Art History and the Rise of Western Modernism* (London: Phaidon, 2003), 431.

7 Jean Baudrillard, *Impossible Exchange*, trans. Chris Turner (London: Verso, 2001), 19.

is not only determined, in the most immediate sense, by the text prompt used but also by a statistical sampling of elements—of objects—in the hundreds of millions of images that have been used to train contemporary AI systems. Visual generative AI tools like DALL-E are able to create this kind of image because they are premised on an understanding of images as content containers rather than representative media. In other words, digital images—particularly photographic images—are used as the eyes of the computer. The field of computer vision concerns itself with an object world pictured through digital photographic images. Thus, an image is not a whole. It is primarily a collection of objects to be perceived—to be "recognized."

Once confined largely to government and military surveillance systems, computer vision technologies are an increasingly ubiquitous part of our daily life. While they are still used as a means to control, police, and wage war, they are also increasingly present in more quotidian applications. For example, we open our phones with facial recognition, we organize photographs with image categorization techniques, and we are asked to prove we are human by identifying bicycles or fire hydrants in reCAPTCHA (Completely Automated Public Turing test to tell Computers and Humans Apart) images provided from Google Street View.

Starting a Yahoo! Mail account circa 2005, a user would be greeted with a verification system displaying an image of some distorted letters with lines running through them.[8] They would have been asked to type in that string of garbled text into a textbox to create their account. Developed by computer scientist Luis von Ahn and collaborators a few years prior, the system known as CAPTCHA (and an updated version called reCAPTCHA) was designed to mitigate the onslaught of automated spam accounts that had grown into an enormous problem for internet users at that time.[9] To do so, Von Ahn and others had to devise ways to separate human users from automated systems, and one of the things that still set humans apart was their visual perceptual abilities. As CAPTCHA was taken up around the internet, Von Ahn realized that his invention required a certain amount of labor from users. Hoping to "do something useful" with this time, Von Ahn implemented text fragments from digitized

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8 Luis Von Ahn et al., "CAPTCHA: Using Hard AI Problems for Security," in *Advances in Cryptology — EUROCRYPT 2003*, ed. Eli Biham, vol. 2656 (Berlin/Heidelberg: Springer, 2003), 294–311.

9 Finn Brunton, *Spam: A Shadow History of the Internet* (Cambridge, MA: MIT Press, 2013), 113.

books and periodicals, effectively asking users to aid in the training of OCR (optical character recognition). And so, ironically, CAPTCHA was involved in the process of training computers to "see," which would ultimately void its usefulness. In a very real sense, CAPTCHA dug its own grave.

After Google acquired reCAPTCHA in 2009, they continued to enlist unwitting users to perform computer vision training tasks in the name of internet security.[10] Since 2012, Google has used its vast repository of Street View photographs as part of the reCAPTCHA system, beginning with house numbers.[11] After OCR, i.e., text recognition, was effectively solved, Google moved on to objects pictured in Street View images. Internet users today are thus still asked to choose which squares from a street view image contain bicycles, traffic lights, or crosswalks.

The rise of deep learning in computer vision, aided in part by twenty years of CAPTCHA input data from users, has made the idea behind image-based security measures obsolete.[12] Images of all kinds are now, in fact, extremely machine readable. Computers can accurately decipher garbled text or identify unclear objects in photographs. What this means is that the camera is often conceptually positioned and implemented as the artificial eye of the computer. Because of this, one might naturally leap to the assumption that machines can "see." However, the process by which camera/computer and eye/human operate are very different. So, computer "vision" or "sight" is simply a metaphor.[13] Nevertheless, as the camera and eye are conflated, both are understood as mere mechanical tools, passively able to take in information about the world. They

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10 Leena Rao, "Google Acquires reCaptcha To Power Scanning For Google Books And Google News," *TechCrunch* (blog), September 16, 2009, https://techcrunch.com/2009/09/16/google-acquires-recaptcha-to-power-scanning-for-google-books-and-google-news/.

11 Sarah Perez, "Google Now Using ReCAPTCHA To Decode Street View Addresses," *TechCrunch* (blog), March 29, 2012, https://techcrunch.com/2012/03/29/google-now-using-recaptcha-to-decode-street-view-addresses/.

12 Although consumer-focused tools are often programmed to reject user requests to decipher CAPTCHAs, machine learning expert Denis Shiryaev published his successfully attempt to trick Bing Chat into decoding a CAPTCHA in October 2023. See Benj Edwards, "Dead Grandma Locket Request Tricks Bing Chat's AI into Solving Security Puzzle," *Ars Technica*, October 2, 2023, https://arstechnica.com/information-technology/2023/10/sob-story-about-dead-grandma-tricks-microsoft-ai-into-solving-captcha/.

13 Wasielewski, "DALL-E in Flatland: Illusion, Space, and AI-Generated Images" *Media Theory* [forthcoming]

are seen as neutral in some way, or pure in how they receive impressions from the world.

In "Surrealism and Painting" (1928), André Breton begins with the line, "The eye exists in a savage state."[14] For Breton, vision is a form of bodily automatism, disconnected from the rational thought that pollutes it. As art historian Rosalind Krauss explains, "Besides being untainted by reason, vision's primacy results from the way its objects are present to it, through an immediacy and transparency that compels belief."[15] Vision is, thus, reduced not just to an automatic procedure but to one with a singular purpose: object recognition. Vision is a means by which to access objective reality, or the ontology of objects.

Jean Baudrillard's writing addresses precisely the nexus of relations that AI and object recognition raise, between images, objects, and the real. For Baudrillard, photography is a process of objectification, and AI image generation ultimately reinforces the view of photography as objectifier.[16] Vis-à-vis automation, photography is understood to reveal the latent objective world. For the Surrealists, it was also a manner by which to tap into the symbolic world of the mind that was often situated in the form of the object. AI-generated photographs, in turn, reveal the hidden facets of the data used to produce them—the object world of the dataset.

It is not often acknowledged but Baudrillard was an image-maker—a photographer—in addition to being a writer/theorist, though he only addresses photography's history and theory directly in a few of his essays. Baudrillard saw photography as, essentially, a process of objectification.[17] He writes, "To take photographs is not to take the world for an object, but to make it an object, to exhume its otherness buried beneath its alleged reality..."[18] Following this, object recognition is not the primary site where the photograph becomes a collection of objects. Instead, it provides a further layer of objectification on those things already long-objectified in the image. Said differently, the photographic images used to train computer vision systems have already transformed the world into a set of objects, and, so, the layer of data produced to

14 André Breton, *Surrealism and Painting*, trans. Simon Watson Taylor (New York: Harper & Row, 1972), 1.

15 Rosalind Krauss, "The Photographic Conditions of Surrealism," *October* 19 (1981), 10.

16 Nicholas Zurbrugg and Jean Baudrillard, "Fractal Theory," in *Baudrillard Live: Selected Interviews*, ed. Mike Gane, trans. Nicholas Zurbrugg (London: Routledge, 1993), 168.

17 Ibid.

18 Jean Baudrillard, "For Illusion Isn't the Opposite of Reality...," in *Jean Baudrillard: Photographies, 1985–1998*, ed. Peter Weibel (Graz: Hatje Cantz Publishers, 1999), 132.

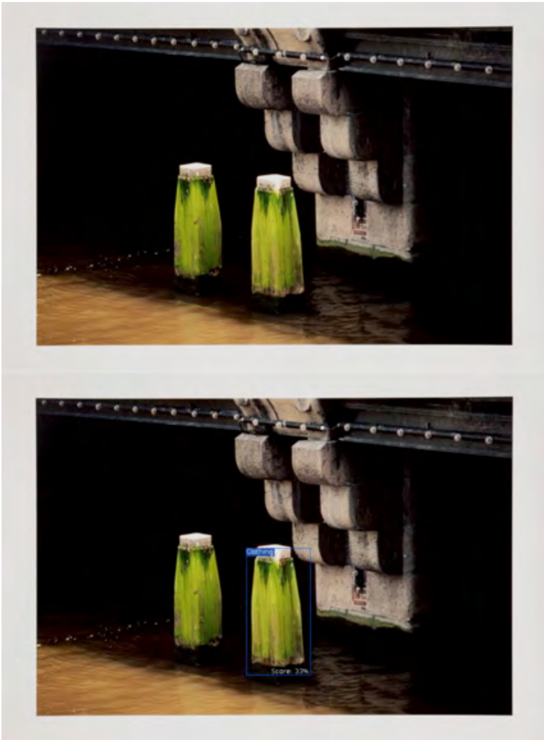
help identify those objects with words and automate their categorization represents a further objectification.

In Baudrillard's photography, he does precisely what he describes in the quote above: he harnesses photography's objectifying powers. The images he creates have an uncanny quality, where a skillfully cropped detail takes on a strange otherness despite its ordinariness. His photos often show objects in a state of decay or weathering, either well-used or long-abandoned. Objects pictured in these photos crack or rust or peal in a direct affront to their supposed usefulness. In *The System of Objects*, Baudrillard reflects at length on the concept of functionality in relation to objects. He writes, "The materiality of objects no longer directly confronts the materiality of needs, these two inconsistent primary and antagonistic systems having been suppressed by the insertion between them of the new, abstract system of manipulable signs—by the insertion, in a word, of *functionality*" [italics original].[19] In a way, then, Baudrillard uses already unfunctional objects and removes a second layer of functionality. He takes away the symbolic layer of function for the image, i.e., the layer of language, where one might assign a name or a type (and thus, a function) to each of the objects. Following this, AI-enabled object recognition attempts to put language back into the image.

In Baudrillard's photograph *Amsterdam* (1992) (Fig. 1.1), for example, a pair of bright green algae-covered piers poke out of a river in front of a bridge support. The close cropping of the photo abstracts these elements from any reading of the image that points to their highly functional purpose, namely the protection of the bridge from errant boat collisions. They become part of a flattened collection of purposefully-formed objects with no evident purpose. Before beginning to write about this photo, I puzzled over what these objects in the water are actually called. I could not find any other term except "pier," which felt a bit too generic. Never mind. I need not have bothered anyway, since the identification of the object seems so decidedly unimportant to the image. The objects depicted have, in other words, somehow been stripped of their recognizability, despite my natural inclination to describe them in some categorical terms.

19 Jean Baudrillard, *The System of Objects* (London: Verso, 2020), 68.

1.1 Jean Baudrillard, Amsterdam, 1992, 60 x 90 cm (paper size); 50 x 75 cm (image size), giclée print on pure cotton paper.



Source: Château Shatto gallery. © Jean Baudrillard. Reproduced with the permission of Marine Baudrillard.

In addressing this quandary, I decided to turn to AI object recognition software. Aided by several free online tools, which all appear to use Google's Cloud Vision API, I found that these objects were identified as "clothing" by the AI computer vision algorithm. While there may be better object recognition tools available that could identify these objects with more accuracy, the exercise seems to neatly demonstrate the point above, namely, that these photographs defy both the function of the objects depicted and an additional layer of functionality reserved for the image itself.

When the filmmaker Harun Farocki coined the term "operational images" in his film series *Eye/Machine* in 2001, computer vision and object recognition were still rudimentary in their capabilities.[20] Farocki defined operational images as images that "do not represent an object, but rather are part of an operation."[21] Thanks to contemporary deep learning and neural networks trained to do object recognition, any and all images today could be deemed "operational." This means that all images now have the potential to be used as part of operations, i.e., they are all machine readable and interpretable. Farocki discusses the use of operational images as those that are, in a way, free from authorship or intention—free even from being "custom-made to mean something to us."[22]

In both his film work and media theory, Farocki was influenced by the theorist Vilém Flusser, who used the term "technical images" to describe electronic images in the mid-twentieth century.[23] He describes these images as abstractions from texts, that are "not surfaces but mosaics assembled from particles."[24] Farocki similarly describes operational images (implying *automated* images) as those in which "each movement is broken down into fragments, and each fragment of the movement is performed with equal dedication."[25] Flusser's work and its description of the fractured nature of the technical image can be usefully applied to AI-generated photographs, which are likewise piecemeal or particulate compositions that have been abstracted from large datasets and text-based prompts.

As I have discussed previously, the underlying operation of computer vision and object recognition is, on a technical level, a fractured process, which reflects the make-up of most digital images (and thus their machinic processing) as a grid of pixel values.[26] These fractured processes are not done in the ser-

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20 Volker Pantenburg, "Working Images: Harun Farocki and the Operational Image," in *Image Operations*, eds. Jens Eder and Charlotte Klonk (Manchester: Manchester University Press, 2016), 49–62.

21 Harun Farocki, "Phantom Images," trans. Brian Poole, *Public*, January 1, 2004, 17, https://public.journals.yorku.ca/index.php/public/article/view/30354.

22 Ibid., 18.

23 Christa Blümlinger, "An Archaeologist of the Present," *E-Flux Journal*, no. 59 (November 2014), https://www.e-flux.com/journal/59/61092/an-archeologist-of-the-present/.

24 Vilém Flusser, *Into the Universe of Technical Images*, trans. Nancy Ann Roth (Minneapolis: University of Minnesota Press, 2011), 6.

25 Farocki, "Phantom Images," 17.

26 Amanda Wasielewski, "Authenticity and the Poor Image in the Age of Deep Learning," *Photographies* 16, no. 2 (May 4, 2023): 191–210.

vice of connecting or constructing an understanding of the whole but, rather, in *segmenting*. Segmentation is a term used in computer vision to indicate the division of the image into neatly delineated and identified objects. Each object is an individual in an empty two-dimensional field, independent from that field. It is discrete. It is not part of any relation, except a binary ontological one, i.e. whether the object is present in the image or not. For example, an automated security camera using computer vision software is not designed to capture a scene per se but, rather, to capture *objects* as they appear/wander into its field of vision. These objects pass under the security camera's machinic eye, individually recognizable as a type. The common way that segmentation is represented in image data for human consumption is as a bounding field that isolates and labels the object, separating it from the surroundings. Even the specificity of individual objects is thus reduced to abstraction.

Given this, what is at stake in object recognition? Say, for example, a *person* is the object that will be recognized in an image. This person is an individual and will thus will be identified and labeled in some way that names them. It may be their actual name or it could be "person" or another larger category. This label might be prejudiced, unfair, simplistic or erroneous, but it will nevertheless point out the pattern of pixels that represent the appearance of individuality in an image and match it to others like it with a high level of precision.[27] The label is the final gloss on what is otherwise simply a matching exercise. In other words, there is a connection to the real in such exercises (even if that real is mischaracterized) but each training image is still a photographic representation that is distanced from its real-world referent by its representational transposition through camera and lens. Computer vision, in other words, is not the same as a machinic eye. It is the identification of patterns in photographic representations. This creates the illusion that such systems *understand* objects—that they understand the world in general—but they do not.

What we call artificial intelligence today is not equivalent to artificial *general* intelligence (AGI), the powerful thinking machines that are familiar from science fiction. Despite the Silicon Valley rhetoric around AGI, there are currently no machines that think, plan, and adapt the way that biological creatures do, despite the rapid development and increasing sophistication of deep learning systems. Baudrillard wrote about artificial intelligence (at least, in this hy-

27 Kate Crawford and Trevor Paglen, "Excavating AI: The Politics of Images in Machine Learning Training Sets," 2019, https://www.excavating.ai/.

pothetical sense) long before the present developments, but his statements resonate with the situation today:

> Let us say, before it is too late, that artificial intelligence is incompatible with thought for the simple reason that thought is not an operation, that it is not exchangeable for anything whatever, and, most particularly, not for the objectivity of an operational calculation of the input-output type.[28]

It is a remarkably prescient statement, given the current debates around whether computer can be trained to truly understand the meaning of words or images.[29] According to Baudrillard, it is an impossibility that computers can think or understand for the simple reason that *we* are not computers. Thought and computation are not equivalent. Computers may be able to imitate or simulate "our psychological and social mechanisms," he argues, but they are performing nothing more than a kind of "plagiarism."[30] Indeed, he points to the same manner of conflation between computer and human being that haunts rhetoric on the camera and the eye.

In order to explore this concept of imitation further, I return once again to Baudrillard's *Amsterdam* photograph. This time, rather than try to categorize it, I plagiarize it. In other words, I use text-to-image AI models to create something of its type. The task, paradoxically, is to describe an object that defies description. I used DALL-E 2 (with outpainting) and Midjourney (v.5.2), a competitor of DALL-E, for the exercise since DALL-E 3, at time of writing, does not produce images that look sufficiently photographic.[31] A selection of two of the resulting images, from around fifty images generated (Figs. 1.2 and 1.3) resonate with Baudrillard's photograph. All three images—the two AI-generated ones and Baudrillard's photograph—are closely cropped and relatively abstract. All three contain the same shade of algae green, though Baudrillard's photograph is more visually striking in its contrast and composition.

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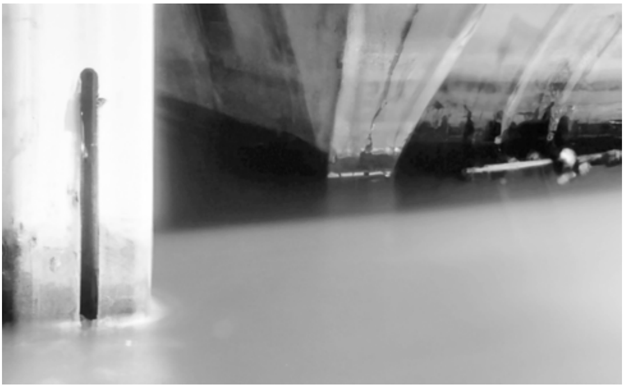
28 Jean Baudrillard, "Beyond Artificial Intelligence: Radicality of Thought," in *Impossible Exchange*, trans. Chris Turner (London: Verso, 2001), 146.

29 See, for example, the "stochastic parrot" debates: Emily M. Bender et al., "On the Dangers of Stochastic Parrots: Can Language Models Be Too Big? 🦜," in *Proceedings of the 2021 ACM Conference on Fairness, Accountability, and Transparency* (FAccT '21: 2021 ACM Conference on Fairness, Accountability, and Transparency, Virtual Event Canada: ACM, 2021), 610–623.

30 Baudrillard, "Beyond Artificial Intelligence," 148.

31 This change in DALL-E was notable from version 2 to 3

1.2 DALL-E-2 image created with the prompt "photograph 35mm photorealistic green pillar sticking out of brown water under a bridge green abstract next to stone bridge" (June 2023).



1.3 Midjourney image created with the prompt "photograph 35mm green pillar sticking out of brown water under a bridge green abstract next to stone bridge –ar 16:9 –style raw" (December 2023).

In the end, what is produced does not actually reverse the object recognition task, since there is more to these images than the text itself describes. We do not see two piers in a blank field but rather in a field populated by chance encounters, i.e. things statistically weighted to be appropriate to this image prompt. Applying the object recognition software once again to these AI-generated photographs, I find that Figure 1.2 (DALL-E 2) is labeled "window" and

Figure 1.3 (Midjourney) "fountain." The latter is, perhaps, the more accurate of the three. However, the exercise still demonstrates the extent to which these AI-generated photographs seem to defy functionality in a similar way that Baudrillard's photographs do.

Imagining the Photographic Form

The value of the image for object recognition operations in computer vision, then, is not in its overall meaning or composition—not in a thought process that comprehends the image per se—but rather merely in its contents/what is depicted. By contrast, Generative AI takes the segmented or fragmented nature of training images, i.e., those images that have been used for object recognition exercises, and compiles images from the places in the latent space of the model where image fragments associated with those words are located. In other words, the AI model is no longer trying to successfully identify a bicycle pictured in a photograph but, rather, is trying to create a new bicycle based on the learnings from the training data. Object recognition categorizes the individual to a general label, whereas generative AI produces an individual from a general category. Thus AI-generated photographs do not produce general objects (as a category) but rather produce a *specific* object (an individual).

Midjourney is accessible through a Discord server, where users create images by typing the command "/imagine" along with the text prompt describing what they want the image to contain. While scholars may debate the creative capacity of AI, it is clear that these tools can be used to "create" or "imagine" in the most basic etymological sense of producing images.[32] But what kind of images can they imagine? A typical text prompt consists of words that describe the content or objects pictured in an image and, perhaps but not necessarily, words that describe the style in which those objects are depicted. The visual field is, thus, conceived of as a plane on which to fill in things. It is a kind of stage to be choreographed or arranged.

32 See, among others, Joanna Zylinska, *AI Art: Machine Visions and Warped Dreams* (London: Open Humanities Press, 2020); Bojana Romic and Bo Reimer, eds., "Artificial Creativity," *Transformations Journal*, no. 36 (2022); Hye-Kyung Lee, "Rethinking Creativity: Creative Industries, AI and Everyday Creativity," *Media, Culture & Society*, vol. 44, no. 3 (April 1, 2022): 601–12; Ziv Epstein, Aaron Hertzmann, and the investigators of human creativity, "Art and the Science of Generative AI," *Science* 380, no. 6650 (June 16, 2023): 1110–11.

However, unlike a painting that is created from a blank canvas, everything that appears in an AI-generated image has *not* been decided or specified by the prompt writer. In this way, AI-generated imagery is far more like photography. As a test, I input the prompt "an umbrella and a sewing machine on an operating room table –ar 16:9 –style raw" into Midjourney. This prompt is, of course, an attempt to "imagine" the evocative line from the *Les Chants de Maldoror.* The operating table is sometimes translated as dissection table, but neither the words "operating table", "dissection table" or "operating room table" came through with an image that very strongly reflected this simple description. Instead, in the dozens of images I created, the sewing machine was always placed on what looks more like a normal sewing table rather than a medical bench. The training association between the sewing machine and the purpose-built sewing table is too strongly weighted, it seems. Nevertheless, the objects that I requested appear in the images produced.

1.4 Midjourney image created with the prompt: "an umbrella and a sewing machine on an operating room table –ar 16:9 –style raw" (November 2023).

But they are not all that appears. Looking closer at one of the resultant images from this prompt (Fig. 1.4), one can see that there are some objects pictured that were not specified in the text, as there always are in AI-generated images. One of these objects is a spotlight lamp, shown hanging over the table in a somewhat gravity-defying manner. The other object is difficult to describe. It looks like some kind of surgical room equipment—a chair? a table? a stool?—covered by a thick fabric with piles folded on top. The periwinkle blue fabric and its thick, shiny texture evokes the material worn by surgeons in the operating room or the kind of protective gear a medical professional or their equipment might have. On top of this strange object is what looks to be a pan for surgical implements. As this example demonstrates, AI-generated images tend to contain two broad categories of anomalous objects: those we might expect to be there and those we struggle to identify. For example, in a prompt requesting a street scene, we may expect that cars and people and other elements of the street will be generated in the image even if not specified in the prompt. These are things that are typically part of a street. However, there may also be things we cannot recognize or identify—hybrids or blobs that are hard to decipher.[33]

Like photography, generative AI captures the incidental details of what "is there"—the accidental objects that happen to be in within its frame. For photography, this means that, when one presses the button or closes the shutter, one cannot always control *all* of the things that appear in the image. Photographers may try to curate the subject of a photograph, arranging or selecting certain elements they see, but there are always ambient details that are unplanned or, even, unwanted. For AI-generated imagery, capturing what "is there" means capturing the image data that is associated with certain words in the latent space of the AI model, i.e., the matrix of associations built up when the model was trained on millions of images and text pairings.

The details that appear in the AI-generated image are thus phantom image parts and truncated textures or appearances of certain pixel combinations that are somehow proximate to the words of the prompt in the model. In the case of the umbrella/sewing machine image, this strange surgical equipment/fabric combination has wandered into the frame, so to speak. Baudrillard writes, "The robot is a symbolic microcosm of both man and the world, which is to say that it simultaneously replaces both man and the world, synthesizing absolute functionality and absolute anthropomorphism."[34] The AI-generated image is a kind of snapshot, then, not directly representing the world but instead representing a *model* of the world, which is itself represented by photographs.

33 There is also a third, though less likely, category of objects that may appear: those that we do not expect to be there but recognize as known objects. For example, it is possible that an elephant would appear in the aforementioned street scene. This is highly unlikely, however, because most of the *training* images of street scenes would not picture an elephant.

34 Baudrillard, *The System of Objects*, 129.

Baudrillard's concept of the real, as discussed in "The Precession of Simulacra" (1981) is illustrative here. He opens this famous essay with a discussion of the Borgesian map that is so large it becomes the territory, claiming that this classic fable about representation is "unusable" and that there is no longer any difference to draw between the two, i.e., between the real and representation. The "map precedes the territory," he argues.[35] This is exactly the kind of representational relation that occurs in visual generative AI. These AI models are essentially representations, a kind of map of the world. This map is not a direct representation of the world, however, but rather a collation of image-based representations. The underlying reality behind the model is thus difficult to trace. Despite this complex dimensionality, however, the model is able to *generate* a real—or a hyperreal—in the form of singular images. Thus, the map *produces* the territory for AI-generated imagery. Baudrillard writes, "The real is produced from miniaturized cells, matrices, and memory banks, models of control—and it can be reproduced an indefinite number of times from these… It is no longer anything but operational."[36] So we are dealing not only with operational images but a kind of operational reality, where simulations beget simulations.

There is a common misconception today that AI-generated images are a collage or mashing together of existing imagery. Collage and remix require fragmentation and, even, repetition, but are essentially heterogenous mixtures that still maintain the integrity of their parts. AI-generated images, on the other hand, are the products of a chemical reaction where the parts that go into making it are fundamentally transformed in the process. The outcome is no longer merely a mixture or a mashing together of parts but something new.

This does not make AI-generated images less derivative, but it does represent a fundamental change of state. Baudrillard writes that, for simulation, "everything is already dead and resurrected in advance."[37] The process of objectification means that there is no underlying reality to reference, no real to compile or collage. So, despite their origins in individual datapoints, AI models are not creating new images based on a mashing or a mixing. There is no reference, no "living" reality behind these images but rather another set of objects. In other words, they are pure simulacrum.

35 Baudrillard, *Simulacra and Simulation*, 1.

36 Ibid., 2.

37 Ibid., 6.

Photography has often evaded claims to realism based on technicalities. It could not be called "realistic" because it lacked color. Or because it is still. Because it is silent. Because it is cropped. Because it is a lens-based reflection, distortion or transposition.[38] Baudrillard writes that these factors mean that "the photograph is the purest and most artificial image."[39] True in theory, perhaps, but these faults or failings never did much to quash photography's popular association with the real.

The rise of Photoshop and digital photography in the 1990s, however, seemed to eliminate the need for such technicalities. Instead, the lack of realism in the photographic image could be easily explained away by the ubiquity and seamlessness of image manipulation, of "photoshopping." Given the recent advances in generative AI technologies and platforms, any need for such technicalities or claims of manipulation fall away entirely. Photography cannot possibly lay claim to the real anymore. And yet, it inevitable and inextricably does. The aspects of form that seem so essential to photography are, in fact, not. Adjacent to these arguments is the idea that photography was not the paradigm-shifter it is sometimes claimed to be.[40] The paradox of contemporary photography is that it cannot escape its history. So it does not matter how distant the contemporary products of AI are from camera and lens-based photographs, they nevertheless continue to evoke the real, even when there is little to none to reference. From *The Pencil of Nature* to camera phone documentation, the photographic subject exists in a state of expectation or presupposition for the real.[41]

Surrealist photographers used this facet of the medium to evoke the uncanny. No sophisticated techniques were necessary: simple cropping or multiple exposures were often enough to do the job. The work of Jacques-Andrés Boiffard, for example, captures body parts in unexpected ways through cropping and camera angles. Realism and the sense that something is off coexist in photographs such as *Orteils et doigts croisés* (1929), which depicts toes and fingers interlaced together in an unnatural-looking way. This image is reminiscent of

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38 Sabine T. Kriebel, "Introduction," in *Photography Theory*, ed. James Elkins (New York: Routledge, 2007), 4–5.

39 Baudrillard, "For Illusion Isn't the Opposite of Reality," 140.

40 Kirk Varnadoe, "The Artifice of Candor: Impressionism and Photography Reconsidered," *Art in America*, vol. 68, no. 1 (1980): 66–78.

41 Henry Fox Talbot, *The Pencil of Nature* (London: Longman, Brown, Green & Longmans, 1844).

the digit confusion that continues to appear in even the latest iterations of text to image generators, such as DALL-E-3 (Fig. 1.5).[42] The photographic appearance of the image heightens the sense of uncanniness because it is accompanied by the assumption of the subject's realness.

1.5 DALL-E-3 Image (via Bing Image Creator) created with the prompt "photograph of fingers and toes interlaced together" (December 2023).

A corpse is uncanny not only because we know that this body was once animate but because it has been reduced from a living thing to an object. It still carries the name it once had but it has completely transformed. It is no longer a person, no longer *that* person specifically. So too are the things pictured in a photograph, which are always already objectified. Baudrillard observed this, saying, "We are continually speaking of the disappearance of the object in photography—that's how it was, it's not like that now—and there is indeed a kind

42 Amanda Wasielewski, "'Midjourney Can't Count': Questions of Representation and Meaning for Text-to-Image Generators," *IMAGE: Zeitschrift Für Interdisziplinäre Bildwissenschaft*, vol. 37, no. 1 (May 2023): 70–81.

of symbolic murder in the photographic act."[43] Baudrillard was by no means the first to associate photography with death or the act of murder.[44] But his triangulation of photography, objects, and death leads in a slightly different conceptual direction to the evocation of the uncanny.

Part of what makes *AI-generated* photographs uncanny is their double objectification, first in a distant way as photographic training data and then, more specifically, as categorized or segmented forms with names or labels. The objects and appearances in AI-generated images are, in other words, like dolls assembled from individually-created parts. They resemble the things that populate human experience and yet they are not. They are doppelgangers. They bear their names and appearances but they are transformed. This is why these images can seem strange and uncomfortable, even when rendered seamlessly. They emerge from a regress of objectification.

Conclusion

If object recognition dissembles a level of understanding it actually lacks, generative AI exposes the illusion through the process of creating individuals. So, what is at stake in image generation? The extrapolation of individuals to create something new of a type, of a label. Whatever one finds oneself labeled as, therefore, generative AI can create a new one of "those" (meaning, you or me or anyone/anything else singular) and it will be non-identical to anything it has created before or after. It will be singular but still derivative, and, unlike the objects identified in an object recognition exercise, it will be something without reference to the real. It is more apt, then, to call it hyperreal, a virtual photograph with no connection to the real.

Baudrillard's assertion that "the model comes first" has never been more literal than it is after the advent of generative AI.[45] The visual generative AI model, however, is not a model of reality per se but a model built largely on

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43 Baudrillard, "For Illusion Isn't the Opposite of Reality," 147.

44 Many have noted this facet of photography, see, for example: Susan Sontag, *On Photography* (New York: Penguin Books, 1977); Roland Barthes, *Camera Lucida*, trans. Richard Howard (London: Vintage, 2000); Philippe Dubois, *L'acte photographique et autres essais* (Paris: Nathan, 1990).

45 Baudrillard, *Simulacra and Simulation*, 16.

photographic representations. These photographs, in turn, have already operated on the world in a specific way. Following Baudrillard, they have objectified it. Photographs are the end of a process but also the beginning of a new process.

2. Photography as Speculative Fiction

David Bate

Photography is so embedded in everyday life that when its values change the semblance of everyday life changes too. This chapter addresses, both directly and indirectly, the concern that seems to be expressed everywhere about the relation between computational images, photography, and AI. The theme of AI (Artificial Intelligence) is quite often a short-hand way to refer to a clutch of different aspects of a fast-changing visual image culture, and more specifically concerns the key role inherited from photography and adopted in digital culture. Many of the questions that are asked about this relate to two fundamental anxieties. The first anxiety is that the computer image has replaced reality: reality is nothing but a series of images, repeated endlessly across a network, whose architecture today is the World Wide Web. In this network of networks, reality does not seem to be what it used to be. The second anxiety, which only appears to be more recent, is that the photographer (and their ability to exert agency) is being automated: replaced by computer algorithms and software. Automation is not what it used to be either.

These two key anxieties, whether expressed as personal, social, political, or economic concerns can easily become emotive issues as well, compounded perhaps by a third anxiety: mega corporations, whose new meta powers of development and control of technical processes seems to outstrip any capacity to regulate them. It is thus quite easy for such discussions to become rather abstract and generalized, so I want to refer to specific examples that will, I hope, help to demonstrate some of the issues in more concrete detail. It is also necessary to say that the critical theory of photography has been left somewhat lost and perplexed about these changing technological conditions of photographic images. What is to be done with the popular suspicion that what you see is not what you get with digital images? This perplexity is compounded by the fact that (despite what has just been said) photographers continue to make images described as "photographic" and still viewed and circulated with complete faith in their visuality. While a virtual photograph is image appears to make direct reference to reality, at the same time it is also acknowledged and recognized (depending on any individual's skepticism) that a number of machinic processes are involved in its making, which now make any data image suspiciously subject to accelerated manipulation and bias. What is raised is the specter of old debates between what is true and false, reality and fantasy, symbolic and imaginary, dualities that seem under stress from new technological developments. I will start with an example from the advertising industry, before moving towards the question of creative work, visual art, and generative AI. Advertising is an important case study because it relies on conventions of photographic realism as well as fantasy.

75% Virtual Photography

If you have heard of IKEA then you will likely already know that it is a Swedish brand of home furnishings distributed worldwide (over 400 stores around the world). "Flat pack" or ready-to-assemble products are ordered from shops, websites, and apps. IKEA sells not only single products but also presents these goods in photographic images as realistic scenes of a whole lifestyle. The images generate domestic ideals, designs for living as a variety of combinations of "Scandinavian-inspired" lifestyle choices. These virtual rooms, imagined bathrooms, kitchens, lounges, dining, lobby, child-friendly playrooms, home offices and so on are a vital component of their business model and success. IKEA's ideal is presented as photographic scenes which function to educate and inform consumers about how to use and organize their IKEA products, how to combine them into a "personal design" choice, as a lifestyle image. The visibility of the products combined in these photographs, as scenes, is thus central to IKEA: these photographic images can be said to constitute the public interface of IKEA, its reality is manifest as a brand through these images. IKEA are the first to admit that the styles and values of their photographic images are key, absolutely central to their worldwide identity and global success.

In August 2014, the popular USA magazine *Good Housekeeping* reported: "There's a secret behind IKEA's catalog photos." The sub-heading added: "And you're not going to believe what it is."[1] The magazine revealed that 75% of IKEA

1 See https://www.goodhousekeeping.com/home/a25588/ikea-catalog-cgi/ (accessed August 11, 2023)

catalogue photographs were actually "computer generated images" (CGI), meaning that their catalogue images are mostly generated on computers at a desk and not produced by a camera in a photography studio with real furniture. The photography website *PetaPixel* published the same story in the same month with a more direct headline: "When You Flip Through an IKEA Catalog, 75% of the 'Photography' You See is CGI." Photography has been replaced by computer generated imaging. Note that they put the word "photography" in "quote marks" as under suspicion, implying computer generated imagery is not really photography, replaced by CGI.

The same story echoed across other media outlets like a rhizome. As these stories bounced around media channels, the source of the story turned out to be IKEA itself. It was Martin Enthed, Swedish head of digital management at IKEA, who in an interview given to *Computer Graphics Society* website revealed the 75% statistic, claiming that most of IKEA's catalogue photographs were generated by computer engineers rather than photographers, no longer photographed with a camera by a photographer. Enthed elaborated:

> about 75% of all IKEA product images are CGI, and rendered at 'ridiculously high resolution' so they're good for everything from web viewing to wall-sized displays in IKEA's stores. And as time goes on and rendering software continues to get better, traditional photography promises to play a smaller and smaller role.[2]

In fact, all this had started before 2014. Already two years earlier in 2012, *The Wall Street Journal* had announced that IKEA was using CGI images with the cheerful headline pun: "IKEA's New Catalogs: Less Pine, More Pixels."[3] In the UK, the liberal newspaper *The Independent* had also run the same story in 2012 with the fact-sounding literal headline: "Three quarters of the Ikea catalogue is CGI."[4] We learn that detailed 3D models of products are dropped into vir-

2 See: https://petapixel.com/2014/08/28/flip-ikea-catalog-75-photography-see-cgi/ (accessed August 17, 2023)

3 Jens Hansegard, "IKEA's New Catalogs: Less Pine, More Pixels Computer-Generated Images Aim to Save Money on Marketing Costs as Photographers Are Retrained to Apply Skills to 3-D Scenes," *The Wall Street Journal*, Aug. 23, 2012. https://www.wsj.com/articles/SB10000872396390444508504577595414031195148 (accessed July 4, 2023)

4 James Vincent, "Three Quarters of the Ikea Catalogue is CGI," *The Independent*, 1 September 2014, https://www.independent.co.uk/tech/three-quarters-of-the-ikea-catalogue-is-cgi-9704120.html(accessed January 30, 2024)

tual CGI rooms. *PetaPixel* too had already run a similar story in 2012 as well with the headline: *IKEA Slowly Shedding Photography in Favour of Computer Renders*.[5] The article went on to include visual examples, asking: "Of the two images above, one of them is a computer render and which one of them is an actual photograph. Can you tell which is which? If you can't, why should IKEA?" They continued:

From the furniture to the beautiful light falling on the countertops and wood floors, what you're looking at is a CGI rendering that has replaced 75% of the 'photos' in the IKEA catalogs.[6]

The essence of all these news stories bubbling around 2012–2014 was that IKEA replaced 75% of its photography with computer generated images, made by computer engineer/designers not photographers. The implication of the story is that photographers and photography itself is no longer needed, was becoming extinct, surplus to requirements. Little comfort that 25% of images are still photographs made by photographers with cameras.

Now, before I turn to the implications raised by all this for "photography," there is an obvious question: *why* did IKEA do this? Why invest in "new tech" and turn away from studio photography? Why turn computer-generated images into images designed to resemble photographic images, rather than computer graphic images? Why not just continue shooting in photography? Firstly, IKEA cite essentially practical reasons: *cost* and *efficiency* as driven by the company's motto, its mission and aim to reduce year-on-year costs (a key criteria of IKEA's business structure).

CGI saves time and money. For studio photography, products have to be shipped around the world for photo-shoots. Furthermore, IKEA produces thousands of images of products for dissemination all over the world, each of these are often produced in different colors, sizes, series, and combinations. As a global business, IKEA has many hundreds of different product lines that must be organized, catalogued and listed as "product shots" as well as then also often combined into the pictured scenes, designed to appeal to local regional tastes. It takes a huge amount of work and effort to photograph new objects and re-photograph them again every year. Even if the product only has

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5 Michael Zhang, Petapixel, 24 August, 2012, "IKEA Slowly Shedding Photography in Favor of Computer Renders," https://petapixel.com/2012/08/24/ikea-slowly-shedding-photography-in-favor-of-computer-renders/ (accessed August 23, 2023)

6 Ibid.

minor modification or upgrade, it needs to be photographed again, because it has to match the actual product bought by consumers. Anneli Sjogren, head of photography at IKEA noted in 2012 that kitchens are the most complex and expensive to create for studio photography: "A kitchen has to be built in a week or two and then torn down the following week to make room for a bedroom shoot, everything has to run like clockwork."[7] So, with a virtual computer generated room, virtual product images can be placed in it instead, the kitchen and other rooms can be designed almost completely as computer generated virtual images. The designer can then choose from these computerized virtual products and other CGI items (plants, toys and other homely items) to organize them into a coherent whole with the furniture, drapes and flooring. IKEA also does not have to throw away products used on sets after a photo shoot. This way, a virtual kitchen scene can be quickly adjusted for local taste, IKEA notes, for example, in Germany and the USA customers typically prefer dark toned furniture, whereas Scandinavian and Japanese cultures prefer lighter toned products. The CGI basil plant on the counter, never wilts, Sjogren says. It saves money and environmental resources to not have to ship objects to photography studios, to build room sets, and so on.[8] As will be seen, such issues of economy and efficiency are not only about a business model, they also relate to the ideological function of photography, its convention as a medium of transparency, which is central to issues in communication theory: the economy of information, the transmission of meanings, and the effectivity of messages.

What are the implications that arise from these new processes of image production and their effect on what we still call *photography*? Are these anxieties about the replacement of one type of labor (photography) by another one, computer automation and software? Or is it about the effects on photographic realism being replaced by computer simulations of photography? What *are* the effects of these processes of datafication? What and where are the actual differences inside the *image* itself? Does it make any *difference* to the conception of the image and its references (e.g., IKEA's products?) or any other kind of social value of photographic image? Let's start where IKEA started.

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7 Hansegard, "IKEA's New Catalogs."

8 The IKEA catalogue takes 10 months from concept to printing, and even with 75% of the product shots being CGI they still have 285 people working full time on photo shoots: photographers, carpenters, interior designers and related people. The IKEA 3D team is housed in the same building (in Europe).

Datafication of photography

IKEA started all this process in 2005, when three computer graphics students (from the USA) interned there set out to create one IKEA product image using only computer software. They chose to build a computer-generated image an IKEA chair, the *Bertil* model. It took them a year to achieve it.[9] Excited about the image, IKEA published it inside their 2006 catalogue to see if anyone would notice any difference. Apparently no one did, they say (although it was quite small at 2x2cm). The *Bertil* chair became IKEA's first computer generated "photographic" image (Fig. 2.1).

2.1 IKEA Bertil chair.

Courtesy of IKEA.

9 See Hansegard, "IKEA's New Catalogs."

We might distinguish this CGI image as a "digital object," a term used by Yuk Hui, in his book *On the Existence of Digital Objects*.[10] For Hui, a *digital object* is something new, specific to digital computers and can be distinguished from traditional technical objects (the historical chair), in that the digital object belongs to new computational technologies: "Digital objects are new forms of industrial objects."[11] Hui identifies two dominant forms of digitalization, one familiar to photographers, videographers and drone pilots as digital *mimesis*: the production of images made by digital cameras (still, video, photogrammetry image captures), which he names as the *objectification of data*.[12] A second form of "coding in the digital milieu," the software process which he names as the *datafication of objects* as in the IKEA CGI images. [13] In a technical engineering sense then, there are two different methods of image production, *mimesis* (images that produce objects digitally), and *coding* (digital objects produced through coding in computational language). While the images produced from these two different methods can or may look the same, their technical systems as ways of working, as modes of production are different. For IKEA the important requirement is that their digital objects resemble a photographic image of the object. In other words, the digital object is produced according to the specific criteria of industrial photography, as a "product shot."[14] Product shot (or "pack shot") photography has a particular set of conventions, characteristics and photographic codes, which companies and customers alike have come to expect: the specific values of photographic realism and verisimilitude.

Product shot photography aims to highlight the presence and visibility of a commodity as an object, and to minimize anything that interferes with this,

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10 Yuk Hui, *On the Existence of Digital Objects* (London/Minneapolis, MN: University of Minnesota Press, 2016), 49.

11 Ibid.

12 Ibid., 50.

13 Ibid. I would like to add a third category here, but there isn't the space at present, this would be the 'robotic image' as what we currently call generative Ai photography. The generative (Ai) image in my view constitutes a new stage of technical development for virtual images (after CGI) dependent on the internet and datasets for its production.

14 The 'pack shot' photograph can be said to have its origins in early German industrial photography of the 1930s as championed in the aesthetics of 'new objectivity'. However, the rules and technical codes of product shots have varied and developed over time in different cultures, often dictated by creative fashions and other imperatives. See David Bate, "The Object of Still Life" in *Photography: the Key Concepts* (London: Routledge, 2019), esp. 141–145.

hence: neutral backgrounds, a medium-soft lighting distributed evenly across to give the object a subtle tonal range to show all its surfaces and shape; it is photographed in a focus that is deep enough to look sharp from front to back, so it can all be seen as an object. The image should not have any lens distortion and show the three-dimensional shape as best. All these conventions and rules help to present the object, give it visibility to the viewer, so that customers can see as much of the object as possible. The aim: to incite the desire of the consumer for the object, so that they imagine they can possess it. The product image of a chair made of wood, for example, would be expected to show key properties of its shape, to present its neutral *objectness*, to show the contours of its surface, how its style is made, how the material has been shaped, cut, and designed, with clear details of the texture, its surface and quality of finish. Such technical specifications give rise to informational values that are typically required for most product shots in most industrial product photography (with occasional aesthetic variations and exceptions). IKEA images uses these photographic conventions and demanded of its computer-generated versions of photography too.

To achieve photographic quality with CGI digital object software required a substantial and sophisticated technical development. Martin Enthed certainly acknowledged this, admitting the IKEA technological development periods had technical and aesthetic challenges:

> We understand how important the knowledge of home furnishing is. How homes look, how homes feel, and so on. The experienced photographers at Ikea have been working with the interior designers on re-creating this feel for 15 to 20 years, some of them. We needed to translate that knowledge over to the 3D artists, who were tech-savvy, but in some cases coming directly from school. We needed them to understand the kind of feel we wanted the images to convey. It was very hard at the beginning.[15]

One of the interesting solutions to these differing knowledges and skills between computer engineers and photographers at IKEA was to develop an exchange program between the CGI computer engineers and studio photogra-

15 Martin Enthed quoted in "Say it ain't so: Ikea reveals 75% of catalog images are CGI" *Today*, 4 September 2014. https://www.today.com/home/ikea-reveals-75-catalog-images-are-cgi-1d80127051 (accessed August 2023)

phers.[16] A studio photographer will be acutely aware, for instance, of the quality and direction of light, and how its highlights, mid-tones and shadows can help show key features of an object and give it particular character, for instance, to show texture: a shiny object reflects light differently to a matt object and so on. IKEA understood that computer engineers see virtual objects and rooms differently from product shot studio photographers. In studio camera photography, most dedicated optical lenses work best at smaller apertures (e.g., f.11-16), after which the lens develops optical "diffraction," which reduces overall image sharpness. Objects in the image begin to appear slightly softer overall. Some photographers and studios use "focus stacking" to overcome such optical limitations. Studio photographers are finely attuned to these photographic issues of light and its effects on textures, forms, shape, sharpness, and the character feelings they project onto an object. Such aesthetic codes and conventions of studio photography were introduced to IKEA computer engineers by photographers, and reciprocally, CGI imaging engineering to photographers. While such nuances of representational aesthetics may be missed by speedy IKEA consumers, they nevertheless matter to IKEA as a matter of visual consistency, the representational stability of its image-products and for thinking about how these new virtual processes relate to the historical traditions of photography.

In the light of such technical and conceptual differences we can follow Yuk Hui's dual distinction in modes of digital image object production (*mimesis* and *coding*) to ask: what in fact *is* the difference between a photograph of a chair and a computer code generated image of a chair? Given both images refer to the same real object (the *Bertil* chair), what exactly is the problem? Why is it that knowing the IKEA chair image is a CGI digital object (rather than a "photographed" object) disturbs our perception, yet is not disturbing at the same time? Indeed, can we in fact realistically argue that there is no "object" created by the CGI image because it is merely a *digital* object? Do we not already know chairs exist before seeing these representations of them? Does it matter what mode of production is used to make its image? In what way does the CGI image of a chair in fact differ as a visual presentation of a chair? If there is no difference, does it matter exactly what technical form its image takes or what we call it: photograph, virtual image, simulation, computer-generated image?

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16 IKEA's scheme offers a useful model for the training of industrial image-makers, where the co-existence of computing and photography specific skills and knowledge is essential. This may be a model that existing educational institutions with photography programmes would do well to consider.

Have these rapid digital developments outstripped the language we use to create a new confusing ontological problem of images and objects? What is the real chair if the image of it is generated by computer software? Where is the digital object if it is only actually located in its coded image?

The CGI rendering of the IKEA wooden chair as their first object to be rendered reminded me almost immediately of the famous conceptual artwork by Joseph Kosuth, *One and Three Chairs*, 1965 (Fig. 2.2). Although Kosuth obviously uses a different chair, both have in common an air of simplicity, both are simple chairs, stripped of ornamentation, decoration and adornment. Their design seems driven by a simple purpose: something to sit on.

2.2 Joseph Kosuth, One and Three Chairs, 1965.

Digital image, The Museum of Modern Art, New York/2024
© Photo Scala, Florence.

Kosuth's philosophical artwork is often a reference for many discussions about art, but also as here, the concept of image and object as representation. The artwork presents the idea of a chair in three sign forms: as *object* (in the gallery space), *photograph* (pinned to the wall), and *text* (printed dictionary definition of a "chair"), chair as *text*. The artwork draws attention to the interrelation of these three semiotic systems, a chair presented as object-photograph-text, yet also highlights their differences, non-identical forms. The artwork encourages the spectator to understand their *difference* yet *interdependency*, echoing the argument made by Jean-Paul Sartre in his philosophical book *L'imaginaire* (*The Psychology of Imagination*) about images, who also conveniently uses a chair as a philosophical example:

> When I perceive a chair it would be absurd to say that the chair is *in* my perception. According to the terminology we have adopted, my perception is a certain consciousness and the chair is the *object* of that consciousness. I shut my eyes and I produce an image of the chair I have just perceived. The chair, now occurring as an image, can no more enter *into* consciousness that it could do as an object. An image of a chair is not, and cannot be a chair.[17]

Sartre draws a clear distinction between the object and its mental image. The commonsense idea of photography tends to encourage us to think of these as the *same*, as identical. The everyday doxa of photography: what is presented in the image is *the same* as the thing that exists elsewhere as an object. Sartre's problematic is *what is* the image of an object (or person) in consciousness:

> And what exactly is the image? Evidently it is not the chair: in general, the object of the image is not itself an image. Shall we say then that the image is the total synthetic organisation, consciousness?[18]

Sartre thus resolves the split of object and image issue by saying the image is a synthesis, a "synthetic organization". The image of something is formed in consciousness: "the object makes its appearance to consciousness, or, if one prefers, a certain way in which consciousness presents an object to itself."[19] The image of an object is a synthesis, so that the process of *imagining* a chair in our mind is given its sanity by its relation to actual chairs, as things that exist as objects. The object gives rise to perception in the imagination (while they remain different things) and whose image is given significance and meaning by reality, its symbolic context. The image offers an "imaginary" object to a (perceiving) person. So photographic images and digital object generated images operate similarly: as vehicles to make objects present as images. Yet, there is an assumed difference: a digital image produced in software is an object that may have no existing symbolic reference (in reality), whereas a photograph

17 Jean-Paul Sartre, The Psychology of Imagination (London: Methuen, 1972), 5.

18 Ibid.

19 Ibid.

partly relies on the object to mediate the image. If all images rely on the imaginary/symbolic/real relations, then the question is: what relation to "reality" do digital objects have and does that differ from photographic objects? Whereas photography traditionally (but not exclusively) supposes an automatic reference to the world (existing things in front of a lens), a digital object has no such ideological presupposition or given essence.[20]

Indeed, Hui suggests that with *data* and digital objects we need to *reconsider* the philosophy of objects in digital culture.[21] Data, "as transmissible and storable computer information … can no longer be assumed to refer entirely to sense and noetic data."[22] This is because the "givenness" of things in photography, the sense of presence that images made by a camera gives to their objects, is no longer the norm for data and its digital objects. Although the theoretical assumptions about photographic images cannot be carried over to digital objects this is complicated by the fact that photography is itself a technical format incorporated into computer images as one of its digital objects.

The IKEA CGI *Bertil* chair image, for example, is presented in the likeness of a photographic image of a chair, familiar because it relates to (a) existing semiotic codes of photographic images and (b) the cultural experience and knowledge of chairs. Although traditional codes of photography have been absorbed into a computer code format to make digital objects, the digital object produced in this way does not necessarily refer to objects that exist in the symbolic world, which of course also raises important questions about their ethical and aesthetic conditions of existence.[23] In the case of IKEA, the mission was to produce digital objects that replicate the rhetoric of product photographs. The

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20 We might ask however, from where is any image produced? Is it not conscious and unconscious processes that drive the production of images? We may ask the same thing of traditional photography, while there is no guarantee of ontological knowledge, where did the image come from? However, this is not the direct issue for this paper. (Even if the old ideological debates about photography are still not resolved, they are modified by contemporary developments and the rhetorical networks in which they now exist.)

21 Hui, *On the Existence of Digital Objects*, 49.

22 Ibid. The issue relates not only to photography, of course, but all other forms of digital communication too. For example, D.N. Rodowick writing on the digital numerical image in cinema argues "a new philosophical perspective is required for these kinds of images, if they can be called such." See D.N. Rodowick, *The Virtual Life of Film* (Cambridge, MA: Harvard University Press, 2007), 175.

23 I have written elsewhere about this trilogy of concepts, representative, ethical and aesthetic, as 'three regimes of the image' from Jacques Rancière's work. See David

transformation of photographic values into new software images was necessary for their distribution in the new data economy where digital objects are distributed through other data networks. However, what if the same coding technology was used in different ways? What if there is no such normalized requisite, with no pre-existing industrial product or object as such? In such cases an author's imaginary and or generative algorithms of (Ai cybernetic) computational processes can be used to produce images that have no reference to existing symbolic reality. Such practices are of course not new, and relate to established spaces of the human imaginary, fantasies, for example, already familiar in historical and art avant-garde movements, which did not use or rejected dominant paradigms of photographic realism. But here we are not talking about margins or exceptions to the rule, but the question of a new general rule. In short, does the coding of digital objects liberate them from the semantics of symbolic reality and open data images to the possibility of new imaginary spaces: speculative images that generate speculative fictions.[24]

Speculative Fiction

In 2011 Margaret Atwood Atwood made a useful distinction between science fiction as "fantasy" and what she calls "speculative fiction" where what can be *imagined* about the actual future is explored by an author.[25] A good deal of recent contemporary art photography has taken up exactly this address to imagined futures: *speculative* fiction is a scenario that seem plausible within the potential reasoning and logic of a conventional symbolic order: "this could happen" even if it has not yet been seen to happen.[26] The term *fiction* has its own

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Bate, "Jacques Rancière: Aesthetics and Photography," in *The Routledge Companion to Photography Theory*, eds. Mark Durden and Jane Tormey (London: Routledge, 2019).

24 Given the specific technological conditions discussed here, generative images as speculative fiction can be aligned to Jean Baudrillard's *third* category of simulacra, of simulations: "based on information, the model, cybernetic play." See Jean Baudrillard, "Simulacra and Science Fiction" [1991], in *Science Fiction: Documents of Contemporary Art*, ed. Dan Byrne-Smith (London: Whitechapel & MIT Press, 2020), 51.

25 See Margaret Atwood, "Is Science Fiction Going out of Date?" in *Science Fiction*, ed. Byrne-Smith, 22–26.

26 Margaret Atwood gives the example of H. G. Wells's 1897 novel, *The War of the Worlds*, since "people thought at the time that intelligent being might live on Mars, and since space travel was believed to be possible in the imaginable future." Ibid., 25.

specific problematic ambiguities in photographic discourse and criticism. In photography the concept of "fiction" is still popularly understood as an opposition to reality, rather than as a mode of expression of reality. Little is understood, it seems, of the way we may daydream ourselves into imaginary scenarios based on actual situations, images or events we have seen or experienced. Instead fact and fiction are still seen as binary opposites of a positivist logic that lead in totally opposing directions that should be refused any connection. Today's technology of digital objects moves us further towards abolishing these old binary habits, fiction/reality at the level of the image itself. When the only guarantee that an object exists is that we have seen another image of it, then we have entered a very different image-world. If digital objects as software semblances are not as real things referred to elsewhere, then in the unreal image-world of digitally generated existences the distinction between objective and subjective become unreliable, even more untenable.

Traditionally, the perception of specular images is located in the imaginary, but subject to meanings given through symbolic culture, discourse, language, and their connotations.[27] So, for example, the IKEA product image is an imaginary image, but it corresponds to an symbolic object referred to in the real world: image is neither speculative nor "fictive." IKEA images retains a semblance of realism, not only because of the semantic properties of the computer-generated image is coded as "photographic," but because such images also refer to (and anchored by language) to tangible objects within the experience of the viewer and their culture: chairs. One does not have to have seen an actual IKEA *Bertil* chair to recognize the "chairness" of the product image, because our general experience of chairs is sufficient to recognize the object as belonging to that same category of object experienced as a chair. Whilst a computer-generated image might be expected to subscribe to such criteria if it is to replicate photography, it is not technically obliged to follow such logic and thus becomes open to speculative fiction. To build a digital object with computational software means it can construct an image outside of traditional networks of meaning, where "reference" is not governed by symbolic laws of rationality.

A primary example here can be drawn from experiments by IKEA made in 2023.[28] Ikea sub-contracted a design/data company to use old IKEA catalogue

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27 "Investment in the specular image is a fundamental phase of the imaginary relation." Jacques Lacan, *Anxiety: Seminar X* (Cambridge: Polity Press, 2014), 38.

28 "Space10 is a Swedish design agency that Ikea has been funding and uses as a research and design partner that cab explore technology like AI, augmented reality,

photographs as the dataset source material for AI experiments to create new chairs (as digital objects): speculative images as speculative fictions (Fig. 2.3 Studio10, generative AI chairs from IKEA catalogue chair datasets, 2023. https://www.fastcompany.com/90871133/ikea-generative-ai-furniture-design).[29] Some of the digital images could not be made into objects because they were not logically possible to make. "Fiction" here functions in the very fabric of the images, yet they remain visually potentially plausible because they remain withing the bounds of "chairs" as real referents.

All these morphographic results depend on the dataset used, the color palettes, variety of shapes and designs of the IKEA catalogue images from the 1970s, 1980s and so on. Statistical "averaging" produces new normalities, as the images processing merges, blends, remixes each into other strange new other forms. It would be possible to discuss here all kinds of potential creative practices inspired with such fictional otherness. It is these "other scenes," the very concept of speculative fiction that are overwritten (and overdetermined) by the anxieties and uncertain feelings of the role of generative technologies in contemporary culture. The uncanniness of such speculative images signifies a machinic disturbance in the logic of photography, but also appeal to a human disturbance of the real. Digital objects, produced through coding and computational processes enable their operators to take all this a step further and draw an equivalence between machinic processes and the inner life of the author or imaginary projections of it into other spaces, other scenes. In traditional cultural theory (via psychoanalysis) the "other scene" is an uncanny double, people or things that seem to be exactly similar, yet somehow different at the same time.[30] In this context, we have to confront the idea that photography has become alienated from itself. Alienation leads to anxiety and separation.

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and Web3." Ida Torres, "IKEA experiments with Generative Ai for possible new furniture design," 14 April 2023. See: https://www.yankodesign.com/2023/04/13/ikea-experiments-with-generative-ai-for-possible-new-furniture-design/#:~:text=They%20used%20generative%20AI%20to,the%20brand%20in%20the%20future (accessed September 3, 2023).

29 The experimental computational process does not necessarily 'replace' designers, because objects still have to be judged, critiqued and transformed from a virtual digital object into a flat packable three-dimensional object design. In this sense, the software operates rather as a speculative tool for designers to use.

30 See for example, Lydia H. Liu, *The Freudian Robot: Digital Media and the Future of the Unconscious* (London/Chicago: University of Chicago Press, 2010).

Conclusion

I started with common anxieties about reality being replaced by images and computers replacing photography. Computational or cybernetic machines do not replace reality, but they do replace and transform the logic of the representational machines and their cognitive systems that we use to present reality. Almost anyone with access to today's computational practices (even on a mobile phone) can now use these apparatuses to generate their own speculative fictions. Photographic values can be used to assert other worldly things, objects and beings newly shaped into different pasts, presents and futures. The Surrealists claimed such an imaginary space as a radical novelty, to bring the space of human imaginary into the same space as symbolic culture and its languages. Such a project seems aligned with Margaret Atwood's words about speculative fiction, to imagine the world as *otherwise*, as social fictions but we cannot guarantee the critical function of speculative fictions today. The human space of the imaginary is now haunted by these processes, images, datasets and histories of representation that inform them. Like all language, images and symbolic culture, these virtual forms exceed the consciousness of any individual and the myriad fantasies produced by these processes destroy conventional boundaries of space, time, perception and meaning.

We can distinguish three overlapping fields of production: (1) traditional *mimetic* practices of digital photography developed from analogue forms; (2) the use of *coding* (CGI) software design and gaming engine constructions of virtual photography, and (3) generative AI as a mutative form. Yet, as night follows day, the logic of photography is stripped out by the plasticity of these distinctions, hollowed out by the imaginary signifiers which infiltrate and resonate inside virtual photography and a new fictive universe.

3. Larval Memories
Spectralizing the Past through AI Photography

Ali Shobeiri

Before the advent of AI photography, the connection between memory and photography was rather obvious—we took photos to preserve our memories. In this approach, the photograph is an *aide-mémoire*, and photography is a *mnemotechnique*. However, what these basic assumptions fail to explain is the evolving nature of photography and the elusive essence of memory—the fact that both photography and memory are inherently dynamic processes.[1] To foreground this fluid disposition, recent debates on prosthetic memory, postmemory, and trauma have shown how photography plays a vital role in the disembodied, transgenerational, and retroactive operations of memory work.[2] These debates have laid bare that neither photography nor memory is ever fully realized; rather, they are constantly shaping their realities. In the age of new media technologies, when having a memory has become almost tantamount to having a photograph of it, the very existence of memory is dependent on its constant actualization through photographs. When photography was associated with fixity and immobility, it was implausible to embody the continuity of memory work photographically. Today, though, we can manifest memory's dynamic features through AI.

Thanks to the virtualization of photography enabled by AI, we can now actualize a memory that has never existed factually. Previously, it was the indexi-

1 Ali Shobeiri, "Photography and Memory," in *The Palgrave Encyclopedia of Memory Studies*, ed. L. M. Bietti and M. Pogacar (London: Palgrave Macmillan, 2023), 1–10.

2 On prosthetic memory and photography, see Alison Landsberg, *Prosthetic Memory: The Transformation of American Remembrance in the Age of Mass Culture* (New York: Columbia University, 2004). On postmemory and photography, see Marianne Hirsch, *The Generation of Postmemory Writing and Visual Culture after the Holocaust* (New York: Columbia University, 2012). On trauma and photography, see Ulrich Baer, *Spectral Evidence: Photography of Trauma* (Cambridge, MA: MIT Press, 2005).

cality of photography that authorized the reality of recollection; today, AI photography is erasing the boundary between the present and (memories of) the past. By feeding AI software with existing photographs, one can materialize a memory that is simultaneously authentic and inauthentic, and thus both legitimate and illegitimate in its embodiment of the past. This paradigm shift challenges not only our conception of recollection but also our very perception of photographic representation. It raises the question whether AI-generated photographs can present us with possible memories of the past. If so, what is the ontological status of an AI-generated memory whose nature is synthetic? Simply put, can we assign any mnemonic value to memories actualized through AI photography? To answer these questions, I will draw on the conjunction of memory and photography in the AI-generated photos of visual artist Alexey Yurenev.

Seeking to visualize the memories of the Second World War, Yurenev used machine learning to photographically materialize what one may have experienced during the conflict. His AI photographs were produced with generative adversarial networks (GANs) and existing photos from the war. Although they envision a synthetic memory that is not real, they interrogate the reality of memory. By situating the photographs of Yurenev at the intersection of memory, virtuality, and spectrality, I will explore the formation of a photographically induced memory that can only exist algorithmically. First, I will examine the link between photography and memory to show how the spread of machine learning is reshaping it. Then, by drawing on the works of Gilles Deleuze and Henri Bergson, I will discuss how the construction of memories follows the logic of continuous actualization. Next, I will investigate virtuality through the discourse of spectrality developed by Jacques Derrida, thereby explaining why Yurenev's photos appear ghostly and phantasmal to the viewer. Finally, having discussed the virtuality of memory and the spectrality of photography, I will propose the term *larval memory* as a conceptual framework for the ontological status of the synthetic memories conjured up by GANs.

AI Photography and Recollection

Since its very conception, photography has been a means of exposing the latent operations of memory work. We do not simply recall past events through photographs; we justify and verify them. Seeing photography as a mnemonic device goes back to the early days of the medium, when physician Olivier Wendell Holmes referred to the photograph as a "mirror with a memory."[3] This comparison entangled memory and photography and implied that memory was a material property of photographs. This explains why early photographers saw photos not only as containers of memories but also as their content. At the time, the coalescence of photography and memory was a discovery, but this is no longer the case. In the digital age, in addition to functioning as visual testimonies of our memories, photographs essentially authorize the existence of the past, both individually and collectively. The digitization of photos already challenged the photographic narrativization of the past. Now, the development of AI photography has caused an epistemological rupture in the act of remembering. However, we should bear in mind that recollection has never been direct and instantaneous. Therefore, the task of remembrance through AI photography can be considered an enlargement of the fundamental divide between the immediacy of experience and the mediacy of representation.

Around a century ago, Sigmund Freud foregrounded this divide with the metaphor of the camera as the place where unconscious thoughts and emotions are stored in a dormant state. Freud used several photographic terms to explain the inner mechanisms of the unconscious. He distinguished between two types of memory, namely natural and artificial. The former consisted of the unassisted human ability to recall the past, as one does when recalling a memory. The latter referred to the incorporation of various devices used in memory formation and registration. For Freud, all kinds of "auxiliary apparatuses" invented by humans to enhance and retain their memories were essentially "built on the same model as the sense organs themselves."[4] Whether it was a camera or a more advanced machine, he considered all sorts of mnemonic tools as extensions of natural memory. By distinguishing between natural and artificial memory, Freud revealed that human memory was becoming increasingly reliant on devices and technologies. In his words,

> With every tool, man is perfecting his own organs, whether motor or sensory, or he is removing the limits to their functioning. … By means of spectacles, he corrects defects in the lens of his own eye; by means of the telescope, he sees into the far distance; and by means of the microscope, he

3 Oliver Wendell Holmes, "The Stereoscope and the Stereograph," *The Atlantic Monthly*, vol. 3, no. 2 (1859), 738–748.

4 Sigmund Freud, "The Mystic Writing-Pad," in *On Metapsychology: The Theory of Psychoanalysis*, ed. S. Freud (Harmondsworth: Penguin, 1925), 430.

> overcomes the limits of visibility set by the structure of his retina. In the photographic camera, he has created an instrument that retains fleeting visual impressions, just as a gramophone disc retains equally fleeting auditory ones; both are, at the bottom, materializations of the power of recollection he possessed, his memory.[5]

By drawing a parallel between human (natural) memory and machine (artificial) memory, Freud was not only declaring their dependence but also predicting their inevitable entanglement. In other words, he was anticipating an era in which the artificiality of technologically enhanced memories would become indistinguishable from the (alleged) naturality of corporeally induced ones. Our time is that era—an age when the photographic registration of lived experiences has become almost synonymous with the inscription of memories.

Around a century ago, a photograph could function as a "memento from a life being lived."[6] Today, due to its instantaneous dissemination on the web, it has become a ubiquitous source of information about live events. Instead of capturing irreversible past experiences as mementos, photographs have become what the media theorist José van Dijck calls "momentos" of the ongoing present.[7] This is how photographs can now divulge the innate operationality and ephemerality of memories—by conflating the past and the present in their constant circulation in cyberspace. Still, we should bear in mind that "memories are made as much as they are recalled from photographs; our recollection never remains the same, even if the photograph appears to represent a fixed image of the past."[8] So, instead of seeing digitization and algorithmization as means of the dematerialization and disembodiment of memories, one can argue that *all* memories induced by photographs are inherently mediated memories, or as Freud would have said, all photographically impelled memories are artificial memories. From this perspective, the interpolation of AI into the photographic narration of memories is not necessarily a falsification or fabrication of the past; rather, it is an unprecedented photographic mediation that

5 Sigmund Freud, "Civilization and its Discontents," in *Civilization, Society, and Religion*, ed. S. Freud (Harmondsworth: Penguin, 1930), 279.

6 John Berger, *Understanding a Photograph* (London: Penguin Books, 2013), 53.

7 José van Dijck, *Mediated Memories in the Digital Age* (Stanford: Stanford University Press, 2007), 115.

8 José van Dijck, "Digital Photography: Communication, Identity, Memory," *Visual Communication*, vol.7, no.1 (2008), 8.

requires new modes of contemplation and theorization. Among many examples, GANs are one of the prevalent forms of this mediation.

Deep learning aspires to simulate the intricacy of human decision-making by using multilayered neural networks.[9] In this field, GANs are used to create new data from existing ones. Generally speaking, all GANs have two models that oppose each other, namely the generative model and the discriminative model. The former is used to generate new data from existing datasets, while the latter is employed to compare the new data with the original ones.[10] The term "GAN" was first coined in an article published in 2014, in which the authors exemplified the process as follows: "The generative model can be thought of as analogous to a team of counterfeiters, trying to produce fake currency and use it without detection, while the discriminative model is analogous to the police, trying to detect the counterfeit currency."[11] Typically, GANs continue the exchange of data between the generative model and the discriminative model until the new data (the fake currency) is indistinguishable from the primary data (the original currency). The most common use of GANs has been in image processing and computer vision, where it has been employed for photo blending, photo de-aging, resolution enhancement, and photo augmentation.[12] GAN models entered the mainstream after a website called This Person Does Not Exist started generating realistic portraits of nonexistent people in 2019.[13] Even though the website has not disclosed its datasets and blending procedures, we know that GAN image processing is generally carried out in three ways. The first one is supervised learning, in which the AI program uses well-labeled datasets to create an intended outcome. The second one is unsupervised learning, in which the AI looks for patterns in the dataset without human interference. The third way is semisupervised learning, in which a small quantity of labeled data and a great quantity of unlabeled data are used together. The AI-generated photographs of Alexey Yurenev belong to the third category; they are the products of numerous exchanges between a few labeled datasets and a great number of unlabeled datasets.

9 Shai Shalev-Shwartz and Shai Ben-David, *Understanding Machine Learning: From Theory to Algorithms* (New York: Cambridge University Press, 2014).

10 S. Kumari and K. Aggrawal, "Scope of Generative Adversarial Networks (GANs) in Image Processing: A Review," *International Journal of Health Sciences*, vol. 6 (2022), 724.

11 Jan J. Goodfellow, et al. "Generative Adversarial Nets," *Advances in Neural Information Processing Systems*, vol. 27 (2014), 1.

12 S. Kumari, "Scope of Generative Adversarial Networks," 725.

13 See https://this-person-does-not-exist.com/en [Accessed 23 February 2024].

3.1 Alexy Yurenev, War Actor, part of the Silent Hero series, 2023.

Courtesy of the artist.

Aspiring to understand what his grandfather could remember from the Second World War, in 2019 Yurenev began to explore the possibility of using GAN models as mnemonic devices. Unable to experience what his grandfather had, he began a photographic collaboration with GANs, which led to a series of photographs that were not taken but synthesized and amalgamated. Though he could not recall the atrocious memories of the conflict, perhaps AI could perform the act of recollection for him. By using StyleGan, a GAN model developed by NVIDIA in 2018, Yurenev gathered a dataset of approximately 35,000 existing photographs from the war. This dataset included, but was not limited to, photos of destroyed cities, dead bodies, abandoned landscapes, and war weaponry. To organize this substantial amount of data, he defined the following three themes: portraits, battles, and landscapes. Then, he instructed the GAN to process each theme through a "forger" (i.e., the generative model) and a "critic" (i.e., the discriminative model) for numerous cycles of learning. In each cycle, the forger generated new photos based on the dataset, and the critic validated them according to the original data—a continuous process of fabrication, differentiation, and verification. In each learning cycle (also known as an "epoch" in StyleGan), the AI model became smarter. Eventually, it started generating low-resolution images that transmitted the horror of the war in peculiar ways even though they did not actually represent it. Being curious to see the algorithmic transformation of his dataset, Yurenev allowed the GAN model to go through more than 5,000 consecutive epochs to generate new photographs.[14] This resulted in a series of synthetic portraits of unrecognizable, defaced, and eerie figures that he called *War Actors* (Figs. 3.1, 3.2, and 3.3).

3.2 Alexy Yurenev, War Actor, part of the Silent Hero series, 2023.

Courtesy of the artist.

Although these AI-generated portraits are based on existing photographs, they no longer correspond to the original dataset, having been excessively processed by the generative and the discriminative models. Thus transformed, these unnerving portraits convey memories of the war that are not factual;

14 See https://www.yurenev.com/ (accessed February 23, 2024).

however, these memories are emerging as we look at them—they are being actualized. In other words, they show how photography can materialize *a memory that is on the verge of constant actualization without reaching a final realization*. This does not mean that these AI-generated portraits are illegitimate memories of the past. Drawing on Henri Bergson's work, we may see them as photographic proof that the totality of the past can exist only in a virtual form, which is always waiting to be actualized.

3.3 Alexy Yurenev, War Actor, part of the Silent Hero series, 2023.

Courtesy of the artist.

The Virtuality of Memory

> "Differentiation is always the actualization of a virtuality that persists across its actual divergent lines."
> (Gilles Deleuze, *Bergsonism*)

In his seminal work on the world of matter and the realm of memory, Bergson made a crucial distinction between two kinds of memory work: spontaneous recollection and learned recollection. When remembering the past, the former leaves nothing behind and captures all temporal and spatial details; hence, it is "perfect from the outset." In contrast, the latter only summons disjointed, alienated, and "impersonal" particulars.[15] To clarify these two types of recollection and their associated memories, Bergson asks: What does one remember of a lesson that has included many readings? Do we recall the entire lesson or each separate reading as a constituting part of the whole? He suggests that we recall these two types of memories sequentially—first, the memory of the entire lesson; then, the memories of each reading. While the memory of each reading comes to us as a distinct and transparent representation, the memory of the entire lesson appears as a general and opaque consciousness of the past. According to Bergson, the memory of each reading enters our mind in the form of a "memory-image": "It neglects no detail; it leaves to each fact, to each gesture, its place and date." The memory of the entire lesson, however, constitutes what he calls "a whole past."[16] Unlike the former, which is always concerned with the *exactitudes* of the past, the latter is concerned with *performing* the entirety of the past. As he puts it,

> This consciousness of a whole past of efforts stored up in the present is indeed also a memory, but a memory profoundly different from the first, always bent upon action, seated in the present, and looking only to the future. It has retained from the past only the intelligently coordinated movements which represent the accumulated efforts of the past; and it recovers those past efforts, not in the memory-images which recall them, but in the

15 Henri Bergson, *Matter and Memory*, trans. Nancy Margaret Paul and W. Scott Palmer (Mineola, NY: Dover Publications, 2004), 95.

16 Ibid., 92.

> definite order and systematic character with which the actual movements take place. In truth, it no longer *represents* our past to us, it *acts* it.[17]

For Bergson, this general sense of "a whole past," which cannot represent the past but can perform its contours, is the original means of remembering because, without it, we would not be able to coordinate our memories. To be clear, the whole past is a general sphere in which specific parts of the past can unfold; it is an overall sense of previous time through which explicit memory-images are formed in the present. That is why the whole past cannot be the particular past of one person; it is the general past of an entire people, bereft of any individuality and specificity. It is precisely this opacity and this generality of the whole past that operate as the existential axes of impersonal memories—recollections that belong to no person in particular but to all depersonalized individuals. Going back to Yurenev's photographs, these AI-generated photos do not intend to embody how a specific war actor looked during the conflict—that is, they do not pretend to show the memory-images of the past. Instead, in their sheer generality and totality when approaching the past, they establish a collective representation of war actors during WWII. This means that they do not embody a particular past through the exactitude of spontaneous recollection; they perform the whole past through the generality of learned recollection. In doing so, they act as *impersonal anamneses of war actors as such*—recollections that are as hazy as they are broad in scope. For Bergson, it is precisely this generality of the whole past that inserts a virtual element into the fabric of remembering. As we try to recall a period of our history, he writes,

> we become conscious of an act *sui generis* by which we detach ourselves from the present in order to replace ourselves, first in the past in general, then in a certain region of the past—a work of adjustment, something like the focusing of a camera. But our recollection still remains virtual; we simply prepare ourselves to receive it by adopting the appropriate attitude. Little by little it comes into view like a condensing cloud; from *the virtual* state, it passes into *the actual*.[18]

Bergson suggests that our recollection involves a process that is similar to how we adjust a camera's lens to focus on an object. First, we must situate ourselves

17 Ibid., 93 (original emphasis).

18 Ibid., 171 (emphasis added).

in "the past in general" (or in "the whole past"), then, we must search for specific memories in "a certain region of the past." Through this mnemonic maneuvering and calibration, a memory transitions from the virtual state to the actual state like "a condensing cloud." Building on this idea in *Bergsonism*, the philosopher Gilles Deleuze warns that we must avoid interpreting Bergson's argument merely in a psychological way. When we place ourselves in the past in general, wherein memories exist in a purely virtual form, we enter an entirely different ontological state—we leap "into the being in itself of the past. It is a case of leaving psychology altogether."[19] For this reason, Deleuze suggests that the key to understanding the Bergsonian theory of recollection lies in the ontological transformation of the virtual into the actual. According to him, unlike the realization of the possible, which requires "resemblance" and "limitation," the Bergsonian notion of memory is concerned with the actualization of the virtual, which operates through "difference" and "divergence." He explains this point as follows:

> While the real is in the image and likeness of the possible that it realizes, the actual, on the other hand, does not resemble the virtuality that it embodies. It is difference that is primary in the process of actualization—the difference between the virtual form which we begin and the actuals at which we arrive. … In short, the characteristic of virtuality is to exist in such a way that is actualized by being differentiated and is forced to differentiate itself, to create its lines of differentiation in order to be actualized."[20]

Following Bergson, Deleuze suggests that our recollections are not realized from a possible past but are actualized from the general past, wherein memories reside in a purely virtual form. Moreover, for a memory to be actualized, it does not have to follow the logic of resemblance and limitation; that is, it does not have to imitate, nor does it have to be restricted by, what it refers to. Instead, when one leaps into the general past through recollection, one actualizes a memory through a constant differentiation—according to the degree to which each region of the past differs from the other. While the actualization of the virtual is a philosophical endeavor in Bergson and Deleuze, it is a photographic experiment in the AI-generated photos of Yurenev.

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19 Deleuze, *Bergsonism*, 56.

20 Ibid., 97 (emphasis added).

Produced entirely through the differential mechanism of the generative and discriminative models, Yurenev's photographs are *not* the realizations of the past. They do not pretend to bring into existence a past that could have existed—a possibility. Instead, having been produced by the continuous differentiation of the "forger" and the "critic," they signify the actualization of the whole past—a virtuality. Rather than realizing the memories of the war through resemblance and limitation, they actualize them through difference (from the generative model) and divergence (from the discriminative model). Accordingly, they no longer resemble the generative model, nor are they limited by the discriminative model; instead, they merely exist as an index of difference between the two. In other words, having gone through 5,000 epochs of constant differentiation, these AI-generated photos show how memories can pass from the virtual state (the general past) to the actual state (the algorithmic present). As Deleuze would have said, the difference here is between the virtual (memory) from which we begin and the actual (recollection) at which we arrive. It is this ontological leap from the virtual past to the actual present that confers a ghostly veneer to these photographs—a creepy atmosphere that subtly suffuses them.

The Spectrality of Photography

> "This spectral, someone other looks at us, we feel ourselves being looked at by it, outside any synchrony."
> (Jacques Derrida, *Specters of Marx*)

Having actualized the general past photographically, the *War Actor* portraits appear ghostly and phantasmal to the viewer, as if they were stuck between the past and the present. Incapable of crystalizing the specific memories of an individual, they appear to be anonymous apparitions of the past that have been algorithmically conjured up by the generative and discriminative models. Although this algorithmic thaumaturgy seems to be a novel photographic means, the practice of summoning ghostly figures in photography is nothing new; it goes back to the late nineteenth century, when so-called spirit photographers tried to capture ghosts and other spiritual entities in photographs. By juxtaposing the portraits of deceased family members with their grievers, spirit photographers sought to prove the existence of ghosts and specters.

At the time, the invention of the telegraph aimed to eliminate temporal and spatial distances. On their part, spirit photographers aspired to explore the archaic dream of disincarnation, claiming that the human soul could exist independently of the flesh. Regardless of whether the images in question were "spiritual revelation[s] or trickster's hoax[es]," spirit photographers managed to create a "spooky effect" that blurred the ontological boundaries between empiricism and spiritualism.[21] By superimposing two or more images photographed at separate times, they created paranormal portraits that showcased the "encounter of two ontologically separate worlds"—the world of the living and the world of the dead.[22] Despite the disappearance of spirit photography in the twentieth century, our fixation with photographic ghosts has proved to be an enduring phenomenon. As the media theorist Tom Gunning notes, our obsession with summoning ghosts through photography comes down to two fundamental fantasies.

> *First*, [the ghostly] envisions a phantasmatic body, fundamentally different from ordinary bodily experience, whose appearance seems to make us doubt or rethink the nature of our senses, our grasp on reality. … *Second*, the ghostly represents a fundamental untimeliness, a return of the past not in the form of memory or history but in a contradictory experience of presence.[23]

In the nineteenth century, fulfilling these fantasies required the superimposition of photographs. Today, this can be achieved through the differential operations of GAN models. Having been produced by the algorithmic amalgamation of thousands of portraits, Yurenev's *War Actor* portraits are intrinsically and ineluctably discorporate; their bodily existence is fragmentary, displaced, and synthetic. For example, in Figure 3.1, we may be looking at the forehead of one soldier, the nose and ears of another person, and the neck and cheek of

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21 In his compendious study of spirit photography, Louis Kaplan combines photography theories, the history of science, American cultural history, and religious revivalism to shed light on the so-called spooky theory of photography from the middle of the nineteenth century to the present. See Louis Kaplan, *The Strange Case of William Mumler: Spirit Photographer* (Minneapolis, MN: University of Minnesota Press, 2008), 212.

22 Tom Gunning, "To Scan a Ghost: The Ontology of Mediated Vision," in *The Spectralities Reader: Ghosts and Haunting in Contemporary Cultural Theory*, ed. María del Pilar Blanco and Esther Peeren (New York/London: Bloomsbury, 2013), 213.

23 Gunning, "To Scan a Ghost," 232.

yet another. First, it is this bodily mixing that creates the phantasmal feeling in these portraits—the fact that we cannot be sure about the corporeal unity of what we are looking at. In their somatic blending, they emerge as ethereal bodies corporealized through AI. This means that instead of concretizing definite memories of the past, these ghostly figures encapsulate the entirety of the past into one haunting body. That is how they complicate the ontologies of presence and absence—by simultaneously congealing the former and consolidating the latter.

To study this phenomenon, Jacques Derrida coined the term "hauntology" (a portmanteau of "ontology" and "haunting"), which replaces the priority of being and presence with the figure of the ghost as an entity that is neither present nor absent. According to Derrida, from a hauntological perspective, "a specter is both invisible and visible, both phenomenal and nonphenomenal: a trace that marks the present with its absence in advance."[24] Based on this argument, being haunted by a specter equates to feeling the presence of an absence and embracing the visible in the invisible, thereby recognizing the contradictory existence of the ghostly body—the materialization of an immaterial being. To make hauntology tangible in *Specters of Marx*, where he introduces the logic of spectrality and haunting, Derrida asks: What is the function of a helmet's visor in the armor of a soldier? His answer: "The power to see without being seen."[25] For Derrida, this one-sided sight makes us feel as if we are being watched without being able to see who is watching us. This is the cornerstone of the spectral. Elsewhere, he refers to this phenomenon as "the visor effect," which he uses to flesh out the basis of hauntology.

> The "visor effect": the ghost looks at or watches us; the ghost concerns us. The specter is not simply someone we see coming back; it is someone by whom we feel watched, observed, surveyed, as if by the law. We are "before the law" without any possible symmetry, without reciprocity, insofar as the other is watching only us, concerns only us—we who are observing it. … The fact that there is a visor symbolizes the situation in which I can't see who is looking at me; I can't meet the gaze of the other, whereas I am in his sight.

24 Jacques Derrida and Bernard Stiegler, "Spectrographies," in *The Spectralities Reader: Ghosts and Haunting in Contemporary Cultural Theory*, eds. Esther Peeren and María del Pilar Blanco (New York: Bloomsbury, 2013), 39.

25 Jacques Derrida, *Specter of Marx: The State of the Debt, the Work of Mourning and the New International* (New York/London: Routledge, 1994), 8.

> The specter is not simply this visible invisible that I can see; it is someone who watches or concerns me without any possible reciprocity.[26]

While corporeal disfiguration is the initial reason for the ghostly appearances of the *War Actor* portraits, it is their impenetrable eyes that confer a second layer of spectrality to them. Having been vacuumed from (Fig. 3.1), laminated onto (Fig. 3.2), or plunged into (Fig. 3.3) their faces, the eyes of the war actors appear simultaneously present and absent. That is why, when looking at these portraits, we feel ourselves being watched, observed, and surveyed by a *unilateral gaze*—a ghostly gaze of which we are the recipients but to which we cannot respond. Being exposed to the actors' obscured and obscuring gazes, we arrive at the paradoxical logic of spectrality: the invisible visible that lingers before our eyes, phenomenally present, yet perpetually absent. In addition to their deformed expressions, it is this ontological simultaneity of absence and presence, caused by their distorted and disturbing eyes, that imparts a spectral atmosphere to these portraits. Put differently, each of these portraits reveals the logic of spectrality through the concurrent *generation* and *degeneration* of the eyes—through the creation of a gaze that has "the power to see without being seen"—a visor effect par excellence. Consequently, we feel haunted by what we cannot see, though we are certain of its presence, were it not that it is the presence of an absence—the specter of the whole past.

Larval Memories

> "Spectrality is a form of life."
> (Giorgio Agamben, "On the Uses and Disadvantages of Living among Specters")

Having discussed the virtuality of memory and the spectrality of photography, I would finally like to foreground a specific kind of spectrality that corresponds to the AI-generated photos discussed in this chapter both ontologically and mnemonically. In a short article entitled "On the Uses and Disadvantages of Living among Specters," the philosopher Giorgio Agamben contends that

26 Derrida and Stiegler, "Spectrographies," 40–41 (emphasis added).

spectrality needs to be understood as a form of life—"a posthumous or complementary life that begins only when everything is finished."[27] From this point of view, becoming a ghost means continuing a life that has come to an end corporeally through a spectral metamorphization. However, Agamben argues that not all spectral renewals (or forms of life) are meant to fulfill the same function, namely the continuation of a concluded life. While some specters have nothing to do with their previous lives, others do not accept the fact that their former existence has come to an end. Having lived through unsettling circumstances, some ghosts resist being announced dead in the first place. Agamben distinguishes between these two types of specters in the following passage:

> There is also another type of spectrality that we may call larval, which is born from not accepting its own condition, from forgetting it so as to pretend at all costs that it still has bodily weight and flesh. Such larval specters do not live alone but rather obstinately look for the people who generated them through their bad conscience. They live in them as nightmares, incubi or succubi, internally moving their lifeless members with strings made of lies. While the first type of spectrality is perfect, since it no longer has anything to add to what it has said or done, the larval specters must pretend to have a future in order to clear a space for some torment from their own past.[28]

The spectral feeling engendered in the viewer by the *War Actor* portraits through their bodily amalgam and/or ocular expunction is essentially larval. Having been created from thousands of images of real soldiers, people whose lives came unexpectedly to an end due to the brutalities of WWII, these AI-generated portraits do not seem to accept their condition. In other words, like larvae awaiting metamorphosis into their next forms of life, these spectral figures await transmutation into their previous existence so as to demand retribution for the torments they have suffered. Like larvae whose condition is defined by in-betweenness, these ghostly portraits appear stuck in the liminal state between a life that has not ended and a life that has not yet begun. Unwilling to accept their death and unable to come back to life, these phantasmal figures are thrown into an algorithmic limbo—an ontological purgatory made of the

27 Giorgio Agamben, "On the Uses and Disadvantages of Living among Specters," in *The Spectralities Reader: Ghosts and Haunting in Contemporary Cultural Theory*, eds. María del Pilar Blanco and Esther Peeren (London/New York: Bloomsbury, 2013), 475.

28 Ibid.

perpetual differentiation implemented by the generative and discriminative models. It is this specific kind of photographically instigated and algorithmically sustained memory that I call *larval memory*—a memory that is as much virtual as it is spectral in its form of appearance and existence.

Larval memories are neither on the surface as factual remembrances nor sunken as possible recollections. They exist in a state of cryptobiosis; that is, a transitional state during which one is neither alive nor dead but suspended between the two. Coagulated by the generative and discriminative models, larval memories endure a purgatorial condition in which a memory is neither inhumed nor exhumed, neither sepulchered in the past nor resurrected in the present. Therefore, when we look at these photographs, we do not recall memories that are finished, as if they were fully realized in the past, but ones that are being actualized between the virtual past and the algorithmic present. To put it concisely, *larval memories are virtual memories of the general past undergoing actualization in a particular present, resulting in opaque, fragmented, discorporate, and spectral recollections*. It is precisely because they fail to realize lucid memories of the past that larval memories manage to actualize its atrocities. Let loose among us like incubi and succubi, larval memories spectralize the past without the possibility of reciprocity.

Conclusion

By situating Yurenev's *War Actor* photo series at the intersection of memory, virtuality, and spectrality, I have discussed how AI photography can induce a spectral memory that is being constantly actualized without ever being fully realized. I have drawn on the virtuality of memory through Bergson and discussed the spectrality of photography through Derrida. In doing so, I have shown how the disjointed bodies and distorted eyes of the AI-generated portraits induce a spectral feeling in the viewer—a haunting sense of the whole past summoned through the perpetual differentiation executed by the GAN's generative and discriminative models. Therefore, I have argued that if AI manages to conjure up memories of the Second World War, those memories are innately spectral and larval; they exist in a liminal state between life and death as well as presence and absence. Larval memories are photographically induced and algorithmically infused recollections that are suspended in a cryptobiotic state between facticity and fabrication, authenticity and artificiality, and remembering and forgetting.

Part II:
In-Game Photography and Virtual Adventurism

4. From In-Game Photography to Playable Imaging

Marco De Mutiis

Practices of image captures within game worlds have challenged traditional understandings of the photographic medium, as well as questioned how notions of play and games can be transformed by the photographic act. The influence of photography on computer graphics can be seen through the development of photorealism, which has become an almost compulsory feature of contemporary AAA games. On the other hand, ideas of photographic capture, the camera apparatus and the role of the photographer have been shaped by different forms of play and specific relations to games. Not all game images are made equal: the game might encourage or hinder photographic endeavors, promote or resist the production and circulation of images, reinforce or undermine specific politics of representation as well as image economies. Images are not simply captured from a screen, they are "extracted" during a play experience, negotiated within the game boundaries.

The intersecting trajectories between game and photography – and the development of the multiple forms in which phenomena known as in-game photography or virtual photography have emerged and developed – show how image-making in computer games have become unique practices within discourses of digital and networked images. Not only the game image needs to be understood for its own properties and specificities, but it must be rethought through a relational approach that centers on the affordances and obstacles of the game object.

Yet this relation is not a static system among clearly defined stakeholders, but rather an evolving network of actors and forces with a long history. The history of game images is intertwined with the development of computer graphics, the evolution of videogames as a medium, as well as the transformations of image capture systems recording the screen and the digital and networked transformation of the photographic medium. The activity of taking pictures of games changes and evolves together with the development of game hardware and software, with the evolution of game culture and is affected in turn by the transformations of the photographic image and systems of capture that are attached to these computational systems. While the term in-game photography only appears in the early 2010s, the larger history of game and photography is inextricably connected to the history of computers, video games, computer graphics, photography and networked images.

This chapter offers a brief overview of the relations between photography and computer games from the 1950s until today, reflecting upon the different roles in which games and play have shaped different image practices, and their social and political implications. How is the photographic medium transformed, reclaimed and reshaped by the game and through acts of play? Can we rethink in-game photography as a form of playable imaging and what does that reveal about the politics of contemporary digital and networked images?

Screen Images, Polaroid Evidence, and High Score Photography

Analog photographs of computer screens are employed in the early days of computers[1] as a way to document computational outputs and graphical user interfaces. These photographs are part of a broader history of photography that media scholar Winfried Gerling traces to the German notion of *Schirmbild* (screen-image). Gerling defines screen-image photography (*Schirmbildfotografie*) as "the photo-technological capturing of illuminated screens (screen images) using a photographic apparatus,"[2] and points to their complex status: at once a photograph of a monitor's surface while simultaneously a copy of the image displayed on the screen. He traces the origins of this practice to the mass-screenings of x-rays in the 1930s. Brazilian physician and scientist Manuel de Abreu is the first to implement a way to photograph the image of x-rays on an illuminated screen with a small-format camera. While the first digital computers were completed in the early 1940s, it took almost another decade for the first computer games to emerge. The earliest forms of computer games, such as Josef Kates' *Bertie the Brain* or Robert Dvorak's *Tennis for Two*,

1 The first digital computers were completed in the early 1940s, but graphical user interfaces only appear with Sutherland's 1963 Sketchpad program.

2 Winfried Gerling, "Photography in the Digital," *Photographies*, vol. 11, no. 2–3 (2018), 149–167.

mostly served as public spectacle to demonstrate the capabilities of computers to mass audiences or simulation systems for warfare and military training. Projects from this era originated almost entirely from military fundings and were not made accessible to the general public. Therefore, available images of these early computer games are mostly photographs used to promote the potential of computers.[3] They show the large game screen and computer apparatus next to the player, rather than focusing on the screen image itself (Fig. 4.1).

4.1 Life magazine photo of comedian Danny Kaye standing in front of Bertie the Brain at the Canadian National Exhibition in 1950.

Photo: © Bernard Hoffman for Life Magazine.

The 1950s are "a decade of false starts for the video game. Almost as soon as anybody [starts] exploring the idea they [walk] away, convinced it [is] a waste of time."[4]

3 See for an example the *Life* magazine photo of comedian Danny Kaye standing in front of *Bertie the Brain* at the Canadian National Exhibition in 1950 (accessed April 22, 2024). https://en.wikipedia.org/wiki/Bertie_the_Brain#/media/File:Bertie_the_Brain_-_Life.jpg

4 Tristan Donovan, *Replay: The History of Video Games* (Hove: Yellow Ant Media Ltd, 2010).

In the 1960s, computer screen-images were produced as photographs of computer monitors, created “to make the work on the first interactive CAD computers visible to a larger audience than the scientists working directly with these computers.”[5] With the advent of the Graphical User Interface (GUI) at Xerox PARC (Palo Alto Research Center), interaction designers and developers used Polaroid to document their work. Computer engineer Bill Atkinsons’ work on the Apple II and Apple Lisa remains a notable example of screen-images from the late 1970s, taken by the author to record “his prototypes by taking Polaroid photos of the screens, annotating them, and storing them in binders,”[6] documenting the development of new ideas, prototypes and work in progress through photographic records. Specific camera apparatuses were developed with a dedicated camera hood to achieve “sharp focus, fram[ing] the image, and block[ing] ambient light.”[7] Polaroids of game screens start becoming popular in the 1980s, with players taking pictures of arcade machines and early game consoles. Typically, players would submit photographic evidence of their high scores, to be officially featured in top player rankings and gain rewards. Game scholar Mikael Jakobsson discussed how Activision, a US video game publisher, encouraged players to achieve special milestones by providing rewards in exchange for photographic evidence.[8] Activision introduced unique challenges for its Atari 2600 games, printing them in the game manuals. “If a player managed to beat a challenge, they could send a letter to Activision, normally with a photo of the TV screen included as a proof, who in return would send a decorative fabric patch together with a form letter congratulating the player and welcoming them to ‘the club’”[9] (Fig. 4.2).

5 Gerling, “Photography in the Digital,” 149–167.

6 Bill Moggridge, *Designing Interactions* (Cambridge, MA: MIT Press, 2006), 99.

7 Advertisement for Polaroid CU-5 Hard Copy Camera for CRT terminals, ca. 1970, accessed April 22, 2024, https://www.laboiteverte.fr/wp-content/uploads/2014/10/vintage-screenshot-capture-ecran-ancien-07.jpg

8 See a picture of Jeff Sparkman standing next to his high score of over 112000 points in the game Seaquest which he submitted as a proof to obtain an Activision club patch, August 22, 2005, archived on Internet Archive on November 23, 2021, https://web.archive.org/web/20231121190311/https://siftin.blogspot.com/2005/08/great-moments-in-human-achievement.html

9 Mikael Jakobsson, “Achievements,” in *Debugging Game History: A Critical Lexicon*, eds. Henry Lowood and Raiford Guins (Cambridge, MA: MIT Press, 2016), 7.

4.2 Photo of Jeff Sparkman in April 1983, standing next to his high score of over 112000 points in the game Seaquest (Steve Cartwright, Activision, 1983), which he submitted as a proof to obtain an Activision club patch.

Courtesy of the photographer

David Crane, co-founder of Activision, reported in an interview that "that was typically done with Polaroid pictures of the screen." Crane also added that most of these images, while being considered objective proofs to determine achieved high scores, were not archived and preserved, and are now lost: "As far as I know, none of those were saved for much more than a few weeks – certainly not 35 years. Photographic evidence definitely existed at one time, but it has most certainly been lost for decades."[10] This is partly due to the widespread consideration of computer games as trivial toys and consequently of these images as being unworthy of being properly stored and archived. Popular game magazines like *Nintendo Power* also accepted photographic evidence and included players' names and highest score in a dedicated section.[11] Additionally, these

10 Jesse Collins, "Dragster Designer David Crane Has No Doubts Of Todd Rogers' Record [UPDATED]," *Twin Galaxies* website, January 23, 2018, 10:20 PM, archived on Internet Archive on November 9, 2020. https://web.archive.org/web/20201109032951/https://www.twingalaxies.com/feed_details.php/87/dragster-designer-without-a-shadow-of-a-doubt-about-todd-rogers-record/1

11 See the section "NES Achievers" on *Nintendo Power*, Sept/Oct 88, page 103, for reference: http://transience.paragonsigma.com/nintendo/Nintendo%20Power%20002%20-%201988%20Sep-Oct.pdf. Page 104 also contains an illustration to instruct play-

magazines contained lots of pictures of gameplay too, taken by the authors to accompany texts to guide the players through the game missions, or showing the reader how to access secret areas and special game mechanics and states.[12] Screen-images of games also started to appear in print advertisements, although photographs of players engaging with the game were often employed as well. Both the Polaroids of developers and interaction designers, as well as the photographs of game scores taken by players and of gameplay on magazine columns can be considered as 1:1 copies of the screens, documentation and evidence rather than artistic usage of the camera or of the content on the screen that could be manipulated by the player. Media scholar Jacob Gaboury contested the objectivity of these screen-images as mere proof, and claimed that some of the scores they show appear ridiculous and in fact point to "a form of non-normative play whereby players exploit a game glitch to maximize points."[13] In the 1990s, this form of documentation gave space to more personalized accounts of play, and magazines stopped publishing high scores in favor of portraits of players in front of their television screens and consoles. These images do not only capture a moment of gameplay or a numerical achievement, but can be considered self-portraits attached to a personalized experience of play, what Gaboury describes as anachronistic forms of "screen selfies."[14]

Screenshots and Game Tourism Snapshots

Media scholar Matthew Allen traced a trajectory from the emergence of this conventional form of screen-image photography in the 1960s to the development of the screenshot in the mid-1980s.[15] The screenshot function allows to

ers on how to take pictures of their game screens ("place your camera on something steady", "make sure you don't use a flash," "the camera should be about a yard from the TV"...).

12 See *Nintendo Power*'s columns like "Classified Information" where strategies and tips were shared accompanied by game screen-images.

13 Jacob Gaboury, "Screen Selfies and High Scores," *Still Searching…* blog, Fotomuseum Winterthur, 2019, https://www.fotomuseum.ch/en/2019/07/05/screen-selfies-and-high-scores/

14 Ibid.

15 Matthew Allen, "Representing Computer-Aided Design: Screenshots and the Interactive Computer circa 1960," *Perspectives on Science*, vol. 24, no. 6 (2016), 637–668.

create "an image of the interface unable to be optically differentiated from its appearance."[16] Screenshotting were developed by different operating systems, with Apple introducing the screenshot with the release of the Macintosh in 1984 – through a combination of keys (Cmd, Shift and 3) being pressed simultaneously – and IBM keyboards introducing a dedicated Print Screen button on their hardware. At the same time, the golden age of game arcades between the late 1970s to the early 1980s was replaced by new generations of home consoles and personal computers.[17] Screenshots from computer games were only possible on computers, and became commonplace in the 1990s and early 2000s, as images of game worlds that were taken to save memorable, bizarre, meaningful or funny moments. In 2002, scholar Betsy Book compared screenshotting practices within games to tourists snapping pictures offline. Book wrote of a form of virtual tourism and explained that "virtual tourists take photos for the same reasons offline tourists do: to commemorate their travels, obtain a visual record of enjoyable experiences, and show evidence of their experiences to friends and family."[18] These screenshots are often intimately connected to the player's experience in the game, with on-screen chats appearing overlaid on the game screen, documenting interaction with other players, with software interfaces included in the picture or accompanied by captions contextualizing the players' visual memories with information about the gameplay experience at the time the picture was taken. Sharing of these screenshots in the 1990s happened with the early development of the internet and with personal players' homepages featuring their game images, commemorating special moments experienced in a game or creating alternative narratives and fan fictions.[19]

These screenshots are radically different from the screen-images of the past, and not simply because of their technical difference. While screen-images can be understood as copies of the computer display, game screenshots

16 Gerling, "Photography in the Digital," 149–167.

17 Video game journalist Steven L. Kent, places it between 1979 to 1983. See Steven L. Kent, *The Ultimate History of Video Games: From Pong to Pokémon* (New York: Three Rivers Press, 2001).

18 Betsy Book, "Traveling Through Cyberspace: Tourism and Photography in Virtual Worlds," paper presented at the conference Tourism & Photography: Still Visions – Changing Lives in Sheffield, UK, July 20–23, 2003. http://dx.doi.org/10.2139/ssrn.538182.

19 The Sims became a popular game to screenshot and use to create alternative narratives, see this archived Geocities page for an example: http://www.geocities.ws/sistergirl555/Chapter6pt2-4.html.

are inextricably connected to the experience of the player who is capturing the image. These images are in fact taken *during* gameplay, rather than at the end of the game – for example in the case of high scores documentations – and show the potential creative qualities of game image-makers. Furthermore, players became able to appropriate and modify computational technologies thanks to access, knowledge and sharing possibilities offered and facilitated by the spread of the internet. Movements like net art and – more specifically in the context of computer games – the birth and rise of modding culture and machinima of the same era, are the neighboring practices and communities of game screenshotting phenomena. The communities that emerged around photographic practices in games share an artistic approach and a creative spirit of appropriation of game-images which differ substantially from the idea of employing photography as a mere proof.

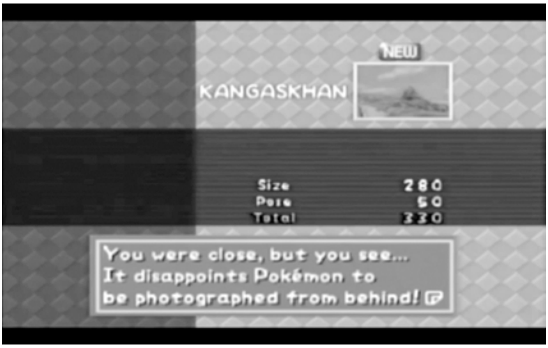
Photorealistic Images and Photography Simulation Games

In the 1990s, the increased computational power of the time marked a development in graphics that evolved from limited pixel based 2D representations – sometimes rather abstractions – of the 1970s and 1980s to the first forms of 3D graphics. Photographs were used as texture sources, as image portions to be added to the surfaces of the game 3D models. Usually, game elements were created using photographs from stock image databases available on CD-ROMS, applied as textures of early games employing 3D graphics.[20] It is interesting to observe that when photographs started being used by developers to implement higher level of graphics and more realistic 3D models, on the other side of the screen players started taking more and more "photographic" screenshots of game worlds. As players act more and more as photographers, some games even start to incorporate the photographic act in their own game mechanics, turning the act of capturing images into a core part of the gameplay itself. That was the case for *Pokémon Snap* (HAL Laboratory, Pax Softnica, 1999) (Fig. 4.3),

20 Recently, a phenomenon called "Texture Archaeology" has seen communities like the one around Render96 Wiki, who look for the original photographs that were used to create game texture from the 1990s. See for reference the GitHub page "Material Dictionary Volume 6: Four Seasons Nature (SSBM)" to see the corresponding photographs of game elements of nature: https://github.com/Render96/Render96Wiki/wiki/Material-Dictionary-Volume-6%3A-Four-Seasons%E3%83%BBNature-%28SSBM%29

Afrika (Rhino Studios, 2008), *Wild Earth* (Super X, 2006), and many other photography games in which the player was tasked to take pictures of wild animals and creatures and is subsequently evaluated based on the aesthetics of their shots.

4.3 Marco De Mutiis. Screenshot from Pokémon Snap (HAL Laboratory, Pax Softnica, 1999).



Media scholar Seth Giddings, analyzing the photographic missions in the game *The Legend of Zelda: the Wind Waker* (Nintendo, 2002), noted that these game images "do not serve, as they have traditionally done, as trophies or displays of aesthetic accomplishment, rather they function as correct solutions to challenges or puzzles, tasks to be rewarded with maps or tokens useful in the player's progress through the game. Photography here is instrumental, answering the demands of the game, it is not an aesthetic or performative practice."[21] Image-making here is no longer an external act that captures a moment of the game screen or intervenes temporarily to document the play experience. Photography is gamified: it is simulated and broken down into game mechanics where the player is tasked with producing images which are then algorithmically quantified and evaluated through game points. Game scholars Alexandra Orlando and Betsy Brey analyzed *Pokémon Snap* (HAL Laboratory, Pax Softnica, 1999), specifically looking at the way the player is given scores depending on aesthetic evaluations processed by software based on size, technique

21 Seth Giddings, "Drawing without light: simulated photography in videogames," in *The Photographic Image in Digital Culture*, ed. Martin Lister (New York: Routledge, 2013), 41–55.

and pose. The two authors claimed that the game shapes a specific idea of a successful photograph, in favor of other styles and visual cultures. The gamification of the photographic act creates a standardized notion of what a successful photograph can be, promoting what Orlando and Brey call a kind of "photographic colonialism—the limitation to a single viewpoint at the expense and extinction of others by a controlling power outside of the immediate environment."[22] Whether the player is tasked with photographing Pokémon, wild animals or models, all photography games enforce what could be called a "safari gaze." Players are taught to perform the role of the photographer as the hunter, reproducing problematic politics of representation which have been widely critiqued in the field of photography.[23] Performing this colonial safari gaze is rewarded through points that allow the player to move further in the game towards the goal of winning, with players being shaped as subjects that are taught to see the world as a space to be organized and dominated.

Artistic In-Game Photography and Networked Game Images

In the 2000s, with the development of photorealistic rendering and 3D graphics, game worlds started becoming increasingly similar to the visual quality of cinematic and photographic technologies, affecting the practice of screenshotting the game. From a merely touristic snapshot to preserve a personal memory, game images were transformed into pictures created with a photographic mindset and with knowledge of composition, lighting and aesthetic qualities similar to cinematic and photographic traditions. Writing in 2006, media scholar Cindy Poremba pointed to screenshotting practices in video games as carrying elements of analog photography. Poremba wrote about the logic of remediation[24] – or the representation of an older medium in a

22 Alexandra Orlando and Betsy Brey, "Press A to Shoot: Pokémon Snap-shots and Gameship Ownership," *First Person Scholar*, 2015, http://www.firstpersonscholar.com/press-a-to-shoot/.

23 Most famously Susan Sontag wrote that "hunters have Hasselblads instead of Winchesters; instead of looking through a telescopic sight to aim a rifle, they look through a viewfinder to frame a picture." Susan Sontag, *On Photography* (Maleny: Rosetta Books, 1977), 11.

24 Jay David Bolter and Richard Grusin, *Remediation: Understanding New Media* (Cambridge, MA/London: MIT Press, 1999).

subsequent one – of traditional photography, which occurs in digital games in both technical and cultural modes. According to Poremba:

> The remediation of photo aesthetic can be seen in the composition of the shots … and can be inferred by the way the game interface is conspicuously absent in the displayed game images. The removal of visible interface elements is particularly revealing in terms of remediated photo aesthetics, as a more accurate visual depiction of a game image would be to contextualise the screenshot within the interface a particular game. Images without interfaces to some extent deny their origin, instead referencing how an image is supposed to look—like a photo.[25]

Also thanks to the development of faster and more widespread internet connections and the advancement of Web 2.0 technologies, platforms of image sharing like Flickr allowed communities of players to easily exchange their images. Flickr became a popular platform for amateur and professional photographers to host high resolution pictures and create a global community of player-photographers who interacted through dedicated online groups. It was the rise of amateur in-game photographers who shared their screenshots with each other online, but it was also the moment when game screenshotting became a profession. This is best exemplified by the case of Duncan Harris, also known as Dead End Thrills, who started working as professional in-game photographer, creating images for marketing and communication for the release of many major computer games. In 2010, the Dead End Thrills Flickr Group was created by Harris, with the purpose of "celebrating the beauty and imagination of videogames via clean and evocative screenshots."[26] The group description proceeds to state that "Anti-aliasing is preferred and HUDs[27] are not, while anything that shows a game in a new or unexpected light is encouraged. Oh, and no Second Life, please, there's quite enough of that on Flickr already."[28] The early

25 Cindy Poremba, "Point and Shoot: Remediating Photography in Gamespace," *Games and Culture*, vol. 2, no. 1 (2007), 51.

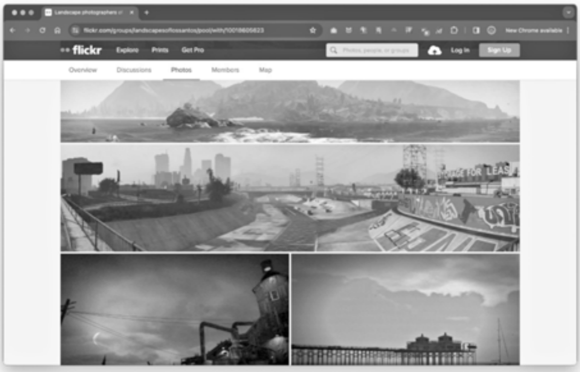
26 Dead End Thrills Flickr Group Page (Now Undeadend Thrills), archived on Internet Archive on May 30, 2010, https://web.archive.org/web/20100530083418/https://www.flickr.com/groups/deadendthrills/.

27 HUD stands for Heads Up Display and is the interface area where players can see relevant information about the gameplay, e.g. character's current health, bonus attributes, armor level, ammunition count, and more.

28 Ibid.

rules of the group revealed the shift in attitude from players as tourist photographers to in-game photographers: aesthetic concerns about images took over the affective and personal value of earlier screenshot culture – encouraging the use of anti-aliasing techniques to improve the rendering of the images, and the removal of the overlaid game interface or HUD. Another important shift was the role of the player-photographer as someone able to offer a unique view, adding an artistic quality to the game screenshot – encouraging the idea of showing the game image through a different angle and promoting a sense of uniqueness by denying content from games like *The Sims*, which was a major title used by "player-tourists."

4.4 Marco De Mutiis. Screenshot from "Landscape photographers of In Game Worlds" Flickr Group.



The phenomenon of in-game photography kept gaining popularity with many similar communities on Flickr, all establishing rules for submissions to their online groups, resonating with the more artistic attitude of the DET group (Fig. 4.4).[29]

29 See the Flickr group "Landscape photographers of Los Santos and Blaine County" (now renamed "Landscape photographers of In Game Worlds") – created in 2013 by Phil Rose: https://www.flickr.com/groups/landscapesoflossantos/ .Its rules page state: "please do not upload photographs that are purely of cars or of people. ... This is a group for landscape photographs specifically" and defines in its rules "no 'selfies'. No crotch shots. No dead animals. No shootings or killings. There are plenty of

In 2012, in-game photography was first featured as a term on Rainer Sigl's blog "Videogame Tourism."[30] In the blog post, Sigl wrote about the emergence of a practice by players who would capture moments within the virtual spaces inhabited by players and highlighted the appearance of "the photographic gaze, that eye for composition and purely visual aesthetic, [which] finds ample opportunity for snapshots in these virtual spaces."[31] Comparing this new image culture to the previous practice of screenshotting games, Sigl added that "it's surprising that in-game-photography – for purely aesthetical reasons as opposed to documenting victories or snapping a pic of an impressive vista for use as a desktop wallpaper – is still as unexplored a country as it still seems to be."[32] The blog post featured a number of practitioners like the previously mentioned Duncan Harris, and "his ultra-stylish, high-gloss pictures of games tweaked to look their very best to still photography in movie production" and James Pollock's "breathtaking" game-photography. One of the main aspects of in-game photography as narrated by Sigl and other journalists covering the phenomenon in the 2010's, is the aesthetic qualities of the game image, their connection to photographic and cinematic tradition and the development of photorealistic rendering technologies which allow such connection. In his conclusion Sigl prophetically stated that "it seems obvious that, with constantly increasing photorealism and the popularity of open-world-games, more and more photographers will also look for inspiration and picture opportunities in virtual worlds."[33]

Finally, it was the blog post title that might be most revealing about some of the aspects of in-game photography that are most interesting in relation to

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places for those! This is a place for landscape pictures only. They can be rural or urban. The ideal is that people will grab a screenshot, take it into Photoshop (or your favourite editor), do their best to make it interesting/beautiful/easily mistaken for reality and then upload it here. So post processing is important though not as important as location, time of day, weather and composition considerations." The "Video Games Photography" Flickr group, created in 2018, claims to be a space "for video games high quality screenshots with a photographic, artistic vibe. More than just simple gameplay captures." https://www.flickr.com/groups/4524127@N23/

30 Rainer Sigl, "The Art of In-Game Photography. Video Game Tourism," July 25, 2012 (accessed April 22, 2024) http://videogametourism.at/content/art-game-photography.

31 Ibid.

32 Ibid.

33 Ibid.

the photographic medium: "The Art of in-game Photography." The game image was consecrated as a form of art and – thanks to its photorealistic 3D rendering graphics – could be inserted within the art historical canon of twentieth-century art photography. Unlike screenshots of 1990s games, in-game photographs of the 2010s were ambiguous images that can be interpreted through an aesthetic and semiotic analysis applied to analogue photographs from the modernist tradition of landscape photography, architecture photography, or street photography.

Photo Modes and Camera Simulations

In-game photography became such a popular phenomenon that led computer game console PlayStation to completely modify its policies related to exporting and copying images from its hardware, when Sony's PlayStation 4 console was released in 2013. While its predecessor PlayStation 3 made it impossible for players to export image and video data without recurring to external and unofficial devices that would enable them to capture the content of the screen, PlayStation 4 added the possibility to export images directly from the controller, with the introduction of the share button. The share button can be considered equivalent to the print screen button of a computer, with the added feature that by default the image can be automatically shared on Twitter or Facebook. The game image is not only extracted by the software, but is now encouraged to leave the game and travel as a networked image on social media platforms. Furthermore, game studios start implementing spaces for in-game photography within the game software, introducing so-called photo modes. Photo modes are a function integrated into videogames that first appeared in 2004,[34] but became most popular after the game *The Last of Us* (Naughty Dog, 2013) was remastered for the newly launched PlayStation 4 in 2014. Photo modes allow players to pause gameplay in order to save an image of a moment within the game world. Unlike a normal screenshot, players can

34 *Gran Turismo 4*'s (Polyphony Digital, 2004) Photo Travel and Replay Photo Mode can be considered the grandfathers of contemporary photo modes. While they differ from photo modes in their relation to the game play (Photo Travel could be considered a separated photography mini-game and Replay Photo Mode can be used during replays, only after the race has been played), they are the first simulation of the analog camera within a game, allowing players to compose and save their images.

navigate this frozen scene: they can position their virtual camera anywhere and move freely around their subject at 360° to find the perfect framing before taking the picture. Once the player decides to end their photographic activity, the game is resumed from the exact moment it was left off. This photographic production at the level of the game software is combined with the addition of the share button at the level of the console hardware. On PlayStation 4, once photo modes are activated and the player is ready to take their shot, pressing the built-in share button on the controller takes, or rather *shares*, the picture. If photorealism and online circulation shaped the phenomenon of in-game screenshotting in the 2000s, photo modes provided a transformation of the tools of image capture at the disposal of the players, after their popularization in 2014. Soon after the release of the remastered edition of *The Last of Us Remastered*, the online edition of *Time Magazine* commissioned real-life war photographer Ashley Gilbertson to document the conflict in the game. In the article, Gilbertson recounted his difficulties to adjust to the role of in-game photographer. As was noted in an article written by Sebastian Möring and Marco De Mutiis, "the anecdote illustrates that … Gilbertson, who is not a regular video game player, was unable to cope with the surges of enemies in the game, which limit his freedom as a player, but, even more so, his freedom as a photographer."[35]

Photo modes were introduced on computer versions of games as well, and engines for advanced in-game content captures were developed to run on PCs. In 2016, graphic card company NVIDIA released their game capture system Ansel, named after photographer Ansel Adams. The company in the launch event clearly named in-game photographers as the target users of Ansel, and celebrated the "art of in-game photography"[36] citing some of the artists from the Sigl blog post four years previous. NVIDIA Ansel continued the narrative of the analogue photographic apparatus in its parameters, while providing the player with algorithmic tools that move beyond the idea of a mere screen capture: enhancement, manipulation and even the addition of visual information

35 Sebastian Möring and Marco De Mutiis, "Camera Ludica: Reflections on Photography in Computer Games," in *Intermedia Games – Games Inter Media: Video Games and Intermediality*, eds. Michael Fuchs and Jeff Thoss (New York: Bloomsbury Academic, 2019), 69–94.

36 NVIDIA, "NVIDIA Special Event: NVIDIA Ansel and In-Game Art (Part 1)," YouTube video, May 7, 2016, https://www.youtube.com/watch?time_continue=260&v=nanaEvnjo8

that was not in the original game image. Poremba claimed that these game images became a further abstraction from photography's reference as "Ansel's actuality is not found in showing the game as it does look, but as it can look."[37] At the same time, the photographic activity of players was also shaped by photo modes and Ansel, as these platforms co-construct "in-game photography practices, in ways which align with … corporate interests, and in particular skew towards monetization potential, like the training of professional in-game photographers on Ansel, the centralization of user-generated content, the integration of its hardware into desired practices."[38] Players, who stop their gameplay in order to enter a space for photographic activity in photo modes and Ansel, are turned back into a regulated space – in what could be aligned to what Alise Tifentale and Lev Manovich call "competitive photographers."[39] What is hidden behind these simulated camera systems are algorithmic and networked imaging systems that recapture the value of in-game photography activities for advertising purposes and within structures of online attention economy on social media. The subversive potential of screenshotting practices and forms of photographic play against the game and its boundaries is turned into a form of manageable image production that is allowed and even encouraged by imaging systems that are structurally connected to the game.

Non-Human Game Photographers and Virtual Photography

In 2016, *Fantasy XV* (Square Enix) introduced a non-playable character named Prompto, who would accompany the player, "taking pictures" within the game world on their behalf. The player is presented with the pictures from Prompto at the end of each game day, and is given the ability to select and share the images on social media platforms. These game images are taken (or rather, created) algorithmically and without the player's possibility to intervene or take part in the capture process. They are served as outputs generated by the game,

37 Cindy Poremba, "Ansel and the (T/M)aking of Amateur Game Photography," in *Screen-Images: In-Game Photography, Screenshot, Screencast*, eds. Winfried Gerling, Sebastian Möring, and Marco De Mutiis (Berlin: Kadmos, 2023), 223–243.

38 Ibid.

39 Alise Tifentale and Lev Manovich, "Competitive Photography and the Presentation of the Self," in *Exploring the Selfie: Historical, Analytical, and Theoretical Approaches to Digital Self-Photography*, eds. Jens Ruchatz, Sabine Wirth, and Julia Eckel (London: Palgrave Macmillan, 2018), 167–187.

with the player-photographer now only able to decide whether they are to be shared online or not – or, in the words of Prompto's developer: "it takes effort to take a good screenshot. However, with Prompto's snapshot it's all 'auto'. To share or not to share is the only question you have left."[40] In-game photography – as claimed by Möring and De Mutiis in a provisional mapping of the phenomenon in 2019 – should be understood as

> a multitude of practices and technologies in which photography and video games interact. These practices and technologies do not share a single set of characteristics, but they show family resemblances in the Wittgensteinian sense. Thus, we refrain from offering an ontological definition of in-game photography. Instead, we describe different types of 'in-game photographies.'[41]

This plurality is necessary to break from the idea implied by the narration of photography in photo modes and game capture systems, which solidify the analogue medium through simulations that produce photorealistic game images that follow the trajectory of advertisement photography and the production of image capital. At the same time, photographies – even in its plural form – remained anchored to the analogue medium and prevents from focusing on the specific properties that make image-making in games possible. The majority of the possible photographies allowed in game spaces are in fact constructed upon algorithmic ways of seeing, computational images made of models and textures, and networked circulation regulated by online platforms with their own mechanics. These can be better addressed through an idea of imaging, although a specific kind of imaging that is connected with and shaped by the play experience with the game object.

Conclusion: Playable Imaging

This overview has shown the complexities of the game image and its interconnected relations to the development of videogames, computer technologies, visual network cultures, play activities, image economies and ecologies. The

40 Prasert Prasertvithyakarn, "Prompto's Facebook – How a Buddy AI Auto-Snapshots Your Adventure in FFXV," presented at Game Developer Conference 2017.

41 Möring and De Mutiis, "Camera Ludica: Reflections on Photography in Computer Games," 69–94.

image moves throughout the years from the surface of the computer screen to the textures that make the game worlds, and from the screenshot copy that documents the game experience to a creative and artistic creation isolated from gameplay. The actors and authors of the photographic act also move between developers documenting interfaces to players commemorating game moments, and from photographers creating stock images to players using photo modes to make photorealistic images from game worlds. Finally, the apparatus itself transforms from film and polaroid cameras to basic screenshot functions and then software simulating the analogue dispositif within the game. The picture, the apparatus and the photographers all seem to move, over the years, from a clearly demarcated "external world" to the inside of the screen, within the machine, while becoming inseparable from the game and enmeshed in the act of play.

In-game photography practices and images develop in parallel to the transformations of the photographic image in the digital and networked turn described by the discourses of image studies. At the same time, in-game photography requires interaction with the game object through the experience of – or the absence of, or resistance from – the act of play. In-game photography incorporates the issues of the digital image discourse from the last thirty years, but it also expands these tensions as it is inherently connected to the relation between the player and the game they operate (and are simultaneously operated by). The photographer, the apparatus and the images that are produced within in-game photography practices must be understood by analyzing them within the context of play: this reveals how the space of play and the affordances of the game allow, encourage, or resist the formation of different image practices. The game object, in other words, is not merely providing a screen for an external photographer to take pictures of, but negotiates with the player the possibility to create images. In doing so different forms of image systems emerge, shaping different forms of player-photographers, image aesthetics, as well as social configurations, economic systems and politics of the game image. Play here is to be understood as an act with very serious consequences, conforming to the rigid rules of the game, or resisting and transforming the game itself.

For these reasons, studying in-game photography cannot ignore notions from the field of play and game studies, in order to analyze the photographic acts and the different photographic agents and game images it produces. Therefore, researching in-game photography, while situated within the discourse of image studies, can be better understood through an idea of playable imaging. Playable imaging is suggested as a term that on one hand highlights the agency of play in relationship to the act of taking pictures of the game world, while on the other proposes the idea of imaging to counter the traditional understanding of photography as a medium that is merely remediated in ludic spaces. The shift from in-game photography to playable imaging not only takes a distance from corporate interest in which the phenomenon has been appropriated by the game industry, but also allows the research to focus on the specificities of play activities connected to forms of image-making and invites the reader to critically rethink the role of both games and photography within discourse of algorithmic and networked images.

The implications of game and play in the role of the game-image open up ramifications that connect the study of games to the field of visual culture. They require many different approaches, and a framework that is able to unite the tensions of image making practices between game and play with the gamification and ludification elements in the expanded ecology in which these images are inscribed. Playable imaging is therefore used as a starting point for exploring photographic forms of play and what meaning they produce. It understands play as an activity that is not disconnected from the social, political, and economic role of the image in contemporary visual networked culture.

5. Becoming Camera in Virtual Photography

A Player-Game-Camera Triangularity

Natasha Chuk

The physical-digital hybrid conditions of everyday life in the twenty-first century create new opportunities to experience and record the world around us, shifting how we perceive and engage with landscapes, both corporeally and virtually. Video games offer digitally built 3D environments that are interactive sites which continue and virtually extend our lived experiences in the physical world, like dreams or the imagination, except they are photographable and can be experienced in real time *as* intradiegetic photographic imagery that come together through our interactions with and within the virtual world. This is possible through the technical proficiency of in-game cameras and improved photorealistic graphics, which together remediate the digital camera and traditional photographic practices, offering many of the same existing creative possibilities and sensibilities and introducing new ones, and produce life-like staging grounds for play and interaction. As a result, the development of photo mode and the rise of in-game photography signal a post-photographic practice that reinforces the idea that interactive virtual environments are viable sites for meaningful experiences and thus worthy of photographic expression and documentation.

This chapter explores how the development of photo mode and the practice of in-game photography in the video game *Death Stranding* reflect our changing relationship to landscape, and both retain and remediate aspects of traditional photography and the landscape photography genre. It details how the game lends itself to an immersive sensation whereby it both looks (through visual representation) and feels (through simulation) like a physical environment, which is traversable, dynamic, and photographable using photo mode, the feature in video games that allows players to photograph the in-game world. This combination synthesizes the human (player) gaze and the virtual (camera) gaze to collapse the distinction between photographer and apparatus, and thus it places participants in the role of gamer, photographer, *and* camera device, forming a player-game-camera triangularity. Together with the game's photorealistic sophistication of 3D modeling, graphics, and animation, an effect of physicality of the virtual landscape is produced. The combination of awe-inspiring qualities in the game's simulation of both landscape and photographic camera gestures toward the technological sublime, an aspect of fascination and wonder generated by interacting with game worlds and the photorealistic in-game landscape photographs. The resulting post-photographic images are "softimages," malleable computational images activated by game play, which can then be fashioned, recorded, and edited into virtual photographs. The photographic series *Place(s)* by fine art photographer Pasco Greco is the result of these combined affordances in the game *Death Stranding*.

Remediation and the Enduring Appeal of Open Landscapes

Sheltering in place, mandated during the global outbreak of the Covid-19 pandemic in 2020, ushered in a rethinking of how—not only to socialize—but also how to explore and traverse open spaces online, effectively traveling to other places through our imaginations and with our avatars instead of our bodies. This type of psychic activity existed before most of the world was trapped in a mandatory quarantine, but the overall appreciation for virtual escapism noticeably grew when meeting in person was deemed too risky or impossible. This moment coincided with new developments in web3 environments: in particular, the explosion of NFTs and the rise in customized metaverse gatherings. But even before this, the steady visual and procedural development of the open worlds of interactive virtual environments and video games had facilitated the ability to virtually wander and experience the physicality of digital objects from one's position in front of a screen. The appeal of a fabricated landscape predates pandemic-related shutdowns and the solace found in digital environments of the internet and video games.

Thus, there was a precedent for the creation and success of the adventure game *Death Stranding* (2019), whose impressive visual verisimilitude, affords experiences which continue and virtually extend beyond our lived experiences in the physical world. Digitally rendered land, water, and sky look and feel tangible because of technical improvements over time and the photorealistic sophistication of 3D modeling, graphics, and animation.

As new technologies build on existing technologies; they demonstrate a process of remediation. For computer researcher Jay Bolter and new media scholar Richard Grusin, every medium is in a relation of remediation with previous media. As they write:

> It is that which appropriates the techniques, forms, and social significance of other media and attempts to rival or refashion them in the name of the real. A medium in our culture can never operate in isolation, because it must enter into relationships of respect and rivalry with other media.[1]

The interactive 3D environments of video games appropriate techniques, forms, and social relevance from many previous media. *Death Stranding*, with its convincing ability to appear (through visual representation) like a physical environment, remediates photography and the landscape photography genre. By producing the feeling that it is a physical environment populated with physical objects (through simulation and interaction), it adds a new sensation of being situated somewhere between the physical and virtual through the mechanic of traversing a dynamic, photorealistic digital landscape. Both digital and photographic landscape imagery build on a broader history of landscape imagery. As geographer Tim Cresswell observes, the concept of landscape at the time of its emergence in Renaissance Venice and Flanders "combined a focus on the material topography of a portion of land (that which can be seen) with the notion of vision (the way it is seen)."[2] The digital environment of *Death Stranding* and a player's experience of hybridity between the virtual and physical encourages a changed relationship to landscapes and physical environments. In such virtual environments, landscapes are valued, and exploration is encouraged, but materiality is relegated to the experience of virtual presence facilitated by the game's camera perspective.

Images created using the photo mode function of *Death Stranding* reimagine analog *and* digital landscape photography by dematerializing the presence of the photographer. Prior to the digital and networked era, the natural world was mainly experienced and recorded through analog means: writing, painting, drawing, and photography. The origin of landscape photography coincides with the emergence of the concept of landscape, dating back several centuries

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1 Jay David Bolter and Richard Grusin, *Remediations: Understanding New Media* (Cambridge, MA: MIT Press, 1999), 64.

2 Tim Cresswell, *Place: An Introduction* (West Sussex: John Wiley & Sons, 2015), 25.

and spanning various geographic regions, which indicates its own remediation of other visual forms that fictionalized and indicated an interest in depicting the natural world. As art historian Abigail Solomon-Godeau writes:

> To produce something visually recognizable *as* landscape was, therefore, to manipulate a set of pictorial devices that distinguished the natural world as such—*natura naturens*—from other related categories: forest, countryside, wilderness, garden, park, pasture, prospect, view, and so forth. This genre-fication of landscape, begun in the Renaissance, eventually permitted for the representations of particular kinds of landscape—mythological and classical, romantic and realist, rural and suburban, and, increasingly important in the nineteenth century, the identifiably national.[3]

When photography arrived at the height of romanticism in the mid-nineteenth century, it was situated somewhere between two poles of protection and loss. On one hand, photography—its own form of preservation—closed the gap between nature's beauty and the mechanical future in a gesture that contained both. On the other, photography joined other technological forces—the train, the telegraph—in annihilating time and space through speed and reorganization, and in doing so signaled a fictionalization of the landscape. As writer and activist Rebecca Solnit writes:

> One way to describe this transformation of the world whose great accelerations came in the 1830s, the 1870s, and the age of the computer is as increasing abstraction. Those carried along on technology's currents were less connected to local places, to the earth itself, to the limitations of the body and biology, to the malleability of memory and imagination.[4]

Photography was among the first to abstract the world in dramatic visual fashion, showing it in fragments selected by angles, framing, and proximity in a blatant distortion of space and time. With its politics of perception reflecting a technical feat, it mechanized a new rendering of the natural world. Technical improvements of photography over time, and particularly the transition from

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3 Abigail Solomon-Godeau, "Framing Landscape Photography (2010)," in *Photography After Photography: Gender, Genre, History*, ed. Sarah Parsons (Durham: Duke University Press, 2017), 107.

4 Rebecca Solnit, *River of Shadows: Eadweard Muybridge and the Technological Wild West* (New York: Viking Press, 2003), 22.

analog to digital photography, encourage a remediation of the medium as well as of abstraction itself. Landscape photography and interactive digital environments come together as synthetic images in *Death Stranding*, a combination that engages a post-photographic sensibility of further increasing abstraction, fostering new ways of representing reality, and allowing us to not only imagine but also embody, manipulate, and record alternative environments which result in a new a kind of landscape photograph and gesture toward the technological sublime.

Virtual Placehood within In-Game Photographs

Rather than merely simulate interactive environments, video games demonstrate a remediation of photography. Both in terms of the visual aesthetic of photographs and through the in-game mechanic of photo mode, a video game's virtual camera refashions previous digital and analog cameras. The concept of the technological sublime is used here to describe the combination of awe-inspiring qualities in a game which create a feeling of admiration and wonder generated by the interaction with a photo-realistic game world and landscape, and through having the ability to at once participate in and be removed from the game world while photographing it. *Death Stranding* achieves the status of the technological sublime in at least three ways: through a player's ability to traverse and interact with the virtual game world, which represents and simulates physical landscapes to produce a sense of virtual placehood; through having the ability to interact with the game world to allow the photographic composition to come together; and through being able to pause the game action to produce a photograph from it.

The concept of the technological sublime can be traced to the American culture historian Perry Miller, who alludes to the idea in passing when describing the "technological majesty" of new technologies, like the steamboat, which received near religious veneration following their introduction into American society during the mid-nineteenth century.[5] The technology historian David Nye expanded on the idea by drawing on aesthetics and the history of the sublime in art and philosophy and applying it to the continuing appeal of awe-inspiring feats of advanced technologies throughout American history. As he writes:

5 Perry Miller, *The Life of the Mind in America: From the Revolution to the Civil War* (New York: Harcourt, Brace & World, Inc., 1965), 303.

> The American sublime drew on European ideas in the fine arts, literature, and philosophy. In art history, the concept of the sublime is often applied to paintings that are unreal, monstrous, nightmarish, or imaginary. In architecture a sublime building usually is vast and includes striking contrasts of light and darkness, designed to fill the observer with foreboding and fear.[6]

While Nye proposes the idea that the American technological sublime represented an ideal that helped bring together a multicultural society, the term is useful in the context of describing the photographic and technological feats of *Death Stranding* as a representation of an ideal that is not uniquely American and that offers a reimagining of the landscape through new ways to access, interact with, and record it. As he writes, "In a physical world that is increasingly desacralized, the sublime represents a way to reinvest the landscape and the works of men with transcendental significance."[7] *Death Stranding* encourages a similar way of rethinking the landscape through the technical tools that achieve experiences, sensations, and aesthetics never previously imagined, and sometimes with uncanny results as we experience movement through sight and simulation over corporeality. It urges a reconsideration of how place and space, physical and virtual, and body and avatar are understood to produce a sense of virtual placehood, or the hybridity between physical and virtual described earlier. As architecture historian and theorist Carl Haddrell writes:

> By 'corporeal,' we may include subject matter that deals with real locations and buildings and how they create space and place, or how our understanding of them is determined by the influence of space and place. In contrast, 'virtual' space and place may be conceived of as notions of such, constructed as representations or commentaries upon the theme 'space and place.'[8]

Death Stranding, with its extensive photo mode mechanic, is the brainchild of video game *auteur* Hideo Kojima. The game is set in a vast, open world, where

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6 David E. Nye, *American Technological Sublime* (Cambridge, MA: MIT Press, 1994), 2.

7 Ibid, XIII.

8 Carl Haddrell, "Introduction: Dialectics of Space and Place across Corporeal and Virtual Topographies," in *Dialectics of Space and Place across Corporeal and Virtual Topographies,* eds. J. Jordaan, C. Haddrell, and C. Alegria (Freeland: Inter-disciplinary Press, 2016), ix.

the solitary player-character Sam confronts a melancholic, dystopian near-future landscape representing both a fractured United States and a tortured natural environment. Tasked with journeying on foot across the country to deliver supplies, the game builds on the kind of movement and environmental interaction one expects of a walking simulator game. As the player-character, you traverse the vast game space and witness the devastation of the land caused by mysterious invisible creatures called Beach Things (BTs), acid rainfall, and the fallout of mini nuclear explosions. Much of the game is spent walking across an empty, sometimes mossy, and other times rocky and infertile terrain. The sky is perpetually overcast, suggesting a permanent layer of dust has settled over the area. The ability to support new or existing life no longer seems possible in this world, which appears and sounds empty for kilometers in every direction. Much of the game is spent wandering through this desolate environment to the beat of your own heavy footsteps and the squeaking sound of your bulky metal gear. Cross-country treks during the first few hours of the game take place in near real time, adding to an immersive feeling of isolation and increasing anxiety. It is Earth, but it feels like an unpopulated planet you are doomed to walk.

The game's high production value contributes to a cinematic feel, placing players in a location with a twisted combination of aesthetics from science fiction and western filmmaking genres. The two styles coalesce into something that looks and feels otherworldly yet familiar. Video games of this caliber are dependent on photographic images as source material for the creation of 3D assets and motion capture technology used on physical actors whose likeness and movements become the basis of their avatar counterparts. Because of the game's uncharacteristically slow pace, as the player character you experience a prolonged amount of time in the game simply walking around, able to study the surroundings without distractions or interference. Mountains appear monumental, occasionally interrupting the empty horizon line. The onset of a heavy fog feels like the closest thing you will get to a warm embrace. The lifeless atmosphere preys on your vulnerabilities, steadily overpowering you. It is at once intimidating and wonderful. One might say sublime. Despite its post-apocalyptic brokenness, it is a divine landscape that is at times reminiscent of the unpopulated dramatic landscape and beauty of Iceland or Greenland. Given the game's highly textured visual and sonic environment, it is easy to feel like you are walking around a real (physical) place.

5.1 Pascal Greco, from the series Place(s), 2021.

Courtesy of the artist.

The Swiss-Italian photographer and filmmaker Pascal Greco's in-game photography project *Place(s)* (2021) emerged at the junction of the Covid-19 global pandemic, a canceled trip, and the expansive and sublime landscape of *Death Stranding* (Figs. 5.1 and 5.2). Greco's plan to visit Iceland to continue a photo project he started was thwarted by the ensuing lockdown. Like many others who looked to the digital world for escape, exploration, and to embark on a journey, Greco found inspiration in the virtual landscape of the big-budget sci-fi adventure game. It is possible his familiarity with analog and digital photography were the inspiration for recognizing similar photographic possibilities using the game's photo mode, and the environment of *Death Stranding* served as the basis of a new kind of hybrid experience of traveling to an otherworldly, yet familiar, place. He, too, found the landscape in this game to be reminiscent of Iceland, which contributed to his desire to make in-game photographs of its virtual environment in lieu of a trip to the Nordic country. His in-game photographs were assembled and published into a book, for which a description of the images on his website reads:

> Using the game and its constraints as a playground for experimentation, I undertook a meticulous yet playful photographic process, translating my approach to photography to the making of digital images. In the same way my Polaroids had previously challenged the stereotyped representations of the country, the images that have emerged frame aspects of the landscape that usually remain unseen…Place(s) embraces its codes and plays with the ambiguity of an anonymous landscape made familiar. As digital images, they question both in-game and traditional photography by setting a point where the two meet and intertwine.[9]

5.2 Pascal Greco, from the series Place(s), 2021.

Courtesy of the artist.

The results are images that depict a virtual place and objects that resemble corporeal locations and topographies, and as photographs, they easily pass for photographic images of corporeal locations and topographies. Greco's images are crisp and lifelike, owing to the virtual camera's large depth of field. They

9 See Pascal Greco's website at https://www.pascalgreco.com/places

show minute details of rock textures, water, foliage, grass, and sky. Given the range of possibilities afforded by the game's extensive photo mode, this is not surprising, but as a result, it is not immediately obvious these images depict a 3D game world and not Iceland, Greenland, or another corporeal location. This is fascinating as it shows how advancements in photo mode and our changing relationship to landscape usher in both a new type of photography and a new type of photographer.

From Virtual Cameras to Becoming Camera

In-game photography is a post-photographic practice emerging from synthetic image-making practices that have grown and evolved alongside the development of video games as a medium. It is difficult to trace this history to a definitive originating point because the technical ability to record content inside a digital environment has been explored across numerous stages. A combination of a hacker's ethos and open-source software characterized video game cultures of the 1980s and 1990s, which led to creative experimentation and technical advancement of video games and computer software. Modifications, or game mods, are changes made by a player to a video game's appearance, functionality, or behavior. Machinima, or animated films, are made using video game content as source material. Players proudly circulate all manner of both creations online. Making still photographs from these environments was not yet the norm in the early days, but these practices showed possibilities for recording in-game experiences and sharing them outside of the game.

The development of in-game, virtual camera technology helped to synthesize player-characters' movements with camera controls, across top-down/isometric, first-, second-, and third-person perspectives. Nintendo's *Super Mario 64* (1996) was one of the first games to include an interactive camera system split into two views: one that focused on the player-character and the other (guided by rudimentary AI) on the surrounding environment. Video games sometimes incorporate photography simulation by requiring players to take photographs during gameplay. A Nintendo game called *Pilotwings 64* (1996) included a "shutter bug" mission, requiring players to take an in-game photo to complete the mission. This intra-diegetic task furthered the goals of the game, and photos were stored in the game's photo album along with images from other missions. Nintendo took this idea further by introducing in 1998 the Game Boy Camera, a camera accessory for the handheld Game Boy video game console. This cartridge-based addition turned the Game Boy into a camera, allowing some basic photo modification, storage, and the option to print with an additional accessory.

Umurangi Generation (2020) is a more recent example of the growing relationship between photography and video games. Developed by the indie studio *Origame Digital*, it is a first-person simulation game, which takes place from the perspective of a photographer. The object of the game is to take photographs using specific lenses to explore a dystopian future environment, then evaluate the photographic results—their use of color, composition, and content—using an expressive grading system. The expansion to the game offers additional camera features, like shutter speed, aperture, and ISO adjustments, plus new means for players to move around the digital world, such as on roller skates. The less subtly named *Photography Simulator* (2023), developed by Madnetic Games, is also a first-person simulation game involving a professional photographer tasked with exploring the wilderness and producing images with ever increasing sophistication to advance their career, achieving wealth and fame along the way. Regardless of their narrative frameworks, these games represent photography as a primary gameplay element and use an impressive photo mode mechanic, a more highly developed virtual camera. Photo mode both relates to gameplay and is used to document the player's in-game experience through a remediation of a digital camera, offering a wide variety of camera options while also introducing the idea of a player-game-camera triangularity.

Video game photo mode has advanced in such a way that the camera has achieved the level of technical proficiency and quality of images of a digital camera, and the player and system collapse into what digital media theorist and artist Joanna Zylinska refers to as a new *para-photographic* genre.[10] In video games, players control a player-character (the protagonist) and assume the game's overarching gaze to view and interact with the game world both as the player-character and as a player. The game's gaze *is* the player-character's gaze, but as players, we also have the freedom to switch functions within this overarching game-camera gaze. We can experience the world as a player-character; assume the gaze of a non-playable character (NPC), and thus gaze *at* the player-character; and examine the world as an outsider using photo mode, which simultaneously pulls us out of and further into the game world.

10 Joanna Zylinska, *Perception at the End of the World (or How Not to Play Video Games)* (Pittsburgh/New York: Flugschriften, 2020), 7.

Photo mode is different from screenshotting using one's device, which is a form of photographic recording but engages an external function rather than an in-game mechanic. By offering camera capabilities as part of a player's in-game gaze, photo mode thus collapses the photographer, the camera, and the game world into a triumvirate relation.

This player mechanic encourages players to shift across these three perceptual planes, keeping in mind aspects of the camera's gaze are performed or actualized through virtual movement by the player within the game world. This augmented perceptual capacity feels like an extension of the avatar's vision, especially when the player-character utilizes the first-person perspective, which secondarily projects a perceptual abstraction of physical weight and movement through a virtual space. But the camera in *Death Stranding* hovers in a third-person or over-the-shoulder perspective, meaning the world is not visualized through the character's first-person view, rather as a bodiless companion who *also* controls the character. This position has no real-world equivalent, having an omniscient presence which is tethered to a fictional character in a fictional world. In this way, the player, or rather the player's virtual body, is the apparatus: the camera that sees and possesses the ability to record. The player *becomes the in-game* camera while also retaining their humanness and capacity to simultaneously read and critique the world during their engagement with it, gesturing toward a state of epic intersubjectivity. This effect is reinforced in *Death Stranding* by the player character Sam's tendency to refer to himself in the third person through internal dialogue.

To activate photo mode, the in-game action must be paused. Through this, the fictional components of the game, which are tied to controlling the player-character, are suspended, in a manner of leaving the "set" to explore independently with the intention of photographing it. Again, the virtual camera has a duality, acting as both the player's eyes in the game world and their recording device, meaning they see the world through both mediated and photographic vision. *Death Stranding*, like other games, allows players to control how the photo is rendered, unlike taking a screenshot through one's device, which offers no customizing options except cropping. Photo mode offers a player-photographer many choices in terms of framing, composition, and lighting, such as rotating the position of the camera, changing the depth of field, adding color filters, and using the grid function to line up objects in the frame, among others. Photo mode allows players to photograph the environment as well as the characters in the game, and virtual cameras also have features that exceed what physical cameras offer. Characters' facial expressions and poses can be controlled by the player's camera settings, turning photo mode into a virtual photo studio and the photographer into a prop stylist and set designer.

During play, the player's physical body remains stationary, save for the controls, while the virtual body hovers over the moving player-character. The virtual gaze extends through and beyond layers of mediation: merging with the camera apparatus through the interface of the computer screen, the 3D visual and sonic game environment, and the various game mechanics that produce object-oriented effects. To be sure, this complex technical system not only shapes but rewires our understanding of our mind's interiority as it relates to the external forces that expand our perceptual range. This is what literary critic N. Katherine Hayles refers to as a new model of subjectivity.[11] In this relation between a player-character and camera as a kind of *kino eye*, the corporeal body remains an active agent in a material-digital synthesis of great complexity. The player absorbs the distance produced by this abstraction without resistance. Photo mode reinforces the game world's logic while bridging material and digital entities. This lends the player the feeling of being present in the game world, sensing and seeing it as their own. Adopting the machine vision of a camera, a player experiences the world through the affordances of this mediation: zooming, cropping, arranging, and otherwise adjusting the virtual world's objects within the frame. In this situation, the photograph is a kind of truth or reality of time and experience in a (virtual) place. Moreover, the tether between player and player-character and game world creates an index between the physical body and the player's in-game experiences.

Other factors contribute to a sense of being in a place, not just a space. Media theorist Alexander Galloway argues:

> Representation refers to the creation of meaning about the world through images. So far, debates about representation have focused on whether images (or language, or what have you) are a faithful, mimetic mirror of reality thereby offering some unmediated truth about the world, or conversely whether images are a separate, constructed medium thereby standing apart from the world in a separate semantic zone. Games inherit this same debate. But because games are not merely watched, they are played, they supplement this debate with the phenomenon of action. It

11 See N. Katherine Hayles, *How We Became Posthuman: Virtual Bodies in Cybernetics, Literature, and Informatics* (Chicago: University of Chicago Press, 1999).

> is no longer sufficient to talk about the visual or textual representation of meaning.[12]

In another text, Galloway makes a different comparison using photography and film: "If photographs are images, and films are moving images, then video games are actions." Then he adds, "With video games, the work itself is material action. One plays a game. And the software runs."[13] Traversing the space of video games is thus an active performance of the software itself. The space becomes a place through which a player's actions as player-character, camera, and photographer are synthesized into a sensation of presence without corporeality.

Fixing the Softimage

The affordances of highly developed photo mode in games like *Death Stranding*, *Umarangi Generation*, and *Photography Simulator* demonstrate how technical, imaginative, and aesthetic conditions come together so that the fictional game world can be a place where players have real experiences through wandering, discovering, and traversing the landscape, then taking a photograph of these experiences, sights, and encounters as validation of the impact those experiences have on virtual wanderers. In these simulated interactive virtual environments, wandering around can be as awe-inspiring and fulfilling as wandering around the countryside. The environments we interact with, digital or material, seem to be in waiting, always at the precipice of becoming images, ready to be locked down, examined, and shared. Being able to easily switch from gameplay to contemplative spectacle and ultimately photographing the environment describes this post-photographic condition.

Like any photograph, in-game photographs signal that a living witness was present. In-game photography engages this combination of documentary and landscape photography, but it is also the result of a complex consolidation of

12 Alexander R. Galloway, "Social Realism in Gaming," *Game Studies*, vol. 4, no. 1 (November 2004). Available at https://gamestudies.org/0401/galloway/ (accessed September 12, 2023).

13 Alexander R. Galloway, *Gaming: Essays on Algorithmic Culture* (Minneapolis, MN: University of Minnesota Press, 2006), 2.

affect and mechanics toward a different form: the *softimage*. A remediation of a so-called *hardimage*, or a fixed representation of the world, softimages are algorithmic images which are, as image theorist Ingrid Hoelzl asserts "not only malleable, i.e. infinitely recomputable, but [are themselves] program (or part of a program)."[14] In a sophisticated combination of 3D modeling, graphics, animation, and photo mode, the video game offers feedback on the level of visual perception and, behind the screen, on the level of computation. The world is calculable *and* calculated through player participation, only *in part* a readymade world awaiting our arrival.

Though players effectively absorb the distance between themselves and the player-character, there is a learning curve to negotiating the sometimes-conflicting variables that require synthesis: the corporeal body and the virtual gaze, oscillating between verisimilitude and accessing the game's nested menus, and engaging in a single-player environment with interlaced cooperative play elements are a few examples. Each of these presents a paradox that forces the player to accept the duality necessary to engage the game world's logic. While the in-game world appears to be at the player's virtual fingertips, it also seems dependent on interlaced approximations. Our engagement with the world through sight, sound, and movement make the approximation of touch possible in video games through haptic visuality, which, as media archaeologist and historian Erkki Huhtamo writes, "confronts the issue of the physicality of touch indirectly, through a corporeal operation involving the eyes and the brain."[15] The ability to photograph these environments adds another layer of mediation and technological sublimity while also validating the environment's materiality.

The logic of *being there* remediates the fictional reality of freezing a moment in time in traditional photography. The result—images made from photographing a physical *or* a virtual place—elicits comparable results. Visually, Greco's images of mountains, grey skies, and heavy fog in *Death Stranding* are indistinguishable from landscape photographs depicting physical places. They share the same signs and significations. They share the indexicality of any photograph, reflecting a specific time and place. While in-game images involve layers produced by the cognitive assemblage of mediation toward softimages,

14 Ingrid Hoelzl, "Postimage," in *Posthuman Glossary*, eds. R. Braidotti and M. Hlavajova (New York: Bloomsbury Academic, 2019), 361.

15 Erkki Huhtamo, "Haptic Visuality and the (Physical) Touch," in *MediaArtHistories*, ed. O. Grau (Cambridge, MA: MIT Press, 2007), 73.

they share the same function of recording a landscape by a witness to an uninhabited place that is difficult or impossible to access.

Conclusion

Death Stranding is an example of a video game whose photorealistic digital environment, 3D graphics, animation, and in-game photography are rooted in traditional photographic image-making practices and technical qualities. Photo mode remediates the technical adjustments available to any photographer-player through a simulation of photography's affordances. Many of the performance features of analog and physical digital cameras are computationally refashioned by its in-game camera, allowing players to make and edit pictures, adjust light, add filters, and crop images. The results are depictions of the game world that both resembles and reimagines the landscape photo genre, as Pascal Greco's series *Place(s)*. The sophistication of photo mode produces softimages, computationally rendered perceptions of the digital world which come together and shift through player-photographer interaction. This engagement is a new sensation that introduces the idea of a player-game-camera triangularity. Players construct the photographable world through play, and the pause function in photo mode creates the opportunity to step outside of the environment, while remaining tethered to it, to *become* camera. What resembles visual trickery in photo mode is both inherited and deviates from its predecessors, as is the photographic evidence and the feeling (and memory) of *being there*. The assemblage and complexity of technical functions enables the player-photographer the hybrid experience of psychically being and corporeally not being present in the world, as they traverse and explore photorealistic environments and pause to make pictures. This practice gestures toward the idea of the technological sublime and the awe-inspiring, fascinating work of new technologies.

6. In-Game Photography
A Remediation of the Picturesque

Martin Charvát

In 2011, the developer studio Bethesda released the official trailer for *The Elder Scrolls V: Skyrim*. In the opening scene, the camera moves from the sky to the high and snowy peaks of mountains, allowing the viewer to experience the perspective of a dragon. Later, the game character can be seen standing on the edge of a cliff, revealing a panoramic view of the mountainous landscape. The brief 37-second Official Announcement Teaser for *The Elder Scrolls VI* in 2018 depicts a comparable viewpoint: the camera pans across a wide area, featuring cliffs that rise in the distance and a seascape that stretches almost endlessly to the right. After the opening sequence of *Skyrim*, much of which takes place in a dungeon, a player finds themselves facing a vast world for the first time: standing at the foot of a mountain, a path unfolded before me leading down into the next valley, with snow-capped cliffs looming on the horizon in the distance. It is a scene for which we could hardly find a more appropriate description than "picturesque" (Fig. 6.1).

This is only one example of a modern trend in computer games, featuring the emulation of the traditional photographic and pictorial style known as picturesque, which is being extended and remediated in the form of in-game photography. Thus, I aim to focus on the remediation of the picturesque in in-game photography and its sharing on various digital social platforms. I hypothesize that picturesque in-game photographs cannot be considered merely subjective expressions of what a particular individual finds picturesque or worthy of capture and that there could, therefore, be a potentially infinite number of them. This is because a consensus has formed within virtual environments and gaming communities as to which places are picturesque and which should be captured, creating a hierarchy in the valuation of given photographs. For on social platforms, a specific aesthetic norm has formed, which those who share their in-game photographs try to follow to get a positive response from the game's fan community.

6.1 In-game photography of The Elder Scrolls V: Skyrim taken by Martin Charvát.

In the first section, I focus on the definition of the picturesque and, in particular, its remediation within the digital virtual environment of video games. I draw heavily on the work of Eugénie Shinkle, who has described precisely how video games seek to trigger both the player's sense of immersion in a given environment – which they achieve by striving for a "natural" landscape – and the "aesthetically pleasing" feelings that players intend to evoke by trying to capture different landscapes in the game world. In the following section, based on an analysis of Reddit forums, I discuss the ways in which the picturesque genre is established, reinforced, and shared through the use of in-game photography. I also aim to show that games implement mechanics that support and affirm the dissemination of in-game photographs and their evaluation. The final part of the chapter focuses on the relationship between in-game photographs and their function as an empowering gaming experience. Making one's character and achievements known to others logically occurs through the sharing of visual material that corresponds to the remediated aesthetic genre of the picturesque.

Preliminary notes on the concept of picturesque

The English writer and printmaker William Gilpin introduced the concept of the picturesque into aesthetics in the second half of the eighteenth century. He used it to describe the specific quality of the English landscapes, which offered places that were intended to delight the eye, evoking images ranging from moors and plains with clouds gathering over them to the ruins of old settlements to the pristine natural corners that have withstood the passage of time and have thus far managed to resist human modification or destruction.[1] Their essential characteristic was a certain roughness and unrelieved or skeletal nature. Not only did Gilpin's notes encourage hiking expeditions and the "hunting" of landscapes, but he also described how searching for these natural sights could be both a thrilling adventure and a leisurely activity. In other words, Gilpin defines picturesque as "a kind of beauty, which is agreeable in a picture," offering visual pleasure.[2] So, Gilpin's traveler, once he was captivated by a natural scene because it looked like a painting, would pull out his sketchbook and try to capture the scene. However, this did not mean he should try to translate the natural landscape into a picture-perfect form, just as a landscape looks. The artist was free not to transfer certain elements of the landscape into the image, or he could modify them at his discretion. For the landscape, which originally resembled a painting, had to be transposed into the painting to meet the criteria of the picturesque; it is, therefore, much more an expression of the landscape as a whole and not necessarily of the individual objects that are depicted.[3] Thus, the first affect that the traveler experiences when looking at the landscape is transformed into a specific form of perception that also entails a

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1 Ron Broglio, *Technologies of the Picturesque: British Art, Poetry, and Instruments 1750 – 1830* (Lewisburg: Bucknell University Press, 2008).

2 See for example John Sager, "A Disputant of the Landscape: Redefining the English Landscape in 'To Autumn'," *The Criterion*, article no. 4 (2023), unpaged; Elizabeth Scarbrough, "Urban Ruins and the Neo-Picturesque Landscape," *Aesthetic Investigations*, vol. 6, no. 1 (2023), 5–18; Dabney Townsend, "The Picturesque," *The Journal of Aesthetics and Art Criticism*, vol. 55, no. 4 (1997), 365–376.

3 Sager, "A Disputant of the Landscape," unpaged.

specific mode of observation marked by the recognition of the observer's position. As art historian David Marshall explains:

> The picturesque represents a point of view that frames the world and turns nature into a series of living tableaux. It begins as an appreciation of natural beauty, but it ends by turning people into figures in a landscape or figures in a painting.[4]

What happens, then, is that the landscape is a condition for the possibility of the picturesque. At the same time, the picturesque, as a particular artistic genre, reshapes the landscape or amplifies and reinforces the pleasing qualities of the landscapes by embedding them in the image while subjecting them to given aesthetic criteria (adherence to picturesque standards, framing, and imaginative alterations),[5] while attempting to evoke the appearance of naturalness: "[P]ictoresque art conceals its artifice and its means of carving space."[6] This means, among other things, that the aesthetics of the picturesque encloses human activity, overshadowing the artist as such, but also the human ability to transform the landscape, while images are, after all, the result of human activity. This tendency is also present in the case of eighteenth-century picturesque landscape gardens because they "set the inherent disorder of nature and natural forms against the order imposed by human artifice. Though intended to emulate the work of nature, the landscape was carefully constructed to resemble a picture, giving a legible structure to a space whose exact boundaries were otherwise unclear."[7] The picturesque landscape, even in the case of gardens, continues computer game theorist Eugénie Shinkle, is shaped by interrelated constitutive elements. The first of these is the "viewing position," the second the "horizon line," and the third the "'vanishing point,"[8] where their combination creates a specific visual experience in which the eye moves from the foreground through the center of the scene to the background horizon, which usually dis-

4 David Marshall, "The Problem of the Picturesque," *Eighteen-Century Studies*, vol. 35, no. 3 (2002), 414.

5 Sager, "A Disputant of the Landscape," np.

6 William J. T. Mitchell, *Landscape and Power* (Chicago: University of Chicago Press, 2002), 16–17.

7 Eugénie Shinkle, "Of Particle Systems and Picturesque Ontologies: Landscape, Nature, and Realism in Video games," *Art Journal*, vol. 79, no. 2 (2020), 60.

8 Ibid., 60.

appears into the sky, surrounded by mist or with the rising sun looming over it.

Not surprisingly, Shinkle describes the relationship between the picturesque and the landscape in some considerable detail, as she argues that computer games attempt to create “naturalistic representation of landscape”[9]in a virtual three-dimensional environment: “Realistic game landscapes are ordered in a way that would have been familiar to the eighteenth-century landscape designer: space is divided into foreground, middle ground, and background, with nearby features and landforms providing the structural basis of the scene and distant ones furnishing its general context.”[10] The connecting feature is the “modelling” of the environment. Software for creating virtual worlds commonly works with both “geological” and “biological” data[11] to make the environment as close as possible to the normal and everyday human perceptual situation. Although Shinkle works with the notion of “realism,” particularly in the case of flight simulators, it is also applicable to those computer games that we might categorize as (not only) fantasy, which in many ways work with the logic of the picturesque. Whether we are thinking of the medieval setting, full of crumbling ruins, lakes and picturesque corners in *Lords of the Fallen*, *TES V: Skyrim* or the *Dark Souls* series, they all work with the fact that the environment is to some extent “realistic” or familiar: the player moves in a landscape that also corresponds to “our” world, although there are different fauna and flora, or special types of enemies. These differences are due to the basic fact that virtual game worlds are created by a mixture of digital code, algorithms, software operations, and human decisions regarding implementing the laws of physics in the virtual environment.[12]

We return to Gilpin’s theses about the importance of the meaning of the whole and the possibility of transforming the scene to make it act as an “image” and be aesthetically “pleasing,” and last but not least, to “imaginative alterations.” Let’s illustrate what I mean with an example from the game *Elden Ring* (Fig. 6.2), where the player‘s character is standing on a grassy knoll in a location from about the first third of the game. In front of them, a lake dotted

9 Ibid., 59.

10 Ibid., 61.

11 Ibid., 64.

12 See for example Anne Balsamo, *Designing Culture: The Technological Imagination at Work* (Durham: Duke University Press, 2011); Eddie Lohmeyer, *Unstable Aesthetics: Game Engines and Strangeness of Modding* (London/New York: Bloomsbury Academic, 2021).

with trees opens up, and on the horizon, in the distance, a castle tower rises, with a few ruins behind it and the huge root of a golden tree. Even though this is a virtual environment, all the objects and items partially mimic objects one might encounter in the real world. And at the same time, the entire setting is carried by the aesthetics of the picturesque. The horizon disappears into the fog, the player is confronted with the passage of time and decay, and at the same time, is given the impression that he is a completely insignificant entity in the game world, that any step he takes towards the unknown is imbued with the risk of death. Simultaneously, the whole scene is "aesthetically pleasing" because it contains a picturesque "roughness," and the whole arrangement of the landscapes gives the impression of "naturalness," even though it was put together with the help of software and algorithms. This is an example of how videogames "inherit many of their aesthetic qualities from a deep lineage of representational media and visual techniques."[13]

6.2 In-game photography of Elden Ring; taken by Martin Charvát.

The deliberate adoption and construction of a specific visual aesthetic by developers and game designers rely heavily on already-established genres and visual schemes. Working with the aesthetics of the landscape and making sure the main character is visible and positioned appropriately is reflected in the

13 Benjamin Nicoll, *Minor Platforms in Videogame History* (Amsterdam: Amsterdam University Press, 2019), 45.

structure of the game environment. The world of *Elden Ring* is rich in cliffs, foothills, rocks and other places for the player to discover, explore, "hunt" and enjoy the attractive scenery or capture it photographically. There is a recursion between the reception of the picturesque genre, its transposition and the game activity that confirms, disseminates, and reinforces this transposition.

In-game Photography: Remediation of the Picturesque

The "hunt" for picturesque landscapes is manifested not only at the level of personal gaming experience but also through its sharing in the form of in-game photography. In her groundbreaking 2007 paper,[14] digital media researcher Cindy Poremba explores in-game photography through the perspective of David J. Bolter and Richard Grusin's remediation theory, which describes how different media interact with one another. Bolter and Grusin distinguish "immediacy" and "hypermediacy" as two remediation strategies,[15] and show how these strategies have been implemented in different media throughout history, specifically in digital media. As in the case of photography, because it can freeze external "reality" and is the product of a camera apparatus, they associate it with "immediacy" because the medium gives the impression that the resulting image is a "natural" capture of the scene. At the same time the position of the artist as someone who merely pressed the camera switch is relegated to the background. From the perspective of remediation theory, in-game photography, "the younger medium, the video game, remediates photography by means of simulation."[16]

In this sense, in-game photography adopts "traditional" photography, because the player has to press dedicated buttons in order to capture the scene he likes; on the other hand, the "external reality" is the reality of the digital virtual world. This is why Sebastian Möring and Marco De Mutiis speak of simulation, which here has a double meaning: in-game photography is inherent

14 Cindy Poremba, "Point and Shoot. Remediating Photography in Gamespace," *Games and Culture*, vol. 2, no. 1 (2007), 49–58.

15 David J. Bolter and Richard Grusin, *Remediation: Understanding New Media* (Cambridge, MA: MIT Press, 1999).

16 Sebastian Möring and Marco De Mutiis, "Camera Lucida: Reflections on Photography in Video Games," in *Intermedia Games – Games Inter Media: Videogames and Intermediality*, eds. Michael Fuchs and Jeff Thoss (New York: Bloomsbury, 2019), 69–94.

to the simulated virtual environment, and at the same time, the ways of capturing the image "simulate" the ways in which the image is captured in our everyday world, including the reasons for immortalizing the scene in pictorial form. Alternatively, in-game photography is a retroactive mechanism for solidifying the impression of immersion in a virtual environment by performatively simulating a person's "authentic" experience of the world. This remark essentially brings us back to the thesis of Eugénie Shinkle, who stresses that the goal of computer graphics is to create the impression of a transparent and natural environment that is perfectly arranged due to algorithmic operations. Whenever we are travelling, on holiday, or simply walking through a city and a scene catches our eye, we reach for the camera and take a picture. The same is true in the virtual environment; we try to get the most beautiful picture, we hunt for places that give us aesthetic pleasure. According to Seth Giddens: "As in the actual world, photographers capture significant places, events and individuals, and these images both look like actual world photography and are collected and displayed in albums and slideshows that draw their interfaces from the physical storage and display media of photographic albums and domestic slide projection."[17]

In-game photography can be produced in several different ways. Whether discussing the availability of screenshot capture on consoles and computers or the implementation of a dedicated "photo mode," wherein the game freezes and allows the player to select the desired viewpoint before taking a photograph, there are various options. The implementation of the "photo mode" in computer games by developers is partially motivated by the desire to provide players with a means to capture "memorable moments" and "visually impressive views."

Let's go back to the in-game photograph from *The Elder Scrolls V: Skyrim* (Fig. 6.1) for a moment. The whole virtual world is basically designed to induce in the player a tendency to capture various places photographically. Whether I am referring to the snow-capped mountain peaks that tower before the player, picturesque nooks and crannies, ravines with lakes, or simply meadows where wildlife roams among the trees and plants. Thus, progressing through the game need not be carried by the desire to finish it, to complete the main quest, but can easily become the goal of discovering all the nooks and crannies on

17 Seth Giddins, "Drawing Without Light. Simulated photography in videogames," in *The Photographic Images in Digital Culture*, ed. Martin Lister (New York/London: Routledge, 2013), 45.

the vast map, creating your own in-game photographic collection of the most beautiful places, some of which, at least in our case, fit the aesthetics of the picturesque.

And we can even mention cases where the game itself is a meta-commentary on the picturesque, if we follow Gilpin's definition, as "kind of beauty, which is agreeable in a picture." In *Darks Souls I* to reach one optional location (Painted World of Ariamis) the player must step into a painting of a snowy landscape with a dark castle towering over it. This picturesque painting on one hand is a capture of a virtual location that the player initially thinks is just one of the references to the past of the game world, and then this virtual and picturesque location unfolds before him in all its beauty, he can move freely in it and even try to create such in-game photography that would match the scene in the painting.

The concept of remediation is thus able to describe the shift that has taken place in the processing of the visual scheme originally associated with painting, adopted by photography and then co-opted by the modes of production and design of video game worlds that emphasize the creation of a "natural" environment.

Sharing of in-game photography: adherence of the picturesque aesthetics

Of course, it is common to create in-game photography for your own enjoyment and include it in your own digital album. However, as Poremba notes, the successful discovery of stunning scenery during a memorable gaming experience, its capture in the form of in-game photography and subsequent sharing on various social media platforms, is fairly common among gamers.[18] It is evident that the enjoyment of a graphically striking landscape in a game is not based solely on subjective feelings or impressions but that the visual format of the presentation also acts as a guide to how one interacts with and navigates the virtual environment.

The sharing of in-game photographs by players on social networks and online forums, particularly on specialized forums such as Reddit, has created a new form of picturesque in-game photography based on the remediation of the picturesque genre, as it can be seen on Reddit forums for discussions

18 Poremba, "Point and Shoot," 52.

on *TES V: Skyrim*, *Assassin's Creed Odyssey*, *Assassin's Creed Valhalla*, *Elden Ring*, and *Dark Souls* games. For the analysis the two filtering criteria were applied: a) posts from the last twelve months (October 2022 – October 2023) and b) the most popular posts. In-game photographs were prevalent in all cases, and those that followed the picturesque aesthetic received high rankings. Characters standing on mountain tops at sunset, dressed in unique armor, characters standing before a huge castle or characters preparing for an expedition into an unknown wilderness. Apart from occasional instances of users displaying their equipment and physique or comparing themselves to others by inquiring about a particular player's "build" or criticizing their choice of weapons and outfit, emphasis is placed on the picturesque feel of the scene as a whole. However, occasional ironic posts can be found where players share images of themselves wearing absurd outfits set against picturesque backgrounds to give the impression that the attire grants desirable abilities, such as fire resistance.[19] Another example of using the aesthetics of picturesque in video games is the in-game photos of characters positioned on the horizon at sunset. These images are not intended to demonstrate a player's game proficiency nor their character's equipment, but rather to exhibit the boundless graphical potential of the game and its visually stunning and "magical" qualities.[20] In-game photos are used as evidence to adhere to the "picturesque" standard.

The *Assassin's Creed Odyssey* subreddit features posts that transport readers back to Gilpin. As the game is rooted in a historical context, players strive to associate their virtual gaming experience with actual travel encounters. Users share photographs of their Greek trips and juxtapose them with the in-game depictions of the locations.[21] One can often come across comments expressing the desire to visit Greece after playing the game. Such comments tend to receive positive feedback (upvotes) or are accompanied by personal stories about trips to Greece. These comments reflect social and economic disparities, as for some, travel itself may be an unattainable aspiration. This is why scenic

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19 Psychadelico, "r/darksouls3," *Reddit*, March 2023 (accessed October 20, 2023) https://www.reddit.com/r/darksouls3/comments/zhqk7a/dont_laugh_this_gives_me_fire_resistance/

20 rocklou, "r/AssassinsCreedOdyssey," *Reddit*, March 2023 (accessed October 15, 2023) https://www.reddit.com/r/AssassinsCreedOdyssey/comments/131t166/odyssey_is_magical_on_an_ultrawide_screen/

21 Red_Dead_Razor, "r/AssassinsCreedOdyssey," *Reddit*, October 2023 (accessed October 17, 2023) https://www.reddit.com/r/AssassinsCreedOdyssey/comments/15febkm/kephallonia/

in-game photographs are coded discursively by an approximation of reality. For instance, in the case of *Assassin's Creed Valhalla*, a user referred to shared in-game photography as "Had to stop and take a photo."[22] The player character walks through a clearing, and a stone bridge emerges from the forest. While the game emulates a fantastical "reality," essentially the in-game photography is more lifelike than actual reality. Or as theoretician of new media Lev Manovich remarked, the digital image sometimes is "too real."[23] This is because it attains complete "perfection" via simulation.[24]

The aesthetic norms[25] determine the rating (upvote or downvote) of particular in-game photographs and always consider the perspectives and preferences of a specific group. Thus, the validity of a particular expressive scheme, specifically the aesthetically pleasing in-game photographs, is determined by the positive evaluation it receives from the fan community.[26] This sends a clear signal to other players, compelling them to conform to this scheme in order to succeed within the community, garner admiration, increase visibility, and enhance their virtual identity. Or, adhering to norms subjectifies the player, who attempts to capture an ideal scenic shot of their character wearing legendary yet aesthetically pleasing gear. Meanwhile, these norms are presented as exemplary, worthy of emulation by the development studios themselves. Thus, under this pressure, the player restricts the game's potential, folds themselves into a particular character, anticipating a positive evaluation of their snapshot, and is subjectified to the expected valuations of a particular fan community.

In *Assassin's Creed Mirage*, the latest addition to the *Assassin's Creed* franchise, there is an amalgamation of social media platforms, gamification, the aspiration for positive reviews, and the platform and game experience itself. Furthermore, there is a normative obligation to capture photographs in specific locations within the virtual environment. *Mirage* ultimately designates points of

22 WeezyWally, "r/AssassinsCreedValhalla," *Reddit*, August 2022 (accessed September 20, 2023) https://www.reddit.com/r/AssassinsCreedValhala/comments/khcmgs/had_to_stop_and_take_a_photo_this_game_is/

23 Lev Manovich, "The Paradoxes of Digital Photography," in *Photography after Photography* (Amsterdam: G+B Arts, 1995), available: http://manovich.net/content/04-projects/004-paradoxes-of-digital-photography/02_article_1994.pdf

24 Bolter and Grusin, *Remediation*, 27.

25 Jan Mukařovský, *Aesthetic Function, Norm and Value As Social Facts* (Ann Arbor: University of Michigan, 1970).

26 Henry Jenkins, *Fans, Bloggers, Gamers: Media Consumers in a Digital Age* (New York: NYU Press, 2006).

interest on the game map where users have taken photos ("daily concept art," "community photo," or "personal photo") (Fig. 6.3) and uploaded them onto the fan and game platform, along with the number of likes or hearts they have garnered.

6.3 In-game photography of Assassin's Creed: Mirage game interface taken by Martin Charvát.

This creates a motive for other players to visit the location and possibly take a photo. Consequently, the aesthetics of the picturesque are reinforced by the points of contact established within the game. The most highly rated photographs are those featuring the figure standing atop a mountain or tall urban structure, gazing into the distance as the sun sets. These interactions reinforce a particular aesthetic norm expressed on dedicated webpage to *Mirage's* in-game photographs.[27]

27 The dedicated page can be found here: https://www.ubisoft.com/en-gb/game/assassins-creed/mirage/photomode/trending

In-Game Photography: Identity, Experience, Upvotes

Not only are the techniques of capturing in-game photography intended to strengthen the player's experience, but they also serve "as a useful tool for managing a player's identity on social media."[28] To some extent, capturing a particular moment can be seen as a fundamental aspect of creating a player's virtual identity within their chosen game. In the aforementioned games, players take on a fixed position within the virtual world and story as a character who possesses the skills to solve problems and become a renowned warrior. The protagonist's progress is structured by "cores," i.e. essential nod points of the story as defined by French semiotician Roland Barthes,[29] which must be traversed to advance the plot. The game allows players to choose their approach to solving complex scenarios through dialogue options, akin to *TES V: Skyrim* or *Assassin's Creed Origins*, where players must choose which side of the conflict to support, or *Elden Ring*, where some dialogue options either lock or unlock key game mechanics such as levelling (if players do not accept Melina's offer at the beginning of the game, they will not gain access to key tools used in the game). All these different decisions also unlock different story endings in the long run, where, in the case of the *Elden Ring*, the "secret" ending is tied to a rather tricky and difficult side quest. Consequently, the game can only be completed by selecting from a predetermined set of options, whilst each game contains both explicit and implicit rules that maintain its cohesion. Nonetheless, every singular playthrough of a game is distinctive; while players' decisions and choices may overlap, the gaming encounter relies on diverse individual factors (whether I am playing a game for the first time, whether I am new to the genre, whether I am an experienced player, what types of games I favor, etc.).

The sense of individuality and identity formation is enhanced in games from the outset due to the diverse range of character customization options available before the player enters the virtual world. The player can select their gender, appearance, eye hue, hairstyle, character archetype, as well as their heritage (and ethnicity), and finally, their "profession" or "class," which determines the characteristics and basic skills they will have at their disposal. There is no issue with creating an in-game character that closely resembles their real-

28 Möring and De Mutiis, "Camera Lucida," 78–79.

29 Roland Barthes, "An Introduction to the Structural Analysis of Narrative," in *New Literary History*, vol. 6, no. 2 (1975), 237–272.

life appearance, and naturally, the player has the freedom to customize their character's appearance in any way they wish.[30]

A popular form of roleplaying game involves players imposing self-imposed restrictions. This includes developing a detailed backstory, character traits, and other defining characteristics influencing their behavior in various situations. Let's stay with the *Elden Ring* for a moment. Either at the beginning of the game or during the game, the player decides (however intuitively) what "build" he chooses (bleed, faith, intelligence, strength etc.). On *YouTube* and other video game content-sharing platforms (*Twitch*), there are plenty of tutorials on how to make the most of a build or what types of talismans and weapons are ideal for a given build. This creates the framework within which the player moves through the game. However, this framework is not unchangeable, there is a wide range of variations and combinations on improving a given character. A radical and specific version of the player experience is then the variant of different game runs where the player imposes restrictions on themselves, for example, the so-called "no hit run"; no enemy can injure them in a fight. Or, more commonly, in games like *TES V: Skyrim*, it adheres to an established and predetermined opinion and moral compass based on the "race" the player is playing. For this reason, too, he or she "has" to make decisions that he or she would never have made if he or she were playing as another character: for example, he or she will not steal from Non-Player Characters (NPCs), even if this closes off certain quests or prevents him or her from obtaining unique items.

A favorite category of posts on gamer's Reddit forums is the introduction of the character itself, a description of its "lore," and the restrictions the player imposes on themselves. This is where the importance of in-game photography comes into play. Sharing them on social forums extends and manages players' in-game and virtual identities. It is essentially an index of the character's existence in the game world, while at the same time, its visual presentation adheres to a picturesque aesthetic genre. Whether they are accompanied by the headline "rate my setup" or "this is my [name of the character]," not only are commenters invited to rate the overall appearance of the character and its

30 See for example *Digital Culture, Play, and Identity: A World of Warcraft Reader*, eds. Hilde Corneliussen and Jill Walker Rettberg (Cambridge, MA: MIT Press, 2008); Rob Gallagher, *Videogames, Identity and Digital Subjectivity* (New York: Taylor and Francis, 2017); Poppy Wilde, *Posthuman Gaming: Avatars, Gamers, and Entangled Subjectivities* (New York: Taylor and Francis, 2023).

equipment, but they are also happy to comment on additional descriptions of the character, such as whether its background makes sense in the game lore, or helps to add to, enhance, or completely change the background of the character.

Sharing in-game photography from this perspective aligns with the principles of modern "post-capitalist gamification" prevalent in digital media.[31] This way, players not only play the game and win awards within the gaming ecosystem but can compete for social media attention. In this context, philosopher and psychologist Shoshana Zuboff employs the term "affective computing" to describe generating a specific emotional response.[32] In our case, this emotion manifests as a sense of affirmation and recognition from within a given community, alongside the enjoyment or satisfaction of achieving a goal. The players' drive to produce and share (picturesque) in-game photographs is motivated by the desire to receive upvotes, to show off their equipment or detailed manufacture of the character's personality and lore. And, as we have seen, the visual genre is predominantly the picturesque one.

Conclusion

In this chapter,[33] I provided an interpretation of how the classical art genre is being transferred to the digital environment of video games. In particular, I was concerned with describing the changes and transformations that the picturesque as an aesthetic category has undergone. I used the notion of remediation to trace how, thanks to the recursive relationship between different media, a certain visual norm is constituted, which is then reinforced by the activity of sharing visual material on online social platforms. Furthermore, in-game photography functions not only as an expression of pleasure, but also as an index

31 See for example Rey P. Jessie, "Gamification and post-fordist capitalism," in *The Gameful World: Approaches, Issues, Applications*, eds. Steffen P. Walz and Sebastian Deterding (Cambridge, MA: MIT Press, 2014), 277–295; Nathan Hulsey, *Games in Everyday Life: For Play* (Leeds: Emerald Publishing, 2019).

32 Shoshana Zuboff, *The Age of Surveillance Capitalism* (New York: Public Affairs, 2019), 285.

33 This chapter is the result of Metropolitan University Prague research project no. 110–1 'Political Science, Media and Anglophone Studies' (2024) based on a grant from the Institutional Fund for the Long-term Strategic Development of Research Organizations.

of the existence of a game character, where the sharing of photographs has significance as an extension and management tool of the player's identity in order to become a member of a given fan community on social media. In seeking to fit in with other fans, the user must conform to already established visual and narrative norms.

7. Dare Me Not
Photography as Adventure in Virtual Space

Paula Gortázar

As someone who was a child gamer before becoming an adult photographer, I have always found a striking resemblance between the act of photographing and the activity of playing video games. This similarity may explain why so many photography enthusiasts who enjoy gaming seem to have found in in-game photography the ultimate fulfilling experience. For some, this connection can be attributed to the perceptual experience of gamers when playing first-person shooting games. As Susan Sontag suggested in her 1977 book, *On Photography*, gun-shooting and the activity of photographing are closely connected, as both actions involve an act of "hunting" a chosen subject.[1] Indeed, the viewfinder of a gun and that of the camera serve a similar purpose: that of pointing before "shooting" a given target. But whilst in-game photo-hunting missions are offered by several video games, like *Wild Earth Photo Safari* (2008), the similarities between gaming and taking photographs go way beyond this figurative hunting experience. As this chapter will discuss, what most gamers and photographers seem to share is, above all, a sense of adventure; a thrill that is generally followed by a range of psychological and biological reactions generated when attempting to fulfil their particular mission, whether this entails completing the game's objective, taking the best possible picture or, in the case of in-game photography practices, the simultaneous accomplishment of the two.

The chapter starts by discussing the similarities between gaming and photography. This includes the bodily and visual perception experienced through both types of practices, as well as the personal motivations often shared by photographers and video game players. The text then moves on to introduce the development of in-game photography and its different production methods,

1 Susan Sontag, *On Photography* (New York: Farrar, Straus and Giroux, 1977).

with the aim of questioning the shifting nature of the photographic medium within virtual space, its social function and cultural meaning. The final section is dedicated to the analysis of different in-game photography practices that contest the virtual narratives created by video game developers, from both a social and aesthetic perspective. It would be argued that for these in-game photographers, the sense of adventure is not necessarily derived from confronting dangerous situations, but most often from challenging the established rules of the game space through a range of disruptive approaches to game-play behavior, with the objective of producing a critical testimony through visual means.

Photography as Gameplay

Photography has been closely linked to humanity's adventurous spirit since the moment of its inception. From the ground-breaking "scientific adventure" that marked its invention to the use of the medium by explorers, travel and wildlife photographers during the last two centuries, the photographic camera has constantly accompanied photographers on their quest for new discoveries and life experiences. In this regard, the possibility of taking pictures offers some sort of emotional encouragement, the motivation one might need when considering the risks of a photographic situation. It is the camera that often pushes the photographer to move forward, "reassuring them" that an exciting scene may lay just around a dark corner, on the summit of the highest mountain or beyond the limits of the subject's visual field. While there is no question that the curiosity that gives birth to every adventure is something inherently human, a thirst for knowledge that can probably be explained by evolutionary theory, the possibility of visually documenting one's discoveries can certainly make the most challenging endeavor worth the risk. One might think, for example, of the selfie phenomenon and the lengths some people go to take their picture, often risking their own lives for the sake of a great shot that demonstrates their presence in what they believe is an enviable scene.

Adventure is then, of course, also at the core of most gaming experiences. Whilst not every video game is designed to offer players a new adventure – such as the classic Windows *Solitaire*, which mission might be defined very differently – a large number of titles offer players the opportunity to enter fantastical worlds where fictional adventures are designed to keep them engaged during extended periods, until the more or less complicated game objectives are met. When entering the game space for the first time, players face a completely unknown world they must learn to navigate. Each video game would then have its own rules, which simultaneously enable and limit the possibilities of gameplay behavior. This is not very different from what a photographer might experience in the material world, especially when they are set to take documentary or street photography pictures. Whether the activity of taking those photographs happens in their own neighborhood, a nearby city or a remote land away from home, the photographer's state of mind enters some sort of fictional existence. The world around them (reality) is no longer there to aid their everyday survival. It is now the scenery for their stories. We might even argue that the people inhabiting those scenes perform as non-player characters (NPCs) – usually present in most video games – as they serve to complement the aesthetics of the picture without necessarily becoming its main protagonists.[2] Besides, during both activities, gamers and photographers can spend large amounts of time performing their practice, as the "winning" sensation that arises either from taking a great shot or completing the game's mission might soon become rather addictive.

Interestingly, when playing in non-immersive environments, gamers approach the game space through a two-dimensional frame (that of their computer monitor, TV, arcade machine, smartphone or tablet), which might then open up into three or two-dimensional perspectives. The adventure is, therefore, framed before their eyes, separated from the physical world by a clear border that distances the player's fictional presence in the game from their physical existence in the material world. This is not dissimilar to what a photographer does when framing a chosen scene before their eyes, as they separate the depicted subject from the rest of the world, isolating the action and limiting their presence to a confined two-dimensional space.

It is also worth noting that visual perception of first-person players within the game scene is practically identical to that of the photographer in the material world when looking through the camera's viewfinder. However, although the former might be perceived as endless from the perspective of the player's camera view, the game space is strictly delimited by game developers to serve the purpose of the video game's objectives. Likewise, the field of vision is always limited by the avatar's camera view, which coincides with that of the player in first-person perspective games. As media theorist Rune Klevjer suggests, the

2 NPCs (non-player characters) are video game characters designed to complement the aesthetic of the game scene. They generally do not compete with the player, though in certain titles they might intervene to make the gameplay more or less challenging.

bodily perception of gamers might be defined as a prosthetic one, whereby connecting visual and manual controls of their avatar players enter an expanded and immersive psychological state, resulting in a first-person identification with the game character. In 3D games, this prosthetic identification is made possible thanks to the game's camera view; a computerized sight that relocates the player's self-awareness into the game scene, generating what Klevjer identifies as "prosthetic telepresence." This, however, is not the product of fiction or imagination, but the result of a complete perceptual immersion.[3]

Similarly, in her book *Perception at the End of The World (or How Not to Play Video Games)*, Joanna Zylinska explains how the gamer's visual perception does not only occur at the level of sight but as an ecological model that involves the immersive presence of the perceiving agent.[4] This embodied experience of a separate reality, whether produced through "telepresence" or immersive being, may also be achieved through the act of taking pictures in the material world. Particularly in the case of DSLRs, where the viewfinder shows a mirror image of that which the camera might eventually capture, the combination of camera view and the bodily presence of the photographer allows them to perceive a reality they are not part of, entering a scene that remains alien to their presence, yet unconsciously simulating a psychological involvement in the depicted event. We might then agree with media theorist Cindy Poremba's assertion that "[p]hotography is an inherently game-like practice."[5] Indeed, the photographer seems to enter the material world in a very similar way to that of a player entering a video game, both at a level of visual perception and psychological anticipation. It is thus not surprising that in-game photography practices merging both disciplines have become so popular during the last decade, with millions of adepts around the world taking pictures inside their favorite video games.

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3 Rune Klevjer, "Enter the Avatar. The Phenomenology of Prosthetic Telepresence in Computer Games," in *The Philosophy of Computer Games*, eds. Hallvard Fossheim, Tarjei Mandt Larsen and John Richard Sageng (London: Springer, 2012), 2.

4 Joanna Zylinska, *Perception at the End of the Word (or How Not to Play Videogames)* (New York: Flugschriften, 2020).

5 Cindy Poremba, "Point and Shoot: Remediating Photography in Gamespace," in *Games and Culture*, vol. 2, no. 1 (2007), 53.

The Photographic Medium in Gamespace

Although the origins of in-game photography date back to 2006 with the publication of the book *Gameplay: Art in the Age of Video Games*, it was in 2014, through the videogame *The Last of Us Remastered*, that photo-modes started to be used frequently in any major videogame release.[6] Since then, the applications of in-game photography practices have expanded considerably. In some cases, taking pictures is an essential part of the game objectives, as in the case of *Pokémon Go!* (2016), for example, where the player is given a certain number of points depending on how well they can compose their photographs according to the game's creative standards. In other cases, in-game photographs are produced as a means of the documentation of the player's achievements, providing visual proof that they reached a certain point within the game's mission or succeeded at achieving one of its goals. There are other occasions, however, where the individual enters the game not as a player but as a photographer. In such cases, the user has no intention of completing the game's objectives. Instead, they confront the screen as a space of photographic voyeurism. They may wander around the different worlds, in "the hunt" for exciting scenes worth capturing. Interestingly, this uninvolved approach to the game mission is often criticized within the in-game photography community, with fellow practitioners pointing at the necessity of actively playing the game if one is to define such practices precisely as *in-game* photographs.

The means by which these images might be produced are also quite varied. One may simply take a picture with a digital or analogue camera of the screen where the game is being displayed. Most frequently, however, in-game photographs are produced through direct screenshots of the game scene or using built-in photo-modes as part of the video game's interface. Sometimes, when the latter is used, the player may pause the game to focus on the photograph they are about to shoot. These photo-modes often come with a range of settings that resemble those of a photographic camera, enabling users to change the depth of field, zoom the subject in or out, choose a lens or camera brand, and select a variety of artistic filters that modify the original look of the scene.

Whether a gamer produces their images through direct screenshots of the scene or through in-game photo-modes, they often find themselves limited by

6 Jan Svelch, "Redefining Screenshots: Toward a Critical Literacy of Screen Capture Practices," in *Convergence: The International Journal of Research into New Media Technologies*, vol. 27, no. 2 (2021), 564.

the few compositional choices available and the reduced points of view from which they can shoot. Game developers intentionally create these limits and can ultimately decide how much the camera view (that of the avatar or the photo-mode) might be moved around the scene. To overcome those limitations, some practitioners, like the celebrated Duncan Harris (also known as *Dead End Thrills*), managed to hack the video game's engine, allowing them to position their camera view in places not originally designed for gamers to access. This strategy was soon adopted by software developer NVIDIA. Their in-game photography platform Ansel, launched in 2016, can be installed in most video games as an external, third-party photo-mode. When using this ad hoc tool, players may pause the gameplay and move the camera view into positions that could not have been reached through regular gaming behavior. Ansel also offers users a large range of sophisticated photo-functions that expand the user's creative possibilities beyond those usually offered by in-built photo-modes. Through a range of filters and photographic settings, in-game photographers can design their shots in a multiplicity of ways, giving the scene a very different look to that originally devised by game designers. In addition, this software can increase image resolution by capturing multiple small images that are then "stitched together" through AI, resulting in hyper-realistic photographs that the regular gamer would never be able to encounter due to the limitations of processing high resolution interactive graphics at speed. It is in part this broadening of creative possibilities offered by Ansel and other built-in photo-modes that, alongside the constant development of new game scenes, stories and characters by the rapidly growing gaming industry, has popularized the so-called in-game photography genre at an astonishing pace.

At this point, it is probably worth asking whether in-game image capture may be effectively defined as photography and, if so, what social function might these images serve in order to be identified and accepted as photographs. As is often the case with emerging art practices, in-game photography, also known as screenshotting, soon become the object of study for several media and art theorists. During the last few years, multiple writers have contributed to the debate around the shifting nature of the medium and how computerized image practices, including in-game photographs and screenshotting, are shifting our understanding of the medium. For some, those practices have very little to do with photography and constitute, at most, a remediation of the medium. As argued by media theorist Paul Frosh, remediation takes place firstly at the level of capture through the use of camera-like photographic settings and, secondly, through the cultural uses of the resulting image. But according to Frosh, in addition to being remediated, photography is also relocated through those screenshot captures. As he explains, this relocation of the medium is one that "persists notwithstanding the radical changes to its core technologies in recent decades." This process would have been made possible thanks to the persistence of a collective memory of photography's form and functions, which is then reconfigured and expanded across other mediums, uses and contexts, despite having lost all connection with its original materiality and discursive nature.[7]

While it is evident that screenshots and photographs – whether digital or analogue – are technologically speaking very different products, rather than putting the focus on their means of production it might be helpful to think about the object of the former, that is, virtual space and anything that might occur or present itself within it. Whilst such space might lack solid materiality, the self operates within it in a very real manner. Indeed, virtual experiences that unfold within the interface of a video game or any other digital platform – such as social networks, online events or remote work meetings – often constitute critical actions for an individual's social existence and biological survival needs. If we consider the current number of social interactions and economic transactions that are usually performed through a screen by the average contemporary citizen, it is only reasonable that those might end up framed via screenshots, either for purposes of personal documentation or social distribution. In the particular case of gaming, these fictional spaces have progressively become virtual communal areas, where avatars belonging to players from all over the world get together to fight against one another or work collectively to meet the game's objectives. Furthermore, some video game titles, like *The Sims*, exist solely for the purposes of socializing virtually, with users developing personal relationships, many of which end up culminating in solid emotional bonds that transcend the virtual realm. Just like one might want to keep a visual memory of their lived experience in material space, videogame users are understandably willing to record their online interactions via in-game photographs. The medium relocation Frosh refers to, therefore, is not something that photography is experiencing in a vacuum, but a phenomenon that has logically followed the relocation of human interactions themselves, now taking

7 Paul Frosh, "Screenshots and the Memory of Photography," in *Screen Images – In-Game Photography, Screenshot, Screencast*, eds. Winfried Gerling, Sebastian Möring and Marco De Mutiis (Berlin: Kadmos, 2022), 187.

part in virtual space as much as in the physical one. It would thus appear of little use to define screenshot practices as a cultural deviation, like Frosh suggests, as if we might be collectively reusing familiar frameworks due to our inability to understand new image forms. On the contrary, what virtual space users seem to be doing is a valuable expansion of the medium's application, one that continues to serve its original social function and, indeed, reinforces photography's indexical properties. After all, as a technological invention, it is evident that the photographic medium has never ceased to evolve, constantly adapting to the shifting social contexts in which it operates. Current screenshot practices may thus simply constitute an additional step in our relationship with photography, a relationship that will unavoidably continue to progress as advancements in AI and virtual technology continue to shape our contemporary ways of making images and relating through them with one another.

Disrupting Virtual Narratives

It has already been discussed how in-game photographs have a variety of applications (vernacular, ludic, artistic), each of which serves a different purpose and might be produced using a variety of methods (screenshots, in-built photo modes, third-party image-capture interfaces, etc.). In her recent essay, "Ansel and the (T/M)aking of Amateur Game Photography," Poremba makes an interesting contribution to the implications of using those production methods. She is particularly critical here about the visual style that the platform NVIDIA Ansel seems to be imposing upon in-game photography enthusiasts, an aesthetic approach that might be prompted by the company's economic agenda and its intention to expand its portfolio of products in the gaming industry. This style, generally characterized by a hyper-real aesthetic, is being further perpetuated by members of the company's online networked gallery Shot with GeForce; a platform that invites Ansel's users to share their images with fellow practitioners. As Poremba explains, amateur in-game photographers have become highly competitive by sharing their creations in those networked spaces. These practitioners often rate each other's work and can praise or critique the images of others through online comments. In some instances, certain communities would give more value to the moment of the captured scene, while in others, it is the capture method – through the use of advanced settings –

that would be given most credit.[8] Either way, these communities function similarly to amateur photo clubs, where artistic efforts are judged and celebrated through peer critique, often shaping a shared "regime of vision" – to use John Berger's words – amongst club members.[9]

But beyond the aesthetic influence NVIDIA might be imposing through their software Ansel, it is also worth considering whether the images produced using this platform might be defined strictly as in-game photographs. Given that a gamer must pause their gameplay to produce the image, it is questionable whether the resulting work can be considered a representation of gaming at all. As explained by media theorist Alexander Galloway, the paradox of in-game photography is that the author of those images is both present and absent from the scene.[10] Most important, however, is the fact that the advanced production settings offered by Ansel are ultimately allowing users to modify the aesthetics of the game design in ways game developers had not contemplated. While this is a perfectly valid creative activity, if we consider that the gameplay as such has been effectively stopped and, therefore, the player is no longer documenting their game practice, what seems to be taking place here is simply the postproduction or modification of an existing design made by the developer of the game scene in question.

I am aware that the above assertion now opens Pandora's box; might not all in-game photographs simply be capturing existing game designs? After all, what players can see through the game's camera view has been envisioned and designed beforehand by someone else (the game developer). Wouldn't in-game photography then need to be treated as a mere reproduction of an existing artwork or, at best, as some form of artistic appropriation? While this might indeed be the case of the images shot through Ansel, the same is not necessarily true when gamers abstain from pausing the scene with the aim of documenting their lived experiences online, including their interactions with fellow gamers. In those cases, despite the fact that game developers have already designed the game scene and the avatar's look, it is the players themselves, through their active gameplay activity and virtual interactions with

8 Cindy Poremba, "Ansel and the (T/M)aking of Amateur Game Photography," in *Screen Images – In-Game Photography, Screenshot, Screencast*, eds. Winfried Gerling, Sebastian Möring and Marco De Mutiis (Kadmos: Berlin, 2022), 223–243.

9 John Berger, *Ways of Seeing* (London: Penguin, 2005 [1972]).

10 Alexander Galloway, *Gaming: Essays on Algorithmic Culture* (Minneapolis, MN: University of Minneapolis Press, 2006), 126.

others, who may ultimately shape the content of the image, thus conferring a sense of agency to the resulting visual work.

7.1 Robert Overweg, from Flying and Floating, 2005.

Courtesy of the artist.

A similar argument might be brought when looking at conceptual in-game photography practices, in particular those that approach the game scene from a critical perspective, producing what Frosh has called "media-reflexive artistic in-game photography."[11] One of the first artists to take pictures in virtual worlds was Robert Overweg. Since the early 2010s, he has been fascinated with the exploration of 3D spaces designed by game developers where players were able to wander around virtual scenes through first- or third-person gaming experiences. Whilst camera view often shows gamers an infinite space, the game scene has a confined area where gameplay ought to unfold. The storyline helps players stay within limits, guiding them through the use of visual and audio signals, conversations with non-player characters or the directives prompted by the mission itself. But instead of following the "natural" gaming behavior that facilitates the completion of the game, Overweg walks his avatar towards the virtual limits of these worlds, visualizing all sorts of glitches across the designated boundaries of the game space and thus redefining his own adventure.

11 Frosh, "Screenshots and the Memory of Photography," 265.

Under his close-up sight, buildings break apart, walls become transparent and objects fly and float weightlessly, detached from the rest of the 3D scene (Fig. 7.1). As the author explains, it is the joy he finds in tracing his own path, looking for virtual errors, and going through "forbidden" places, that ultimately gives him a sense of freedom. His rule-breaking, however, carries few consequences. While his avatar might take longer to complete his mission, these non-playable parts of the game space are often empty of action or danger, which allows the artist to spend enough time producing his images. The resulting work points at the existence of an externally controlled gameplay experience, whilst it celebrates the triumph of free will and the possibilities of owning one's particular virtual path.

Mainstream videogames such as the *Grand Theft Auto* saga (*GTA*) have also been the object of analysis of various artists during the last decade. In her photobook project *Paisaje Ulterior*, published in 2018, Gabriela Mesons Rojo collects scenes from *GTA V* that are printed alongside texts containing her poetical reflections on the game experience (Fig. 7.2). Her subjects belong to Los Santos, a fictional city where gangs have taken control. Populated by the homeless, prostitutes and drug dealers, the game space replicates some of the worst stereotypes of twenty-first-century society. People of color are often depicted as criminals; transgender characters are almost all sex workers and the homeless are often drunk or desperately looking through garbage. In the meantime, criminal behaviors are a key part of the game mission. Stealing, killing or abusing someone is not only celebrated but proactively encouraged to complete the game's mission. In this scenario, Mesons Rojo wanders around the video game in search of visual evidence of the city of extremes. Most of her images document traces: a crashed car, blood stains, an abandoned mattress or an empty chair balancing suspiciously by the edge of the pier. As opposed to other works, like that of Allan Butler's whose project *Down and Out in Los Santos* mostly contains depictions of the video game's characters, Mesons Rojo does not provide a direct account. She enters the scene like a detective, allowing the left-over objects to point at the brutality of events. Like the texts she writes to accompany these photographs, the images, too, have a poetic scent. They show despair and deep sadness, whilst speaking quietly about the inability of regular citizens to intervene or resolve in any manner the chaotic state of things.

7.2 Gabriela Mesons Rojo, from Paisaje Ulterior, 2018.

Courtesy of the artist.

Another disruptive approach to imposed visual regimes within the game scene is that developed by practitioners who choose to use alternative means of production to those offered by game developers. In his project, *The Continuous City* (2017), Gareth Damian Martin took 35mm black and white analogue photographs of screenshots taken in computer game environments, including *Gravity Rush 2*, *Kane and Lynch 2* and *Dog Days* (Fig. 7.3). Once processed, the images were scanned and printed in the form of a photobook. Despite depicting 3D fictional environments, the resulting photographs look astonishingly real, to a point where it becomes impossible to discern whether their subjects belong to game space or the material world. This might be due to the abstraction produced by the black and white film and its silver grains, but perhaps also by the viewer's cultural memory, which might automatically attribute a solid physicality to depicted subjects when those have been captured by analogue means. In an interview conducted by Matteo Bittani with the artist, Martin explained that he was seeking to destabilize the logic of video game and analogue photography aesthetics, a collective knowledge that is mostly based on learnt signifiers. According to the artist, rather than capturing the game scene, he was "aiming to distort or shift the spirit of games (if there is such a thing)."[12]

12 Gareth Damian Martin, "Interview: Gareth Damian Martin: The Aesthetics of Analogue Game Photography," in *Gamescenes. Art in the Age of Videogames*, 2018 https://ww

7.3 Gareth Damian Martin, from The Continuous City, 2017.

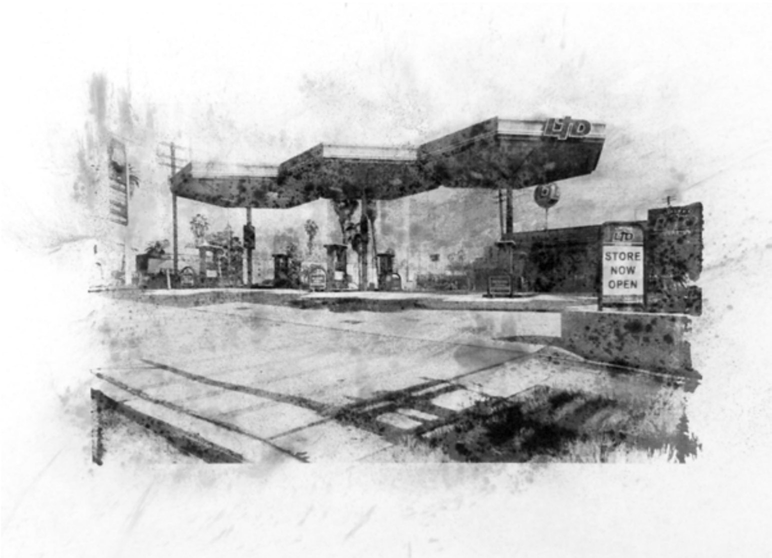
Courtesy of the artist.

A related set of practices is those where traditional works of photography are being re-enacted within the game scene. There are multiple examples in this category, like the war photographs produced by Kent Sheely in the video game *Day of Defeat: Source*, which were taken in homage to Robert Capa and the work he produced in Normandy during World War II. Another example is Allan Butler's photobook, *Nine Swimming Pools and a Broken Glass*, which depicts swimming pools from the video game *GTA V*, re-enacting Ed Ruscha's series of the same title. A step further is taken by artist Lorna Ruth Galloway, who, like Butler, also searches for Ruscha's iconic photographs in the video game *GTA V*, re-enacting the photographer's famous photobook project *Twenty-six Gasoline Stations* (1963). In this case, Galloway reconfigures the existing work by moving from the digital capture to the analogue print, using digital post-production software to create half-tone separations of her images for screen printing (Fig. 7.4). As with Martin's work discussed earlier, if it were not for her project title, *Twenty-six Gasoline Stations in Grand Theft Auto V* (2016), it would be practically impossible to discern whether the work was shot within a computer game environment or the physical world. By re-enacting famous photography works

w.gamescenes.org/2018/04/mterview-gareth-damian-martin-the-aesthetics-of-_analogue-game-photography.html.

in game space, these artists are somehow reclaiming the validity of the photographic medium in the virtual realm, the continuity of its indexical properties and the endless aesthetic possibilities that await beyond the material world.

7.4 Lorna Ruth Galloway, 'Limited Gasoline, Grove Street, Davis,' from Twenty-six Gasoline Stations in Grand Theft Auto V, 2016.



Courtesy of the artist.

Conclusion

It could be argued that the act of photography carries significantly higher risks than that of gaming and thus, we might agree, a greater sense of adventure. While the photographer confronts their mission of taking pictures in the real world from a relatively free but also unprotected and unpredictable position, players always enter a game space that has been carefully designed for them to succeed, albeit with time and effort, but with clear delimitations that guide their gameplay behavior and guarantee the possibility of success. Besides, gamers may play the scene over and over again until they are trained enough to perform their moves victoriously. As a result, in-game photography practices might often appear too constrained (in comparison to those developed in the real world) to be defined as adventures of any kind. This constrained virtual experience, however, might well have its days numbered. Thanks to the applications of generative AI to game design, developers are currently applying generative tools for the creation of automated characters able to develop richer dialogues with players. Meanwhile, some are already envisioning the possibilities of adaptative open-world video games that create unique storylines in response to the gameplay behavior of each user. In the context of the video game industry, the economic benefits of tailored game experiences are quite clear; that is, to engage players in a never-ending mission while giving the impression of continuous victory. But what would happen if it were the users themselves who were able to generate their own game spaces and write their particular navigation rules?

For those who enter the video game environment as a photographic space, generative-AI would offer the unprecedented possibility of building their very own virtual scenarios; a three-dimensional generative scene where their two-dimensional photographs might be designed at will. A place where photographic subjects would hold whatever visual characteristics they might wish, where lighting can be used at scale and tripods may no longer be needed. A replica world where the avatars of friends and family might be invited to come and pose in the most spectacular photographic studio. These generative scenes might even be blended with those of fellow photographers and automatically shift in shape and form as they adapt to their creative needs. In-built cameras would also be packed with generative tools, providing users with full technical control whilst offering live alternatives to improve their generated results. Under such prospect, generative photographic spaces might soon become the most exciting shooting location for professional and amateur photographers alike, one that will also reduce equipment and travel costs, whilst moving the photographic medium closer to global sustainability goals.

But before AI can offer practitioners such an ultimate photographic frontier, today's artists are already approaching photography as an adventure in virtual space as they disrupt the rules of gameplay behavior, contest mainstream aesthetics imposed by the gaming industry or denounce the perpetuation of social inequalities through popular video games. While such a conceptual approach might not necessarily imply taking the physical risks that characterize traditional adventures, the thrill of photography in virtual space can certainly be experienced as a result of engaging in non-conformist art practices.

Part III:

Extended and Limited Realities

8. On the History and Aesthetics of Photorealistic Computer Graphics

Jens Schröter

Although there is at present a considerable hype around images generated with image generation systems based on machine learning (like Dall-E or Midjourney), photorealistic computer graphics is still a far more important field of technologies and practices for the generation of photo-like images. This field is based on modeling and simulation instead of statistics (on which the AI images are based) and has a much longer history, beginning in flight simulation. It has become increasingly important since the 1970s, especially in cinema as a central component of the special effects needed for many types of entertainment cinema. Today, photorealistic computer graphics are used for essential tasks in architecture (presenting buildings yet to be built), science, advertising and many other fields.[1] There are many companies offering services in photorealistic rendering for customers.[2] Photorealistic rendering allows for the planned construction of images that look like photographs – at least until now, this has been a key advantage in comparison to AI images. In the case of AI images, even with the same prompt you get a different image every time since it is based on stochastic procedures, but this type of image is not useful for many applications. "The driving force behind computer graphics for the past 35 years has been photorealism. The quality of images created using a computer is judged by how closely they resemble a photograph."[3] Although photorealistic rendering is so essential, it has not achieved the attention it should.

1 André Kramer, "Täuschend echt. Fotorealistische Computergrafik in Film, Kunst und Werbung," in *c't* 7, 2018, 136–138.

2 When you google "photorealistic rendering," many of the hits are sites that sell software for photorealistic rendering or offer services in that field, see e.g. https://www.render4tomorrow.com/photorealistic-rendering.

3 Bruce Gooch and Amy Gooch, *Non-Photorealistic Rendering* (Natick, MA: AK Peters, 2001), 1.

In my chapter I want to highlight some important episodes in the history of the technologies and procedures that form the bases for photorealistic computer graphics, as well as fields of practice and related aesthetic strategies. Firstly, I discuss its root in flight simulation, and secondly, I underline that simulation is related fundamentally to realism. Thirdly, I will address the notion of photorealism and discuss some of the properties of photography that have to be simulated to generate a photorealistic image, as the "realism" of the computer-generated images is judged in comparison to photography. Following that, I draw some more generalized inferences on the relation of computers and photography and finish the chapter with a short conclusion.

Beginnings: Flight Simulation

Photorealistic graphics had their beginnings in civil and military aviation. In 1910, the first serious aviation accidents occurred, making it necessary to ensure that pilot training was safer, more effective and less expensive. The first ideas for flight training machines (e.g. the *Sanders Teacher* or the *Billing Trainer*) date from this time.[4] However, it was not until 1931 that the first truly operational flight was available, Edwin Link's *Link Trainer*. Pneumatic mechanisms were responsible for moving the machine, a concept which Link knew about from his father, who manufactured mechanical-pneumatic pianos. These mechanisms also allowed for the simulation of simple actuating forces on the control sticks. The audiovisual imitation of the flight situation itself was limited to a horizon line. There were two ways in which flight training could be further developed. On the one hand, by increasing the "realism" of the audiovisual representation of the flight situation and, on the other hand, by improving the interaction between the machine and the pilot. Initially, attention was focused on the first problem. In 1939, Link, now already in the service of the military, developed the *Celestial Navigator*, which was used to teach bomber pilots how to orient themselves in the starry night sky. This required a sufficiently lifelike imitation of the night sky, which was realized by a movable dome equipped with numerous lights. At the end of the 1930s, Fred Waller – sponsored by the U.S. Air Force – worked with several film projectors and screens to fill the pilot's field of vision with "realistic" images ("Cinerama"

4 Cf. J. M. Rolfe and K. J. Staples, *Flight Simulation* (Cambridge et al: Cambridge University Press, 1986), 14–17.

process). These cinematographic specifications would later be followed by computer graphics (see below). The second problem, that is, the realistic reaction of the training device to the pilot's inputs in *real time* ("interactivity"), required the machine to solve complicated systems of differential equations in the shortest possible time, something which initially could not be mastered.[5]

However, when the U.S. found itself in World War II, the development of computers was accelerated by the military need to *quickly* calculate ballistic tables necessary to predict the trajectories of bombs and projectiles. The result of this effort was the ENIAC, one of the world's first digital computers, completed in early 1946 under the direction of J. Presper Eckert and John W. Mauchly. At about the same time, in 1943, work began at the Massachusetts Institute of Technology on an *Airplane Stability Control Analyzer*, initially designed as an analog computer system. Beginning in 1945, Jay Forrester, the leader of the project group, decided to use the capabilities of digital computers that had just been developed to build a universal flight simulator that could simulate different aircraft as needed, saving an enormous amount of money in the long run.[6] This project, called *Whirlwind*, was the first to use cathode ray tubes as a graphical display. In the process, the first precursor of computer games was also developed around 1949: a bouncing "ball" (a dot) which had to be steered "interactively" into a hole by correctly choosing appropriate parameters.[7] More important than the interactivity here is that this "virtual ball" bounced approximately like a real ball: Woolley calls this event the beginning of computer simulation.[8]

5 I will not discuss the aspect of interactivity in the following. Cf. Lev Manovich, "An Archaeology of the Computer Screen," *Kunstforum International*, vol. 132 (1995), 124–136.

6 Cf. Robert Everett, "Whirlwind," in *A History of Computing in the Twentieth Century*, eds. M. Metropolis et al. (New York: Academic Press, Inc., 1980), 365–384.

7 Cf. *ACM SIGGRAPH 89 Panel Proceedings (SIGGRAPH '89)* (= *Computer Graphics*, vol. 23, no. 5) (New York: Association for Computing Machinery, 1989), 21.

8 Cf. Benjamin Woolley, *Virtual Worlds: A Journey in Hype and Hyperreality* (Oxford/Cambridge, MA: Penguin Books Ltd, 1992), 51–52. However, Woolley does not mention that the first simulations (so-called 'Monte Carlos') were already carried out from December 1945 onwards as part of the research on the hydrogen bomb on ENIAC, cf. Peter Galison, *Image and Logic: A Material Culture of Microphysics* (Chicago/London: University of Chicago Press, 1997), 689–780.

Computer Simulation and "Realism"

In simulations, "the real process [...] must be *mapped* in mathematics so that it can then be simulated in the computer by means of algorithms."[9] In other words, from measurement data of all kinds and from these derived, mathematically formulable regularities about the behavior of the process, mathematical *models* are constructed, which describe the process with more or less approximation.[10] "Realism," the reference of the mathematical model to the structure of a real phenomenon, is thus the point where computer simulation begins.

Simulations create models of objects and these are seen as *virtual* objects. It is not possible here to outline the whole history of the concept of virtual, but instead I will only outline its emergence and use in the discourse of computer science. The specific usage of "virtual" in computer science has to be understood to get the meaning of simulation, which forms the base for photorealistic rendering.[11] "Virtual" is first used there in the context of research on virtual *memory.*[12] From 1962 at the latest, *virtual memory* took on the meaning

9 Helmut Neunzert, "Mathematik und Computersimulation: Modelle, Algorithmen, Bilder," in *Simulation. Computer zwischen Experiment und Theorie*, eds. Valentin Braitenberg and Inga Hosp (Reinbek bei Hamburg: Rowohlt, 1995), 44–55, here 44, my translation. On the early discussions of the relationship between simulations and nature, see Galison, *Image and Logic*, 738–746 and 776–780. On the various forms of computer simulation, see Michael M. Woolfson and G. J. Pert, *An Introduction to Computer Simulation* (Oxford et al: Oxford University Press, 1999).

10 An example of the fact that generated images are based on data can be found in Ivan Sutherland and Henri Gouraud, "Les Images Electroniques," *La Recherche*, no. 29 (1972), 1055–1061, here 1058, where it is about computer modeling of a Volkswagen car: "Before one can generate an 'electronic image' of an object, it is necessary to enter the definition of the object into the computer. If the object exists, perhaps this can be done by measuring the spatial coordinates of points on the surface of the object" (my translation).

11 See Jens Schröter, "What is a Virtual Image?," in *Yearbook of Moving Image Studies: Trilogy of Synthetic Realities I: Virtual Images*, eds. Lars C. Grabbe, Patrick Rupert-Kruse, and Norbert M. Schmitz (Marburg: Büchner, 2021), 91–104.

12 According to the *Oxford English Dictionary*, the term *virtual memory* was introduced in 1959 in a paper presented at the *Eastern Joint Computer Conference*, see John Cocke and Harwood G. Kolsky, "'The Virtual Memory' in the STRETCH Computer," *Proceedings of the 1959 Eastern Joint Computer Conference. Papers presented at the Joint IRE-AIEE-ACM Computer Conference* (Boston, MA: Association for Computing Machinery, 1959), 82–93. However, in this text *virtual memory* means something different than in the

we know today: The main problem of electronic computers was that memories with short access times were expensive. Consequently, information that was not currently required had to be swapped out of the main memory into the auxiliary memory. *Memory allocation* refers to the process of deciding which data is currently needed in the main memory and which can be swapped out to the auxiliary memory. In the early years of computer programming, allocation had to be carried out by the programmers themselves using appropriate routines. When higher programming languages came into use in the mid-fifties and the programs became more complex, this procedure turned out to be an obstacle. There were a number of proposed solutions, and the concept of *virtual memory* finally prevailed.[13] It is an automatic method of memory allocation that was first used in the *Atlas computer* developed in 1961. Virtual memory creates the illusion of large, available memory. The programmer can dispose of the "address space" or "name space"[14] as if it designated a contiguous memory. Invisibly to the programmer, the computer system assigns the virtual addresses to the real addresses in the "memory space"[15] with the help of an address-translation function.[16] Only the data which are needed by the program in a certain moment are loaded from the computer system into the actual main memory. Virtual memories therefore operate on the basis of the separation of the logical address space from the physical memory space.

This separation of logical structure and material substrate is the core of the virtual, at least in the discourse of computer science. The very difference between software and hardware is, in this sense, a virtualization. A computer executes software – a logical structure – which makes it possible, for example, to simulate another computer (thus creating a *virtual machine*). The scientifically, medically or militarily used computer simulation of a real object or process consists in the fact that – depending on the question – different mathematically formalizable structures are detached from the materiality of the object (with the example *Whirlwind*: the bouncing behavior of a ball from the material

common usage of the term today. The 1959 text describes as a *look-ahead unit that* is now called *cache* memory – a small intermediate memory that reacts particularly quickly and holds data frequently used by the processor.

13 Cf. Peter J. Denning, "Virtual Memory," *ACM Computing Surveys*, vol. 2, no. 3 (1970), 153–189.

14 Ibid., 157.

15 Which includes both real main memory and auxiliary memory (e.g. hard disks).

16 Ibid. 158.

ball made of rubber), in order to serve then as basis of a model (with the example *Whirlwind*: a ball model is generated, that is, a "virtual ball").[17] The models can then be modified, e.g., to predict the behavior of the simulated process under different conditions or, of particular interest, to anticipate the behavior of a possible future process based on the simulated process. Finally, the models and their behavior are mapped to different displays, be they auditory, visual, or even haptic. Here, the visual output does not necessarily have to be "photorealistic" – in the simulation of molecular processes, for example, this would not make sense.

Photorealism

The virtual object of a simulation is therefore a mathematically formalized structure of a "real" object, detached from matter depending on the purpose, and represented approximately in the computer. In flight simulations, i.e. virtual flights, the projected later flight situation must be anticipated as *realistically* as possible to enable adequate preparation. In addition to the interactivity excluded here, this realism refers to the character of the display through which the pilots see and/or hear the "landscape" through which they are supposedly flying and, if applicable, the "opponents" against whom they are supposedly fighting. The structures of "real" visual experience must therefore become able to be virtually modelled. Generated images are thus approximated to "natural vision" by, for example, procedures for generating lighting effects in generated images that draw on empirically gained knowledge about the behavior of light on surfaces: a simulation with which a *virtual light* is generated.[18]

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17 This detachment from materiality refers to the virtual object in relation to the real object, but not to the hardware that underlies any computational process and limits, for example, the computer speed, which can play a crucial role in the simulation of highly complex phenomena.

18 Cf. Axel Roch, "Computergrafik und Radartechnologie. Zur Geschichte der Beleuchtungsmodelle in computergenerierten Bildern," in *Geschichte der Medien*, eds. Manfred Faßler and Wulf Halbach (Munich: Fink, 1998), 227–254, here 250: "Actual, empirical measurements for reflection properties on rough surfaces are namely available in particular detail for radar. It is precisely these empirical curves on which the theoretical scattering fields of Cook/Torrance are based" (my translation). Roch refers here to Ro-

However, it is with flight simulation that the pursuit of *photorealism* begins, something that characterizes large parts of computer graphics. Computer scientists Martin E. Newell and James F. Blinn, for example, write explicitly: "In the mid-sixties techniques for producing photograph-like images of modelled three dimensional scenes started to emerge. The initial motivation for these was in flight simulation, where the illusion of reality is important."[19] That is, computer graphic realism is not completely absorbed in the conception of simulation as a computer model of a real phenomenon, but often encompasses two objectives that are not identical: "The goal of realistic image synthesis is to produce images that are indistinguishable from photographs or from visual impressions of actual scenes."[20] The fact that the goal of creating a computer graphic that reproduces the "natural" visual impression is not always clearly separated from that of perfectly simulating photography or film is evidence of the paradigmatic function of photographic media even in the digital age. Thus, "realistic" means that the image generated is based on the conventions of viewing that have been shaped by photographs and films.[21] Therefore, research on photorealism[22] refers to the adoption of already established conventions from photography and film.

This similarity is simulation insofar as the properties (of certain characteristics) of photography and film are empirically measured and these data are

bert L. Cook and Kenneth E. Torrance, "A Reflectance Model for Computer Graphics," *ACM Transactions on Graphics*, vol. 1, no. 1 (1982), 7–24.

19 Cf. Martin E. Newell and, James F. Blinn, "The Progression of Realism in Computer-Generated Images." in *ACM 77th Proceedings of the Annual Conference* (New York: Association for Computing Machinery, 1977), 444–448, here 444.

20 Konrad F. Karner, *Assessing the Realism of Local and Global Illumination Models* (Oldenbourg/Graz: University of Technology, 1996), diss., 10.

21 Cf. Gary W. Meyer, Holly E. Rushmeier, Michael F. Cohen, Donald P. Greenberg, and Kenneth E. Torrance, "An Experimental Evaluation of Computer Graphics Imagery," *ACM Transactions on Graphics*, vol. 5, no. 1 (1986), 30–50. The text describes an experiment to evaluate the realistic nature of computer images: A video image of a simple, real-world arrangement of objects and their lighting is presented to test subjects alongside a video image of a generated graphic representing that arrangement: If these can no longer say with certainty what the image of the real arrangement is, the image is considered realistic – under the very constant condition of the video image, which here, although electronic, is counted among the photographic media insofar as it is based on the storage of light.

22 See, among others, E. Nakamae and K. Tadamura, "Photorealism in Computer Graphics – Past and Present," *Computer and Graphics*, vol. 19, no. 1 (1995), 119–130.

used as a basis for the computer models. That is, the photographic nature of photorealism is by no means merely rhetorical in the sense that superficial signs or the "look" of photography are imitated – as, for example, in the artistic current of photorealistic painting, which emerged at about the same time as the first photorealistic efforts of computer graphic artists. Rather, the properties of the photographic (and also cinematographic) apparatus are simulated, and that means, according to the definition of the virtual suggested above, that a *virtual camera* is a real camera – not merely an imitation or even mere fiction – which can be increasingly approximated to its material model, depending on the data available (if a realist camera model is the goal, of course the model can also be willfully altered). This virtual camera is now used to virtually photograph a virtual object field illuminated by a virtual light source.[23] Basically, these are all mathematical structures interacting via mathematical operations.

Virtual photographs or films would therefore have to follow the fundamental characteristics of chemical photography with regard to their visual appearance,[24] of which at least four can be named – photograms excepted.

First, the wealth of unintended details that make up the – as one could say in line with Roland Barthes – "effet du réel."[25] Many generated graphics are classified as not yet realistic enough precisely because they appear too "clean," i.e. show too few scratches, stains and the like on the surfaces of the depicted objects.[26] An analog photograph taken by Lewis H. Hine in 1908 shows many stains, scratches and dirt on the floor which were incidentally in the scene when Hine took the photo (Fig. 8.1). This indexical property of photography is often simulated in photorealistic computer graphics.

23 Cf. William J. Mitchell, *The Reconfigured Eye: Visual Truth in the Post-Photographic Era* (Cambridge, MA/London: MIT Press, 1992), 117–135. Cf. Timothy Binkley, "Refiguring Culture," in *Future Visions: New Technologies of the Screen*, eds. Philip Hayward and Tana Wollen (London: BFI Publishing, 1993), 92–122, 103–105.

24 Montage rules etc. in film are not included here.

25 Cf. Roland Barthes, "L'effet du reel," *Communications*, no. 11 (1968), 84–89, esp. 87–88.

26 Cf. Newell and Blinn, "Progression of Realism," 445–446.

8.1 Lewis H. Hine, Child Laborer, 1908.

Wikimedia Commons, free to use, https://commons.wikimedia.org/wiki/File:Child_laborer.jpg

Secondly, there are the effects caused by the camera optics, especially the image organization according to the rules of central perspective, because computer-generated images could also obey any other projection, but if they want to be photorealistic, they follow the perspective organization handed down by photography and film (see again Figure 8.1 – how the lines of flight recede into the background).[27]

Moreover, computer graphics research strives to simulate not only perspective projection, but also the specific effects of cameras, such as the empirically measurable distortions and focus effects of lenses and shutters, or the shutter speed-dependent motion blur, i.e., the blurring of fast-moving objects (the simulation of "motion blur" refers *ex negativo* to the sharp mo-

27 Cf. James D. Foley et al., *Computer Graphics. Principles and Practice. Second Edition in C* (Reading, MA: Addison-Wesley Longman, 1995), 230–237, esp. 231: "The visual effect of a perspective projection is similar to that of photographic systems and of the human visual system."

mentariness of most photographic images).[28] A photograph by Alvegaspar of a running chicken shows an example of photographic motion blur (Fig. 8.2).

8.2 Alvegaspar, A Chicken Running / Un poulet en train de courir, 2009.

Wikimedia Commons, free to use, https://creativecommons.org/licenses/by/3.0/deed.en

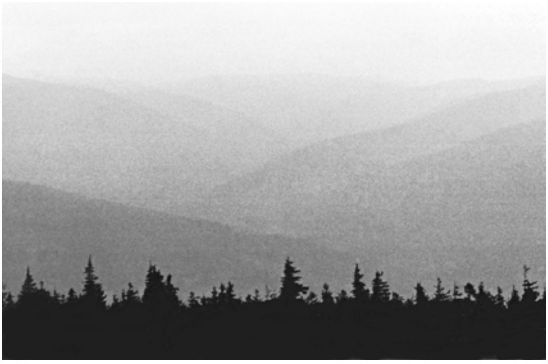
Thirdly, there is the cropped nature of photographic and cinematic images. Except for rare staging strategies found predominantly in the discourse of art that seek to close off the space of these images, images are organized centrifugally – cropped objects, glimpses from within the image space, etc., refer to

28 On the simulation of camera and motion blur, see Michael Potmesil and Indranil Chakravarty, "Synthetic Image Generation with a Lens and Aperture Camera Model," *ACM Transactions on Graphics*, vol. 1, no. 2 (1982), 85–108; "Modeling Motion Blur in Computer-Generated Images," in *Proceedings of the 10th annual conference on Computer graphics and interactive techniques (SIGGRAPH '83)* (= *Computer Graphics*, vol. 17, no. 3) (New York, Association for Computing Machinery, 1983), 389–399. Modeling the effects of lenses is sometimes willfully driven to the absurd – e.g. when 'lens flares' (normally seen as a disturbance caused by the materiality of lenses in photographic systems) are intentionally included in computer graphics. There are many examples for this, one of the most bizarre is in popular Disney-Pixar movie *Monsters Inc.* (USA 2001, Pete Docter). It's especially striking in this movie since the movie is not rendered in only a photorealistic way – instead it combines photorealism (light, shadows, focus and disturbances) and cartoonish non-photorealism in a new way.

various forms of the *off* (see Figure 8.1, in which the machines in the foreground are cropped and moreover – another typical photographic property – are out of focus).[29]

Fourthly, it is the properties of the photographic emulsion itself, e.g., the grainy structure of the image especially in enlargements or very light-sensitive films, that one seeks to virtually model in photorealistic computer graphics (Fig. 8.3: an example of an analog, quite grainy, black and white photo).[30]

8.3 Jacek Halicki, Góry Bialskie, view from Kowadło, 11.10.1980.



Wikimedia Commons, free to use, https://creativecommons.org/licenses/by/3.0/deed.en

Photographic images can look very different beyond these four basic, if not always equally encountered, characteristics – not to mention the countless styles that have differentiated themselves in artistic photography or artis-

29 The classic formulation of the distinction between a centrifugal and centripetal image still comes from André Bazin, "Painting and Cinema," in André Bazin, *What is Cinema? – Vol. 1* (Berkeley, CA: University of California Press, 1967), 164–169.

30 Cf. Joe Geigel and F. Kenton Musgrave, "A Model for Simulating the Photographic Development Process on Digital Images," in *Proceedings of the 24th annual conference on Computer graphics and interactive techniques (SIGGRAPH '97)* (New York: ACM Press/Addison-Wesley Publishing Co., 1997), 135–142. In their proposal, the authors refer not only to empirically obtained data on the behavior of photo emulsions, but also to the suggestions of Ansel Adams.

tic film. The notion, however, that accompanies many computer graphic artists when they want to produce "photorealistic" images apparently boils down to a "normal" (100 ASA) Kodak color photograph, taken in focus with a standard lens (50 mm), or an image from a "normal" 16 or 35 mm motion picture film.[31]

Historically, the first important technological step towards photorealism was the transition from vector to raster graphics, since only computer images no longer consist only of lines, but exist as a set of individually addressable points – only in this way are filled areas, diverse colors, shadows, etc. possible. Subsequently, new developments in the field of scene illumination and shadowing, object transparency and texture were achieved.[32] One important step was the "Phong shading" method that was developed in 1975.[33] Since highlights were white in Phong's algorithm, the objects looked as if they were made of plastic. Later on, ever more complicated models for lighting and texturing were developed.[34] Finally, the paradigmatic function of photographic images for the development of computer graphics is illustrated in a standard work on computer graphics – a photograph of a scene is compared with a similar computed scene – *quod erat demonstrandum*.[35] However, it should be noted that the origin of computer graphic realism from flight simulation had the consequence that, at the beginning, procedures were developed for the generation of objects like trees or clouds. Thus, realism of a computer graphic image remained "partial and weighted" for a long time.[36]

The convergence of computer-generated to standardized photographic and cinematographic images is – as the example of flight simulation already

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31 Ibid, 136, where the authors refer to a "generalized photographic model."

32 In addition to Foley et al., "Computer Graphics," 605–648, a detailed overview of the procedures for generating 'realistic' computer images is also provided by W.D. Fellner, *Computergrafik* (Mannheim et al: Spektrum Akademischer Verlag, 1992), 299–348.

33 Cf. Bui Tuong Phong, "Illumination for Computer Generated Pictures," *Communications of the ACM*, vol. 18, no. 6 (1975), 311–317.

34 See Foley et al., "Computer Graphics," Ch. 16 for a discussing of illumination and lighting – as it was done in 1995. Cf. John F. Hughes et. al., *Computer Graphics. Principles and Practice. Third Edition* (Upper Saddle River, NJ: Addison-Wesley, 2014), Ch. 26 and 27 for a more recent overview. The difference between these chapters shows the rapid development of computer graphics.

35 Foley et al., "Computer Graphics," Plate III.19 (1220).

36 Cf. Lev Manovich, "Realitätseffekte in der Computeranimation," in *Illusion and Simulation. Begegnung mit der Realität*, eds. Stefan Iglhaut, Florian Rötzer, Elisabeth Schweeger (Ostfildern: Hatje Cantz, 1995), 49–60, here 59, my translation; and Geoffrey T. Gardner, "Visual Simulation of Clouds," *Computer Graphics*, vol. 19, no. 3 (1985), 297–303.

showed – institutionally and economically conditioned. From the late seventies on, research on realistic computer graphics was pursued less and less by the military, but to an increasing extent by the film industry. For example, in 1979 Edwin Catmull, one of the leading developers of computer graphics in the 1970s who was in his student times in a university program funded by the DARPA (Defense Advanced Research Projects Agency), went to *Lucasfilm* to head its Computer Graphics Division. There is, of course, a long and impressive history of the use of photorealistic computer graphics in popular cinema, which cannot be discussed here in detail – but one can think of the liquid, reflective robot in *Terminator II* (USA 1991, James Cameron) or the dinosaurs in *Jurassic Park* (USA 1993, Steven Spielberg). In both cases the simulated graphics blend very convincingly into the photographed scenery.

For many military applications, photorealistic graphics are not at all suitable because they provide too much information, which is why complexity-reduced displays are often used.[37] On the other hand, if computer-generated images are to be inserted into a film or even a print advertisement as a *special effect* – unless the artificiality of the images is narratively motivated – they must be sufficiently indistinguishable from the photographic-film context.[38] In the meantime, most of the advances in photorealistic computer graphics are being spurred by the entertainment industry, which does not have to take military interests directly into account.

37 Cf. Foley et al, “Computer Graphics,” 605: “You should bear in mind that a more realistic picture is not necessarily a more desirable or useful one. If the ultimate goal of a picture is to convey information, then a picture that is free of the complications of shadows and reflections may well be more successful than a *tour de force* of photographic realism.”

38 Incidentally, in view of these functions of photorealistic computer graphics, it is not surprising that among ‘artistically’ ambitious computer graphic artists a trend towards *non-photorealistic rendering* has emerged, in which, among other things, processes such as painting or ink drawing, but also styles of artists are specifically simulated, cf. Gooch and Gooch, “Non-Photorealistic Rendering.” However, these processes are not only used to simulate painting and the like, but also cartoons, which in turn makes the use of non-photorealistic processes interesting for the film industry – not least *Disney* has been researching this.

8.4 Gilles Tran, Image d'objets transparents montrant les capacités du logiciel POV-Ray, rendered with POV-Ray 3.6 using Radiosity. The Glasses, Ashtray and Pitcher were modeled with Rhino and the Dice with Cinema 4D.

http://www.oyonale.com/modeles.php?lang=en&page=40, Wikimedia Commons, free to use.

There are several different software packages to render photorealistic images that are based on and combine different algorithmic procedures for different aspects of the image.[39] Sometimes creative empirical approximations, workarounds and simplifications are used that are "good enough," that is, they look enough either like the real world and/or photographic images of the real world, but sometimes meticulously precise simulations of the physics of light etc. are preferred.[40] The decision about which algorithms are used depends not only on explicit or implicit ideals of "realism," but very often on economical questions of computing resources and available time. Sometimes accuracy is discarded in the light of assumed expectations and perceptual abilities of a potential audience. Sometimes photorealistic rendering is combined with

39 Again: Google "photorealistic rendering" and you will be shown many sites where software to render photorealistic images is offered for sale.

40 Alan Watt, "Rendering Techniques: Past, Present and Future," *ACM Computing Surveys*, vol. 28, no. 1 (1996), 157–159, here 157. Because of economic reasons like limited computer power and computing time, the old-fashioned "Phong shading" (see fn 33) or related algorithms are still used – they produce acceptable results with acceptable costs.

sampled images or textures, for example. And most often, all these aspects and more interfere with one another in many different ways. There is not just one way to render photorealistic images (Fig. 8.4: a photorealistic rendered image).[41]

Functions of Photorealistic Images

The computer-generated images in their currently predominant form refer to a rhetoric of truthfulness stolen from photography and film – whether to support the reality effects of illusionist cinema or to serve as a "truthful" reconstruction or prognosis of events and processes. The latter can be marveled at more and more frequently on television in connection with catastrophic events such as September 11, but also in weather reports. But computer-generated images also actually relate to reality, insofar as they are the visual representation of simulations that replicate real phenomena. For example, images of celestial bodies are generated from data from space probes, which need by no means show what would have been truly visible to humans, but what is operational for a particular practice and thus "true" insofar as is necessary for the purpose.

To the extent that simulations are based on models of real phenomena, they are still images and – if you like – more "realistic" than the images based only on the scanning of the light reflected from the surface of the objects. However, when the models are modified to describe possible or future phenomena, simulations can produce the first images that cannot merely semantically refer to the future – this also distinguishes the virtual from the fictional. Simulators are supposed to provide *predictions* about a future reality in order to place military, scientific or economic action on a secure foundation, i.e. they are supposed to function as a "control environment."[42] In particle physics, for example, the results of simulations of future experiments serve as a standard of comparison against which the results of experiments that are then carried out in

41 Friedrich A. Kittler, "Computer Graphics. A Semi-Technical Introduction," *Grey Room* 2 (2001), 30–35, has shown that two important algorithms for global illumination, ray tracing and radiosity (used in Fig. 8.4), are not compatible with each other, although they are used together today or are even superseded by newer methods. Note, however, that Kittler only discusses global illumination and not photo-specific algorithms for the motion blur and other aspects mentioned above.

42 Cf. S.R. Ellis, "Nature and Origins of Virtual Environments. A Bibliographical Essay," *Computing Systems in Engineering*, vol. 2, no. 4 (1991), 321–347, here 327.

reality can first be evaluated, and this applies not only to early research on the atomic and hydrogen bombs.[43] In architecture, mechanical engineering and design, simulations and resulting photorealistic images are often used to design new products on the computer, to test them, and finally to present them to potential customers before they are actually manufactured. This is another important motivation for the photorealistic orientation of generated images – they fulfill functions similar to those previously performed by advertising photography.

These role model and control functions are particularly evident in flight simulators. Flight simulations are not images of a flight that has taken place, but role models that prepare the pilot for a future flight. In other words, the realistic images generated serve to condition the pilot's reactions and body movements in such a way that the best possible response can be achieved in a later real case: James D. Foley unabashedly refers to "maximizing user efficiency"[44] as a goal of maximizing computer graphic realism (with the aforementioned caveat that too much realism can also be too complex). Seen in this light, simulators continue the use of photographic media in the service of disciplining, which found a particularly striking expression in Frederick Winslow Taylor's and especially Frank Bunker Gilbreth's time-and-motion-studies at the beginning of the twentieth century.[45]

The Continuity of Photography and the Universal Machine

Even if chemical photography were to disappear, the emergence and spread of the computer gave photography a new place in the system of media.[46] Obviously, that is the case with digital cameras. But it is also true for the pho-

43 Cf. Galison, "Image and Logic," 746–752, on the role of simulations in particle physics. Computer-based detectors, by the way, are replacing decades-old photographic techniques such as bubble chambers, etc., in the field of particle physics – and surpassing their analytical potency.

44 Cf. James D. Foley, "Interfaces for Advanced Computing," *Scientific American* (October 1987), 82–90, here 83.

45 Cf. Suren Lalvani, *Photography, Vision, and the Production of Modern Bodies* (Albany, NY: State University of New York Press, 1996).

46 Cf. Friedrich Kittler, "The History of Communication Media," in *On-line. Kunst im Netz*, ed. Helga Konrad (Graz: Steirische Kulturinitiative, 1993), 66–81, here 72: "New media do not make old media obsolete; they assign them other places in the system."

torealistic forms of computer graphics. Even if the computer is to be the new leading medium, the images created with it, both in terms of their appearance and their functions, are still strongly indebted to photography and cinema. The question arose (in the 1990s at least) whether this borrowing is merely a "transitory phase [that is] a historical compromise offered by computers to a public accustomed to visuality."[47] Viewed in this way, all digital photography and all photorealism would have arisen from superficially economic purposes – the distribution of computers – and would soon have to disappear once the *specific* potentials of the computer are generally understood.

However, this is countered by precisely the fact that digital computers, as universal machines, possess no specificity that could prevail in the course of history against the initial borrowing of the new machine from previous machines, for "the digital medium [exists] in its multiform metaphoricity."[48] In various discursive practices, computers stand within the framework of different and sometimes conflicting metaphorizations that circumscribe what purpose the machines are supposed to serve and what they are to be useful for. As a consequence of such objectives, which are also often implicit, computers are each connected to different hardware (peripherals) and each programmed with different software within the bounds of what is technically possible. In the sixties, however, the computer was discovered as a medium long before the media-theoretical discussion of the early nineties.[49] As early as 1967, Michael Noll described the computer *as a creative medium* for the image-generating arts and called for corresponding software and hardware developments.[50] This metaphorization had a long latency period due to economic reasons (i.e. the prices for corresponding technologies) until it became a self-evident conception of computers in our present time. Computers as media can be image, sound, written media – or all at the same time. Seen in this way, they do not possess any media specificity. Instead, depending on discursive practice, they are a different dispositive that opens up certain possibilities

47 Hartmut Winkler, *Docuverse. Zur Medientheorie der Computer* (Munich: Boer Verlag, 1997), 187. My translation.

48 Cf. Georg Christoph Tholen, "Überschneidungen. Konturen einer Theorie der Medialität," in *Konfigurationen. Zwischen Kunst und Medien*, eds. Georg Christoph Tholen, and Sigrid Schade (Munich: Brill/Fink, 1999), 15–34, here 21. My translation.

49 Cf. e.g. Norbert Bolz, Friedrich Kittler, and Georg-Christoph Tholen, eds., *Computer als Medium* (Munich: Brill/Fink, 1994).

50 Cf. Michael A. Noll, "The Digital Computer as a Creative Medium," *IEEE Spectrum*, vol. 4, no. 10 (1967), 89–95.

and closes off others. In this context, program routines that are central to a specific discursive practice can literally sediment into hardware, for any software can become hardware as an interconnection of logical gates, as Shannon had already proved in 1938.[51] A pertinent example here is the development of graphics chips, promoted by the movie and then computer game industries, which cast algorithms for generating images (often in a photorealistic manner) in hardware, thus speeding them up. In that way photorealistic rendering became part of the hardware.

Conclusion

So, instead of talking about the "digital revolution" and "post-photography," instead we should say that "digital photography" and computer-graphic "photorealism" will remain for a long time, because photographic and cinematographic appearing images are – as Manovich laconically stated – "very efficient for cultural communication"[52]? That is, photorealistic image generation takes over and enhances important functions of its photographic and cinematographic predecessors, not only in the entertainment industry, but also in military, medical and economic discursive practices. Namely, in terms of the storage, processing and representation of information, enabling classification, analysis, prediction and thus control and optimization. The persistence of photographic characteristics and the rhetoric of truth in digital media would thus point to an inscription of certain power/knowledge dispositives, not triggered by photography alone, but historically associated with it, in the programmable machine computer. Thus, it is not just about the superficially economic objective of selling more computers, but about more fundamental functions of control. This is symptomatically shown by the fact that the tendency of photorealism results in the quasi-utopian "goal of simulating reality," i.e., rooted in the word *virtual* (inter alia "powerfully"), which flashes up in the discourses on what is referred to as *virtual reality* – which promises in the virtual the unification of the fictive with the real and thus a different, better reality.

51 Cf. Claude Elwood Shannon, "A Symbolic Analysis of Relay and Switching Circuits," *Transactions American Institute of Electrical Engineers*, no. 57 (1938), 713–723.

52 Lev Manovich, *The Language of New Media* (Cambridge, MA/London: MIT Press, 2001), 180–181.

9. The Vision Machine and Computer Simulation

Exploring New Horizons in Virtual Photography

Francesco Giarrusso

It took a century of astronomical research to photograph the compact radio source, first identified by Heber Curtis in 1918.[1] This source, spanning approximately 2,005 x 10^{12} kilometers and estimated to be 40 million years old, emitted such kinetic power that it suggested the possible presence of a supermassive black hole in the center of the giant elliptical galaxy M87.

The evidence supporting the existence of this astronomical object, in line with Albert Einstein's theory of general relativity (1915), comes primarily from X-ray[2] and gravitational wave measurements.[3] However, until recently, obtaining event-horizon-scale images of the supermassive black hole candidate was impossible.

Although the "calculated photographs" by Jean-Pierre Luminet[4] significantly contributed to the understanding and visualization of supermassive black holes, it was the observation campaign conducted in April 2017 by the Event Horizon Telescope (EHT) that demonstrated the possibility of detecting the shadow of the event horizon of M87*, transforming a mathematical concept into a physical entity, now accessible and analyzable through repeated observations (Fig. 9.1).

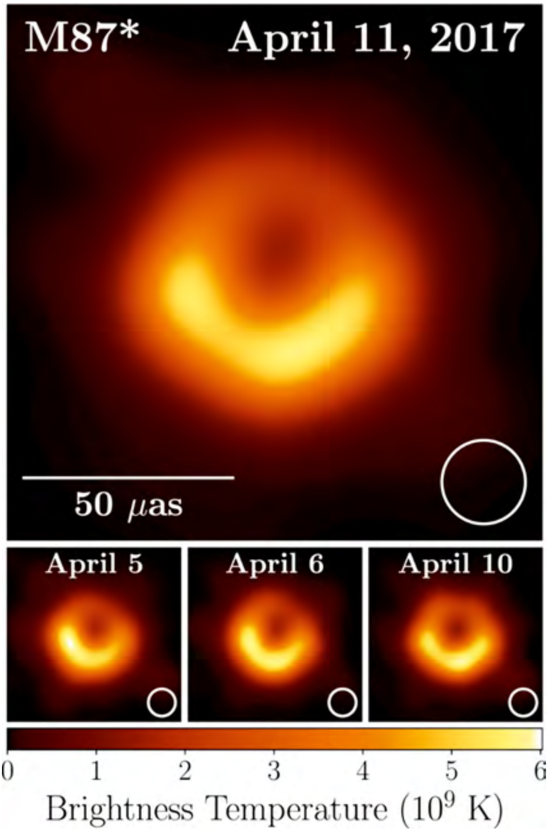
1 The reference to Heber Curtius (1918) was sourced from the bibliography of Kazunori Akiyama et al., "First M87 Event Horizon Telescope Results. I. The Shadow of the Supermassive Black Hole," *The Astrophysical Journal Letters*, vol. 875, no. 1 (April 2019).

2 Ibid.

3 Ibid.

4 Jean Pierre Luminet, "Image of a Spherical Black Hole with Thin Accretion Disk," *Astronomy and Astrophysics*, no. 75 (April 1979), 228–235.

9.1 The top photo shows the EHT image of M87 taken on April 11, 2017, as a typical example from the 2017 observation campaign. This image is created by averaging three different imaging methods, each adjusted to the same resolution using a circular Gaussian filter. The bottom photo presents similar images taken on different days, showing the consistency of the basic image structure and the similarity across various days.*



Courtesy of EHT.

To resolve the shadow of the M87* core, the EHT used the observational technique known as Very Long Baseline Interferometry (VLBI), creating a global array of radio telescopes. This network, operating at a wavelength of 1.3

mm, achieved a very high angular resolution, essential for revealing the finest details of such a minute and distant astronomical object. As the law of diffraction dictates, the angular resolution is inversely proportional to the telescope's diameter (D) and directly proportional to the wavelength (λ) of the observed radiation.[5] To overcome technical limitations, the EHT implemented the very long base interferometry, using the simultaneous and synergistic action of multiple detection stations in different locations on Earth. This technique allowed for the simulation of a telescope almost as large as the planet, ensuring a high capacity of resolution.

Adopting various calibration, imaging, and independent analysis methods enabled the visualization of event-horizon-scale structures around the black hole in M87. The images of the emission region show a ring structure with a diameter of 40 μas and enhanced brightness in the southern part, in line with the event-horizon-scale structures[6] and consistent with the predictions of general relativity.

In the continuation of this chapter, I will explore the techniques and methodologies used to create the M87* images and discuss its epistemological and ontological implications in photography and astrophysics. As will be elucidated throughout this chapter, particularly in the last sections which delve into the ontology of virtual photography, the broader term "image" is employed, not solely for consistency with referenced astronomical literature, but also to denote the single images that punctuate the computational phases inherent to the imaging process. Virtual photography, as I will refer to it, encompasses an amalgamation of images, an accumulation of traces and calculations, constituting a summation-correlation of different detection-imaging phases, synthesized into a coherent form, meriting the term "image synthesis."[7]

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5 To achieve a high angular resolution, using a telescope with a very large diameter or observing shorter wavelengths is desirable. Given that the wavelength of the radio emissions observed by the EHT is 1.3 mm, achieving a very high resolution necessitated a paraboloid close to the diameter of the Earth, the construction of which is clearly unfeasible.

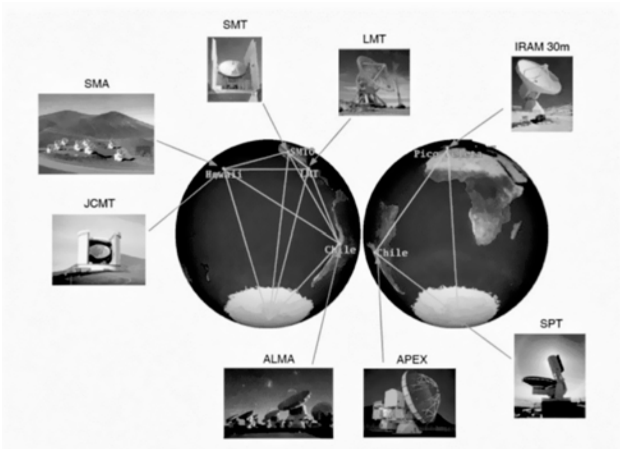
6 Kazunori Akiyama et al., "First M87 Event Horizon Telescope Results. IV. Imaging the Central Supermassive Black Hole," *The Astrophysical Journal Letters*, vol. 875, no. 1 (April 2019).

7 Furthermore, the term "photography" seems apt as I am of the opinion – a hypothesis that I am exploring in my current research project – that the historical trajectory of photographic techniques, from orthochromatic to panchromatic photosensitive sur-

VLBI: Principles and Operational Methodology

Launched in 2009, the Event Horizon Telescope (EHT) embarked on a technologically complex mission to enhance its sensitivity and detect electromagnetic radiation in the millimeter radio wave band with 1.3 mm wavelengths. To achieve this, the EHT set up a global array of radio telescopes consisting of eight stations in six different geographical locations (Fig. 9.2). This configuration established baselines, the distances between the radio telescopes, ranging from 160 meters to 10,700 kilometers.

9.2 During the EHT 2017 campaign, there were eight stations located in six different geographic locations.



Courtesy of EHT.

faces, extends to encompass the entire electromagnetic spectrum. This journey from capturing visible light to embracing ultraviolet, infrared rays, and ultimately, the radio waves utilized in the virtual algorithmic photographs of the M87* black hole, underscores photography's unfolding. From its inception, photography has aspired to transcend the physiological limits of human perception, progressively diminishing the centrality of human agency in favor of automation and externalization, marking a transition from human co-authorship to oversight.

The observation campaign of M87* took place on April 5, 6, 10, and 11, 2017, with scanning sessions varying between 3 and 7 minutes. During the Earth's rotation, pairs of radio telescopes sampled and recorded the radiation field of the source, "filling" the (u, v) plane to achieve optimal spatial coverage. In this context, scanning refers to capturing images of a celestial object from different moving positions, traced by the Earth's rotation[8], almost like a 3D scan performed from multiple angles. Aligning the signals received from the radio telescopes was crucial to ensure data consistency. Each radio telescope was equipped with an atomic clock and an *a priori* Earth geometry based on GPS measurements to ensure synchronization and temporal alignment of the detections.

After data collection, these were sent for correlation at the Haystack Observatory of MIT (USA) and the Max-Planck-Institut für Radioastronomie (Germany). Correlation, a process of fringe-fitting, was vital for combining the data from all the radio telescopes into a coherent image. This step corrects temporal and spatial variations in interferometric observations, maximizing signal coherence and image quality.

Three independent pipelines managed this calibration phase, making it possible to estimate systematic errors in the baselines and validate the data. An output selected from one of these pipelines was designated as the primary data set of the EHT and was deemed reliable for subsequent imaging phases.

EHT observations do not immediately translate into images. Indeed, the EHT collects complex visibilities, representing the Fourier components of the brightness distribution on the observed portion of the sky. The spatial

8 Interferometric detection exploits the rotation of the Earth and is quite different from a brief, instantaneous observation. As the Earth rotates, the relative geometry between the radio telescopes and the celestial object changes. This means that, throughout one night, the interferometer "sees" the object from different angles, as if the radio telescopes were physically moving to cover a larger area. Observations collected at different times during the Earth's rotation are then synthesized together using signal processing algorithms to create a single high-resolution image (image synthesis).

frequency[9] of these components, determined by the projected baseline[10] and expressed in units of the observing wavelength, corresponds to the brightness distribution in the sky. We can imagine the Fourier transform as a tool for decomposing an image (or any other signal) into its frequency components. In the context of interferometry, the (u, v) plane maps these spatial frequencies, with each point corresponding to a specific frequency component of the sky image. "Filling" the (u, v) plane implies sampling these components through different baselines. Once all the complex visibilities are collected, the inverse Fourier transform is used to reassemble the original image of the sky.

Thinking of the EHT as a puzzle, the sky image one aims to obtain is the complete picture of the puzzle. The complex visibilities are the individual pieces, each representing a frequency component of the image. Their position in the (u, v) plane determines the spatial frequency, indicating how detailed a piece is compared to others. The Fourier transform assembles these pieces to form the overall image of the sky.

Imaging Procedures[11]

The processing of images obtained from the EHT faced significant technical limitations. The EHT array's ability to detect a limited range of spatial frequencies and the sparse sampling coverage in the (u, v) plane did not allow for a complete representation of the observed object. The limited arrangement and number of detection stations prevented data collection from all theoretically possible angles, leaving gaps in the collected data. These gaps were filled

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9 Spatial frequency refers to the rate at which the signal's intensity (or brightness) varies from one point to another. For instance, in an image with very fine details or sharp edges, we will have rapid intensity variations and, thus, high spatial frequencies. Conversely, in an image with gradual variations in brightness, the spatial frequencies will be low.

10 To better understand the concept, imagine two people standing on a beach looking at a distant lighthouse. If both observe the lighthouse head-on, the distance between them is the linear distance. However, if one person moves further along the beach and views the lighthouse from a different angle, the "projected" or "perceived" distance between the two changes, even though their physical distance remains the same. This is what "from a particular perspective" means in the context of the "projected baseline" between two telescopes.

11 For further details on the imaging procedures, see Akiyama et al., "First M87 Event Horizon Telescope Results. IV."

through sophisticated imaging procedures designed to integrate missing visibilities and provide a more accurate representation of M87*.

Due to the incomplete and fragmented nature of the data, what is known in mathematics and physics as an inverse problem is under-constrained. The "inverse problem" in the context of EHT VLBI involved reconstructing an image of the sky (the cause) from data collected by radio telescopes (the effects), while "under-constrained" referred to the fact that fewer data or links than necessary existed to determine one single solution, complicating the determination of the "correct" image.

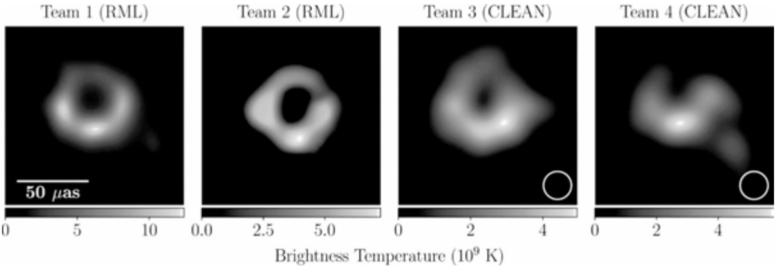
To disambiguate the interchangeability among different images, all potentially valid and reliable but incompatible with each other in reference to the data collected by the EHT, a two-phase methodological approach was adopted for processing the images of M87*.

First Stage

In the first stage of imaging, a blind imaging procedure was implemented. Four independent teams worked on synthetic data without communication for seven weeks. The use of synthetic data reduced the risk of collective biases and ensured that shared expectations or assumptions did not influence the final images. The synthetic data were designed to have properties similar to the EHT M87* visibility amplitudes, allowing for testing reconstructions under controlled conditions and with knowledge of the ground truth: a kind of reliability test or theoretical reference model used as a benchmark to evaluate and interpret experimental or observational results.

The teams adopted different approaches to select data flagging strategies, calibration, and imaging. Two classes of algorithms, RML (Regularized Maximum Likelihood) and CLEAN, were used to find the most probable image from the observed data. Despite differences in parameter choices and methodologies, the consistency among the results obtained by different teams underscored the robustness of the imaging techniques, with all produced images showing a prominent ring of a 38–44 μas diameter with enhanced brightness in the south (Fig. 9.3).

9.3: The images from Teams 1 and 2 were produced using RML methods. Teams 3 and 4, on the other hand, used the CLEAN method. All the images display a similar shape, but there are noticeable differences in brightness temperature.



Courtesy of EHT.

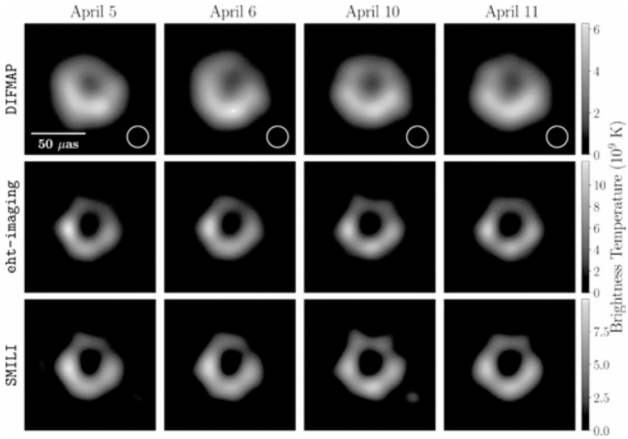
Second Stage

Biases do not solely arise from human intervention. Depending on the parameters used, imaging algorithms can significantly influence the final image, leading to potential distortions in reconstructions. For this reason, a second imaging stage was implemented using three pipelines, each equipped with a specific software package and associated methodology, to examine a certain range of parameters for their effectiveness and accuracy and to verify and validate the robustness of the imaging techniques used. This two-step process included imaging first with synthetic data applied to four simple geometric models in the training set and then with real M87* data.

Each pipeline explored a wide range of imaging parameters, producing about 10^3 to 10^4 images from different parameter combinations. This vast number of images ensured the consideration of every possible scenario, minimizing the risk of bias or errors. A Top-Set of combinations was selected, producing images of M87* consistent with the observed data and capable of accurately reconstructing images from synthetic data sets. All images in the Top-Set featured an asymmetric ring with a diameter of 40 μas.

Finally, a single combination of fiducial imaging parameters within the Top-Set was identified for each pipeline (Fig. 9.4), providing the best results across all synthetic data sets and for each specific imaging methodology. This meticulous and combinatorial approach ensured that the final image was the result of exhaustive analysis, minimizing uncertainties and ensuring maximum accuracy with a high degree of consistency, even in comparison with computer simulations.

9.4. Fiducial images of M87 from all four observation days were produced using three different imaging pipelines.*



Courtesy of EHT.

Visualizations and Imaging: Synthetic Data and Simulation Models

The detection process employed by the Event Horizon Telescope (EHT) diverges from traditional astronomical methodologies. For instance, while optical astronomy measures light intensities, radio telescopes amplify and manipulate radiation before detecting it,[12] which implies that the received energy, prior to measurement, is stored, managed, and subsequently transformed into electrical signals that are cross-correlated with other radiofrequency signals.[13] The correlation between the electric fields recorded by the EHT array anten-

12 Bernard F. Burke and Francis Graham-Smith, *An Introduction to Radio Astronomy* (Cambridge, MA: Cambridge University Press, 2010), 2; 5–6.

13 Ibid., 15.

nas produces interferometric visibilities,[14] which are susceptible to various distortions.

The EHT's imaging process thus contends with data scarcity, as the visibilities do not fully cover the (u, v) plane, leaving "holes" in the data due to factors including the geometry of the antenna array and atmospheric conditions. The resultant image, marred by interferences and imperfections, is termed a "dirty image."

This process, from creating a source image to constructing an elaborated image through synthetic images, necessitates precise calibrations, checks, and validations using advanced algorithms and probabilistic mathematical control methods. The incomplete and noisy nature of the data renders the imaging process an ill-posed problem. In mathematics, a problem is defined as ill-posed when it does not have a unique solution or when slight variations in data lead to significant changes in the solution. This is precisely the case with M87*, where multiple images are concurrently plausible from the same dataset.

At this juncture, it becomes essential to understand how the inverse problem of reconstructing an image from interferometric data was approached. This reconstruction entails inferring properties of celestial sources, which are not directly observable, by interpreting the collected data. The calibration and imaging phase operated in reverse, starting from the complex visibilities to reconstruct the image of the M87* emission ring.

The fact that visibilities are not direct measurements of the image but rather of its Fourier spectrum and are subject to noise and incompleteness may complicate the process. In this context, it is crucial to highlight how algorithms like CLEAN and RML are based on reverse logic and characterized by a trial-and-error process in which various hypotheses and models are tested and compared with the data to find the most plausible solution.

Furthermore, the inability to perceive a direct image of the astronomical object complicates not only the detection and self-calibration phases of the observations but also the imaging procedure of the EHT, whose operational

14 The van Cittert-Zernike theorem establishes that the visibility, measured by an interferometer, is connected to the brightness distribution of a celestial object through a Fourier transform. This transform is a mathematical technique that converts data from space/time to frequency, allowing for the conversion of the brightness distribution in the sky into visibility data of the interferometer. This process enables the creation of detailed images of celestial objects using data collected from multiple radio telescopes, essentially converting the observed light distribution into a clear image of the object.

strategies include a series of methods to refine and ensure the consistency and reliability of the detected data. The methodologies and techniques adopted include normalized cross-correlation, fiducial scripts, data resampling tests, quadrature sum of the measurement uncertainty, and the Mean Squared Standardized Residual.[15] Additionally, the EHT heavily utilized synthetic data to test and calibrate algorithms. This step proved crucial, providing a controlled environment to verify whether imaging methods could accurately reconstruct a theoretically known image a priori.

Synthetic data generated from simple geometric models[16] were used to test and define imaging parameters based on their similarity to data observed by radio telescopes. These data were compared and validated by employing imaging software libraries, such as eht-imaging and SMILI, to ensure their coherence and reliability. This process represented a form of reverse engineering in the astronomical context, akin to industrial or computational reverse engineering, where a system is analyzed to understand its structure and operation without access to original protocols or data. For M87*, synthetic data and simulation models were essential for interpreting the data and refining imaging techniques.

Indeed, navigating through petabytes of data originating from an inherently invisible astronomical object is complex and necessitates advanced

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15 For further details on these methodologies and techniques, see Akiyama et al., "First M87 Event Horizon Telescope Results. IV."
Normalised Cross-Correlation (pNx): A method that measures how well-simulated models correspond to observed data, with values close to 1 indicating high correspondence.
Fiducial Scripts: Automated sequences for processing data uniformly, increasing accuracy and reproducibility while reducing human errors.
Data Resampling Test: A statistical technique to confirm the stability and consistency of reconstructed images, repeating analyses to estimate errors.
Quadrature Sum of the measurement uncertainty: A method for unifying different uncertainties, minimising the total error through overall aggregation.
Mean Squared Standardised Residual: A statistical measure that evaluates the fit of models to data, with low values indicating a good fit.

16 Training Sets: collections of data used to train and optimize imaging models or algorithms, consisting of synthetic data based on geometric models or simulations of accretion disks and relativistic jets. Their primary functions include: training algorithms to enhance the reconstruction of images from observed data; testing the similarity between synthetic data and observed data of M87* to define imaging parameters; and validating simulation models to verify the robustness of the imaging techniques used.

computational tools capable of comprehending and analyzing a vast volume of signals, excluding everything that does not conform to theoretical reference models. The EHT's procedures, from detection to output, have considered only those signals and data predicted by the theory of general relativity to define the event horizon of a supermassive black hole. Moreover, the M87* image is not a direct representation of the object but a visualization of what has been rendered through simulation models.[17] The customary connection between the image and the observed phenomenon diminishes, allowing for a new relationship between the image and the underlying theoretical model. These are visualizations of potential matter configurations, probable configurations of potential relationships that are visually malleable and highly adaptable.[18]

In these terms, reverse engineering emerges as the only reliable strategy to approach a form of reliability. Without a fundamental truth or a tangible referent to check the accuracy of the image reconstruction of M87*, the EHT relied on theoretically rigorous and iterative simulation methods to avoid bias and potential distortions. The apparent direct visibility of M87* is, in fact, the product of a modelling process based on computational visualization in which "the object and the medium of presentation are partly identical."[19] Notably, an intrinsically invisible astronomical object gains visibility through visual iterations and explorations facilitated by the considerable computational power of the employed technologies. These tools, characterized by remarkable responsiveness and performance-based feedback cycles, have allowed for a trial-and-error approach, greatly enhancing the manipulability throughout the imaging process.

The parameters for the synthetic Top-Sets (Fig. 9.5) processed by the three pipelines are derived from their respective simulation models through an iterative comparison process between simulated experiments and visual

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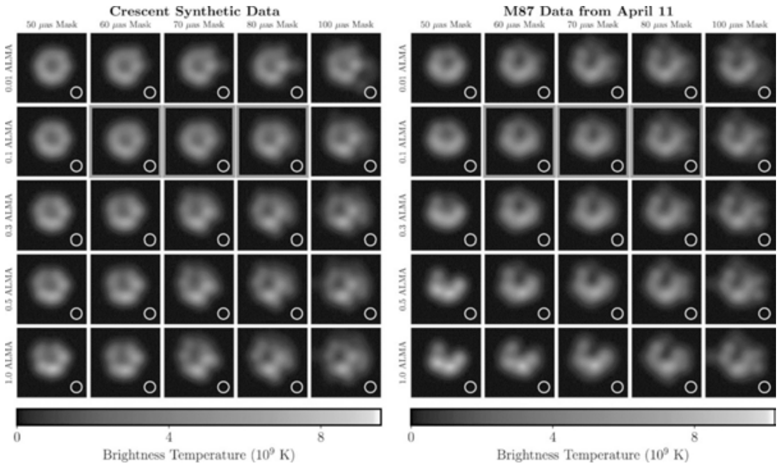
17 See Jean-François Bordron, "Expérience d'objet, expérience d'image," *Visible*, no. 5 (2009), 118.

18 See Maria Giulia Dondero, "La fotografia scientifica tra impronta e matematizzazione," in *La fotografia. Oggetto teorico e pratica sociale – Atti del XXXVIII Congresso dell'Associazione Italiana di Studi Semiotici*, ed. Vincenza Del Marco and Isabella Pezzini (Rome: Nuova Cultura, 2011), 169.

19 Johannes Lenhard, *Calculated Surprises. A Philosophy of Computer Simulation* (Oxford: Oxford University Press, 2019), 50. For further details on this concept, see also Hans-Jörg Rheinberger, "Objekt und Repräsentation," in *Mit dem Auge Denken: Strategien der Sichtbarmachung in Wissenschaftlichen und Virtuellen Welten*, ed. Bettina Heintz and Jörg Huber (Zurich: Edition Voldemeer, 2001), 55–61.

results, wherein visualization plays a pivotal role as a tool for parameter validation. This further illustrates an inverted process through which one accomplishes the adaptation between the theoretical foundation and the observed phenomenon, following a logic that, starting from the resulting simulation image, leads to the definition of an appropriate set of parameters.

9.5. The images delineated in green conform to the criteria for inclusion in the Top Set, thereby highlighting an exceedingly selective subset in comparison to the extensive suite of images generated during the parameter survey employing DIFMAP (CLEAN) on both synthetic and real M87 data. This image utilizes one of the pipelines employed in the complete imaging procedure, specifically pertaining to the EHT baseline coverage on April 11.*



Courtesy of EHT.

Epistemological Issues Concerning Computational Simulations of M87*

The space-time dimension of the images of M87* transcends our perceptual limits. The visualized space of the event horizon adds to reality without replacing it. In this context, machines and visualizations emerge as a new spatial dimension, augmenting and integrating with our experience of the world.

The EHT's experiments do not take place in the phenomenological world but in its computational extension, so much so that machines and visualizations become a different kind of nature.[20] Hence, the empirical verification of the existence of supermassive black holes is not pursued through direct observation in nature but realized through the creation of controlled experimental conditions, within which the theoretical models of these celestial bodies are subjected to validation via computational processing and visualization in the EHT's laboratories. We are thus witnessing the inauguration of a sort of neo-terraforming[21]: an expansion of the phenomenological horizon that transcends and reformulates our perceptual environment where simulation and machine synthesis not only gain prominence but establish themselves as constructive entities of a renewed regime of experience and knowledge.

In this context, simulation becomes a tool for exploring unprecedented scenarios, offering an understanding of the phenomenon beyond mere representation, and surpassing the limits of empirical experiments. This approach, which challenges the traditional division between instrumentalism and realism in science, alters the epistemic landscape wherein simulation is not merely a substitute for experiment but a means that transforms how we comprehend and interact with the world.

Simulation exceeds mere representation of reality and actively contributes to its construction, thereby diminishing the distance between scientific representation and what it represents, between the world and the model. While aiming for near-real fidelity, simulation models gain greater autonomy from their phenomenological referent, creating a world that not only imitates but expands upon the observed one.[22]

Thus, the epistemological issue raised by the images of M87* concerns not only the reduction of the distance between the world and the model – their near overlap – but also highlights the transition from the transparency of mathe-

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20 In this regard, recall the words of Marshall McLuhan, *From Cliché to Archetype* (New York: The Viking Press, 1970), 9. "Since Sputnik and the satellites, the planet is enclosed in a manmade environment that ends 'Nature' and turns the globe into a repertory theatre to be programmed."

21 Benjamin Bratton, *The Terraforming* (Moscow: Strelka Press, 2019); see also Cosimo Accoto, *Il mondo in sintesi. Cinque brevi lezioni di filosofia della simulazione* (Milan: EGEA, 2022), 4; 167–168.

22 See Accoto, *Il mondo in sintesi*, and Lenhard, *Calculated Surprises*.

matical models, characteristic of modern scientific method, to the epistemic opacity of simulation models.[23]

Moreover, the simulation of M87* relies on data that are not traditional empirical measurements but detections, transformations, and combinations of a vast amount of synthetic and real data. For this reason, entrusting machines with the management of calculations becomes a strategic requirement, despite the inscrutability that marks simulation modelling due to its high number of computational steps and the division of tasks into increasingly intricate and complex sub-tasks.

If simulations contribute to extending spatial boundaries,[24] this also occurs timewise in at least two ways. Not only because they compress temporal fossils from deep space onto the screen, but also due to the procedural nature of the imaging process. The concatenation of phases, iterative modularity, and exploration-interactivity of the imaging processes develop over time, leading to a stratification through the combination of images to such an extent that the images of M87* can be defined as the result of an accumulation of traces and calculations, a sort of mosaic/map constructed by summation-correlation of the different detection-imaging phases, where each provisional image constitutes a kind of notational text for subsequent algorithmic operations.[25]

This unstable and recursive process is dotted with a series of images whose role is to halt the computational flow so that each image allows for the control, manipulation, and refinement of data for coherent structuring. Consequently, each image of M87* becomes a sort of temporary stop in what we might define as an "event-image,"[26] understood as the sum of all algorithmic operations of halting and then resuming that occur during the experimental journey.

It is precisely the digital treatment of images through algorithmic processing that liberates these operational freeze frames from their temporal fixity: individual images do not merely "freeze" a specific phase of the imaging process, but rather configure a kind of composite photography whose plural and multidimensional nature is conducive to exploration and manipulation. From

23 See Lenhard, *Calculated Surprises*.

24 See Pier Luigi Capucci, *Realtà del virtuale. Rappresentazioni tecnologiche, comunicazioni, arte* (Bologna: CLUEB, 1993).

25 See Maria Giulia Dondero, "La rappresentazione della stratificazione temporale in astronomia e archeologia," *E|C – Rivista dell'Associazione Italiana di Studi Semiotici* (October 2008), 1–19.

26 Bordron, "Expérience d'objet, expérience d'image," 120–121.

the succession of computational experiments to the establishment of a visualization as the final result of shaping the experiments, we deal with a composite photographic image that records and fixes the various phases of computation, serving an indexical function while simultaneously crystallizing the processing phases and potential configurations through a process of computational formalization.

Ontological Questions about the Computational Simulations of M87*

These composite photographs of M87*, where traces of detections and calculations of the possible coexist in a balance between temporarily stable freeze frames and potential relationships heralding developments,[27] partly transcend the indexical nature inherent in retinal images to open to the manipulable visualization of the computational process. We witness the shift from the ontological primacy of photography as a trace to the procedural nature of manipulable images characteristic of virtual photography. Indeed, the images of M87* result from a process whose visualizations shape potential relationships between the regime of perceptibility and that of virtuality, understood as the iconisation of computational thought lines and their interactions-intersections. Here, photographs are no longer to be understood as a stable and unique point in an indexical relationship between representation and referent; instead, they constitute organizing ideas of a vast number of operations along an intricate procedural line. The photographs form a flow conceived as a set of experimental events, the purpose of which lies in negotiating and stabilizing deduced and reliable visual forms of a purely theoretical object.[28]

In this sense, the image itself becomes an experimental device, a virtual environment in which to practice science with objects resulting from transductions and transcoding, phenomenal data, and physical-mathematical theories: that is, diagrammatic simulations in which there is no plausible representation of M87*, but a symbolic reduction of a complex phenomenon through the iconisation of operational physical models responsible for multiple actualizations of data into images.[29]

27 Maria Giulia Dondero, "Sémiotique de l'image scientifique," *Signata Annales des sémiotiques / Annals of Semiotics*, no. 1 (2010), §103.

28 Ibid., §24.

29 Ibid., §24; §40.

These images are neither indexes nor icons but rather diagrams or icons of relationships[30] insofar as they combine the visual with computational reasoning procedures, traces of detections with their subsequent mathematization-modelling, through a process of selecting data relationships, extracting rules, and transposing results,[31] which makes M87* a combinatorial and virtual image of a theoretical object.

We witness a reversal of the referential value, no longer anchored to iconic recognition but emerging from a chain of mathematical-scientific inferences. This referential impression is no longer an immediate datum but instead supported by referential beliefs mediated by measurability, the computational nature of the images, and the objects represented. This fact shifts the focus from the image's adherence to an inaccessible phenomenological reality to the authenticity of the physical-mathematical theories from which the image takes shape. Thus, the images of M87* configure themselves as cartographies of energy flows and electromagnetic radiations.

The photographs of M87* do not represent a phenomenon in itself but offer a reductive window on the phenomenon to enhance its intelligibility and accessibility. They are virtual entities that actualize themselves in multiple versions, translations, and exemplars[32]: they are the translation and visualization of their logical-mathematical model. In this case, the image of the black hole is not simply the reproduction of a pre-existing visible, but rather the representation of what exists in potential[33] and is actualized each time in a cascading/chain manner through computerized exploration-visualization. Moreover, as Lévy[34] reminds us, everything that is an event, like the images of M87* whose nature is based on the dialectic of the process, is characterized by a specific dynamic of actualization and virtualization.

The images of M87*, reflecting an inaccessible space, primarily manifest as the repositioning of an ordering *logos*, taking shape not from phenomenological reality but rather emerging from the intersection of ideology, theory, and simulation from which the virtual image materializes.

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30 Charles Sanders Peirce, "Collected Papers 4.418," in *Collected Papers of Charles Sanders Peirce Volumes 1–5*, eds. Charles Hartshorne and Paul Weiss (Cambridge, MA: Harvard University Press, 1931–1935).

31 See Dondero, "La fotografia scientifica tra impronta e matematizzazione," 164.

32 See Pierre Lévy, *Becoming Virtual: Reality in the Digital Age*, trans. Robert Bononno (New York: Plenum Trade, 1998).

33 Ibid.

34 Ibid., 74–75.

Simulation and machine synthesis transform the body from an instance that puts into images the sensory experience into an interlocutor-recipient of a synthetic-algorithmic model. Moving from an approach traditionally rooted in *physis*, in physicality and direct sensory experience, we shift towards *logos*,[35] that is, towards a domain characterized by theorization and computation where images are never stable, never complete but subject to multiple manipulations and combinations for formulating new hypotheses and discoveries.

Conclusion

In exploring the transformative impact of virtual photography on scientific exploration, particularly evident in observations like M87*, a kind of virtual realism emerges, where a phenomenon is filtered and reinterpreted through a prism of computational and theoretical models. By integrating computational power with theoretical frameworks, virtual photography not only expands visual representation of astronomical phenomena but also shifts epistemological and ontological perspectives. This method prompts re-evaluation of empirical evidence's nature and simulation's role in knowledge production.

Facilitating direct interaction with theoretical models and enabling visualization of phenomena beyond traditional imaging's reach, virtual photography becomes a tool in redefining scientific exploration. It encourages questioning of former methodologies' limitations and welcomes a future where technology and theory integration unveils new understanding horizons. M87*'s case exemplifies virtual photography's capacity to conceptualize the universe in previously unimaginable ways. It emphasizes the evolving relationship between observer and observed, redefining visualization's essence in scientific pursuit.

M87*'s imaging procedures constitute a "flat laboratory,"[36] where images extend the referent[37] to the point of questioning whether virtual synthetic images impose certain ideologies so that the body, or its substitute, adapts to the

35 See Jean Claude Coquet, *Physis et logos. Une phénoménologie du langage* (Paris: Presses Universitaires de Vincennes, 2007).

36 Bruno Latour, "The Netz-Works of Greek Deductions – A Review of Reviel Netz's The Shaping of Deductions in Greek Mathematics," *Social Studies of Science*, vol. 38, no. 3 (2008), 442.

37 Bruno Latour, *Pandora's Hope: An Essay on the Reality of Science Studies* (Cambridge, MA: Harvard University Press, 1999).

virtual context, to the demands of the brain-machine, necessitating a critical assessment of how these technologies influence our understanding and the ideologies they may perpetuate. Indeed, if the virtual synthetic image emerges from ideology, theory, and simulation, might it mean that it, rather than representing an inaccessible space, is the repositioning of an ordering *logos*?

10. Volcanic Deductions

Photography as a Purveyor of Visual Analogy, Geological Hypotheses, and Knowledge

Kris Belden-Adams

For his 1874 book *The Moon: Considered as a Planet, a World, and a Satellite*, which was among the first photomechanically illustrated texts, amateur astronomer James Nasmyth incessantly sketched views of volcanic craters as he peered through a telescope. After making dozens of drawings, he created plaster three-dimensional models based on imagined composites of these drawings. Nasmyth then photographed the plaster models to use as illustrations for his reports and articles, and took the models to scientific society presentations as illustrations of his theories. He went to such great lengths to grapple with and gain an multidimensional understanding of the structures and behaviors of volcanos, and to aid other astronomers in doing so, too.[1] Nasmyth's manner of thinking fit into broader Victorian-era scientific dialogues that privileged both the facticity gleaned from material *and* from virtual visual analogies. Perhaps

1 By 1874, the Moon had been photographed with and without the aid of telescope-mounted cameras. For more on the history of photographing the Moon and this endeavor's particular fervor in the mid-nineteenth century, please see: Kris Belden-Adams, "John Whipple, William Bond, and George Bond, *The Moon, No. 37*," *Smarthistory* (June 30, 2022) (accessed November 28, 2023): https://smarthistory.org/john-whipple-william-bond-and-george-bond-the-moon-no-37/; Mia Fineman and Beth Saunders, *Apollo's Muse: The Moon in the Age of Photography* (New York: Metropolitan Museum of Art, 2019). These images, offering full-frame views of the Moon, would have been of limited assistance to Nasmyth for studying enhanced, highly detailed views of craters. This drove Nasmyth, the son of established portrait painter Alexander Nasmyth and early student at the Edinburgh School of the Arts, to make his own using a combination of drawing, sculpture, and photography.

for this reason, Nasmyth's approach has been historicized as an approach to image-making that is locked in a distant analog past.[2]

However, Nasmyth's Moon images point to intellectual continuities between analog photography and analogical thinking across the analog/digital divide, and they call for a more fluid reconceptualization of these terms. The synthesis and translation of visual representations of geological forms – while moving from three dimensions, to two, and back – provide an analogy for the function of recent digital-photographic practices for volcano monitoring, the Japanese Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) sensor for collecting photographic data from aboard NASA's Terra satellite.

This chapter places Nasmyth's analog data visualizations in dialogue with digital ASTER images to explore photography's role in data visualizations. Nasmyth's analog practice provides a proto-history for the ASTER data visualization processes and photographic data modeling. These photographic practices also extend the notion of "realities" to accommodate malleable and variegated realisms that presents "the hypothetical," and "the virtual" as it has been defined by Philippe Quéau, as "neither the opposite of the real (the unreal) nor the opposite of the actual (the potential)," but as a hybrid of both.[3] Using Quéau's framing of the "virtual" as an analogy to speak of photographic data visualization enabled an opportunity for further examining moments of continuity and rupture between analog and digital photographic practices.

Introducing the ASTER Images

In January of 2014, the Japanese volcano Asosan – which has erupted a total of 172 times in our geological epoch – began to again show signs of instability.[4] More than two years of steady ash-blowing and explosion activity began with a small grayish-white plume that dusted the area just south of Nakadake Crater

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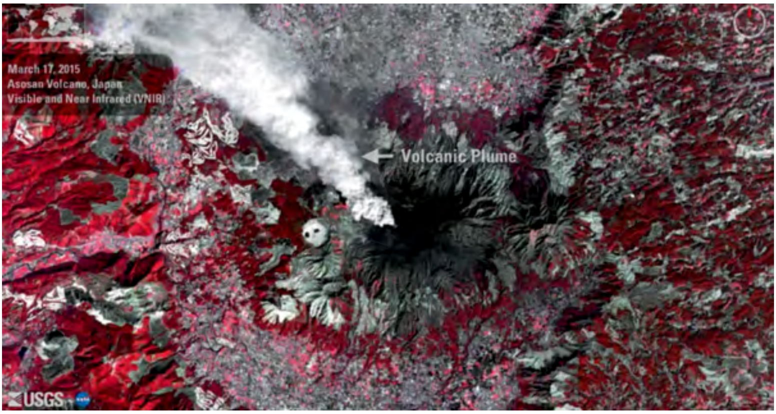
2 Jussi Parikka, *Operational Images: From the Visual to the Invisual* (Minneapolis, MN: University of Minnesota Press, 2023); Michelle Henning, *Photography: The Unfettered Image* (London: Routledge, 2018), 18.

3 Philippe Quéau, "Virtual Multiplicities," *Diogenes*, no. 183, vol. 46, no. 3 (1998), 107.

4 "Asosan: Eruptive History," Smithsonian Institution – National Museum of Natural History: Global Volcanism Program. c. 2016 (accessed September 11, 2023): https://tinyurl.com/3hh3nu2p

with ash. More plumes followed until four very small and "gentle" explosions showered the area from late January until February 19. Asosan would continue erupting, throwing ash, and setting off tremors until April 30, 2016, and would reach level two on the Volcanic Explosivity Index or V.E.I. (with eight being the most severe category – the likes of which have not occurred for more than 27,000 years). While Asosan's eruptions were not even close to measuring in among the most devastating volcanic explosions in history, Asosan's – along with other twenty-first-century eruptions – was substantially and steadily photographed by ASTER's 14-band, visible-light and infrared sensors on the multinational-research Terra satellite (Fig. 10.1). ASTER's imagery is available online, resides in the public domain, and is available for free for amateur and professional vulcanologists and the general public worldwide to use and study. They provide vulcanologists with data for predicting not only Asosan's future explosions for the sake of evacuating the area's inhabitants, but also contribute to the field of knowledge for monitoring the behaviors of other volcanos for hints of imminent activity.

10.1 March 17, 2015, Asosan Volcano, Japan. Visible and Near-Infrared Composite Photograph. U.S. Geological Survey/Japan for the Ministry of Economy, Trade and Industry (METI)/National Aeronautics and Space Administration (NASA).



Public Domain.

Despite this image's contribution to scientific knowledge, it also conveys a view of a volcano that exceeds the purview of human vision by showing us things we cannot see: gradations of heat rendered visually, smoke-free landforms that to the unaided eye would have been covered by a dense fog caused by scorched Earth, and of course, an aerial view of a volcano without the corresponding danger of flying above it. Thus, the ASTER Asosan image is a virtual view, but one that is also an *actual* index of data gleaned from collected infrared light caused by differences in heat intensity.[5] Moreover, the palette of ASTER images differs from that of our known reality. In the overhead-view ASTER image *March 17, 2015, Asosan Volcano, Japan*, a plume rises from a landscape littered with ash and lava. Snow, clouds, and smoke are white – as they would appear to the unaided eye – and volcanic plumes arc to the left and appear in monochromatic gray. Vegetation is a dramatic shade of pinkish-red, whereas lava also is gray, with its newest flows appearing as black marks at the center of the crater. In this visible-light-meets-near-infrared image, the usual expectation – that volcanos will spew firey red-orange lava – is reversed, and red denotes "cool" areas of vegetation that embodied less heat.[6] According to the U.S. Geological Survey, an image with this color palette (characteristics of visual light combined with rays from the infrared-spectrum in a digitally combined composite image) particularly enables the analysis of the contents

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5 This essay adopts the term "index" from Charles Sanders Peirce, who wrote that photographs may function as "indexes" when they have a causal or physical relationship with their subject matter. In the case of the Asosan image, differential heat (physically, causally) emanated as infrared light was collected by satellites (physically, causally) and converted to digital code to make a photograph. Charles Sanders Peirce, "Logic as Semiotic: The Theory of Signs," in *Semiotics: An Introductory Anthology*, ed. Robert E. Innis (Bloomington: Indiana University Press, 1985), 1–23.

6 Infrared light is the closest spectrum to the visible spectrum. Near-infrared light is not visible to the unaided eye. Night-vision cameras are an example of a technology that registers the near-infrared spectrum and makes it visible to us. A mid-far-infrared – or thermal – camera registers the relative temperature of a subject. And far-infrared light is detected as infrared heat. This end of the infrared spectrum is the closest to microwaves. Incidentally, astronomer William Herschel was an early reporter on the existence of the infrared spectrum: William Herschel, "XIV: Experiments on the Refrangibility of the Invisible Rays of the Sun," Reference number: L&P/11/125, *The Royal Society*, Read April 24, 1800. (accessed September 20, 2023): https://makingscience.royalsociety.org/items/l-and-p_11_125/paper-experiments-on-the-refrangibility-of-the-invisible-rays-of-the-sun-by-william-herschel?page=1 His son, John Herschel, would invent the cyanotype.

of volcanic plumes, in which sulfur-dioxide gas would appear cooler in tone. The colors of an ASTER can be adjusted and fine-tuned, according to the image-maker's preferences and the usual expectations of a combination of visible and near-infrared satellite photographs, or composite-source-images called "lithophanes."[7] The image thus reveals, in Roland Barthes's terms, that a photograph's power to certify a subject's *presence* may exceed its power to represent that subject's *appearance* accurately.[8] The differential heat emanating from the Asosan volcano is present in tangible visible form in the ASTER image, allowing the resulting composite image to be truthful to the *presence* of heat (which would not be present without the volcano itself), without describing the palette of the volcano's real-life *appearance*.[9] This tension between a photographic subject's *presence* and *appearance* is particularly complicated by the composite image's constituent infrared lithophane satellite photographs, which detect and record the presence of something invisible to the unaided human eye: heat. Its differential appearance in and around the active volcano is inscribed as an image, a data visualization that expands upon the knowledge gained from the visible-light spectrum alone as it tests our presumptions that photographs only capture our familiar wavelength of visible light.

For viewers accustomed to this color scheme – a characteristic of infrared photographs that is also adaptable by ASTER technicians – the image reveals contours of the crater, wind direction, the appearances of the smoke plume and snow (minus a significant blanket of haze), and it conveys the active spread of

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7 The term "lithophanes" (from the Greek words *lithos*, or "stone," and *phainen*, or "cause to appear") emerged in 1820 to describe thin, translucent relief images moulded from a material such as porcelain. Different thicknesses appeared darker when back-lit, presenting an image. Lithophanes commonly appeared most often in domestic spaces that naturally involving backlighting, such as on lampshades or in windows, and they enjoyed peak popularity from 1840 to 1870. While lithophanes waned in popularity by the late-nineteenth century, they have enjoyed a revival in early-twenty-first century digital three-dimensional printing (an additive process), and in CNC router (subtractive process), and they are recognized as the building blocks for fully free-standing, fully-three-dimensional sculptural images that entirely break free from the flat surface and lose the background space altogether.

8 Roland Barthes, *Camera Lucida: Reflections on Photography*, trans. Richard Howard (New York: Farrar, Straus and Giroux, Inc., 1981), 5–6, 87.

9 The causal relationship between the heat and the volcano is therefore akin to Charles Sanders Peirce's analogy of the relationship between the foot and footprint in his definition of the "index": Peirce, "Logic as Semiotic," 1–23.

lava from the crater's center. Belief in these composite photographs necessitates a suspension of the expectations with which we approach visible-light images, a mindset framed by an understanding of the photographs' rooting in infrared light. It is also contextualized as an "operational image," a category of the medium proposed by Jussi Parikka to describe images that are "not necessarily representational or pictorial," and which emerged for military use around 1990 for observation during the first Gulf War.[10] In one sense, the virtual ASTER image is non-representational, as a representation that departs from the color palette and reveals surface details not visible through dust and smoke in known reality. As such, ASTER photographs create and convey a different kind of knowledge, one that is hypothetical, analogical, and allows humans to peer beyond the smoke and ash to see a "virtual" – representational, yet also real, "actual," and concrete. They present images that are used to speculate and anticipate volcanic events in the future, using the tangible visual language of the photograph as a medium for expressing scientific hypotheses.

As ASTER images such as *Asosan Volcano* digitally generate a legible digital tapestry for vulcanologists, they embody the very definition of "data visualization": the visual presentation of information to make it accessible and understandable, and to tease out patterns in datasets for new discoveries. As a result, these photographic practices extend the notion of photographic "realities" and "the virtual" that accommodate a malleable and variegated range of "the real" that allows for complexity and a greater mobilization of epistemologies.

Virtual Photography: A Little Proto-History of Data Visualization

But they also provide an opportunity for further examining moments of continuity and rupture between analog and digital photographic data visualizations that long predate 1990. After James Nasmyth (1808–1890) retired at age 48 from a successful and lucrative career as an engineer and inventor of the steam hammer, he pursued the hobby of his passion, astronomy. Nasmyth developed his own 20-inch telescope, through which he incessantly viewed and sketched the Moon – a which would not be visited firsthand by humankind for another 95 years. After making dozens of drawings, he then made plaster models – each nineteen-and-a-half-inches wide – based on an imagined compos-

10 N. Katherine Hayles, *Unthought: The Power of the Cognitive Nonconscious* (Chicago: University of Chicago Press, 2017), 24; Parikka, *Operational Images*, vii, 18, 91.

ite of his drawings. Nasmyth's transferal of observed visual surface data from the two-dimensional drawing to the three-dimensional model enabled him to view his own sculptural data visualization, experience the tactility and mass of its components and making, and discover new insights about the volcanic operations and formation of the Moon.[11]

Nasmyth also used these three-dimensional models as the persuasive centerpieces for lectures and demonstrations, and he took them to meetings with other fellow polymaths, amateur "gentleman" astronomers. Before long, Nasmyth's telescopes and astronomical observations – including the ones illustrated by the plaster models, were so well-regarded by amateurs and professional scientists that he was welcomed into the inner circle of the United-Kingdom scientific intelligentsia, which including esteemed astronomers such as Sir John Herschel and son William Herschel.[12] Later, Nasmyth photographed his Moon models (Fig. 10.2) for publication in the 1874 book *The Moon: Considered as a Planet, a World, and a Satellite*, which was among the first photomechanically illustrated books. What began as two-dimensional sketches became three-dimensional models, which then returned to two dimensions as the subjects of photographs for dissemination in print publications, which enabled this knowledge to spread to even larger audiences. Historians have casted Nasmyth's images of the plaster models as examples of scientific photography's embrace of the medium's ties to veristic "truth," but which presented a handmade Moon view that looked so realistic it could have been the actual thing.[13] By reciting the binary truth-versus-fiction debates about Nasmyth's use of the

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11 His explanations of volcanic activity and crater formation still are considered valid theories today. For more on his astronomical discoveries, see: Frances Robertson, "Science and Fiction: James Nasmyth's Photographic Images of the Moon," *Victorian Studies*, vol. 48, no. 4 (Summer 2006), 595–623.

12 Louise Devoy, "Lunar Crater Models Tools of Persuasion, Popularization and Shared Knowledge," *Nuncius*, vol. 35, no. 2 (2020), 300–332.

13 Stephanie O'Rourke, "The Hand-Made Moon," in *Thinking 3D: Books, Images, and Ideas from Leonardo to the Present*, eds. Daryl Green and Laura Moretti (Oxford: Bodleian Library, 2019); Omar Nasim, "James Nasmyth on the Moon: Or, On Becoming a Lunar Being, Without the Lunacy," in *Selene's Two Faces: From 17th Century Drawings to Spacecraft Imaging*, ed. Carmen Pérez González (Leiden/Boston, MA: Brill, 2018), 147–187; Boris Jardine, "Made Real: Artifice and Accuracy in Nineteenth-Century Scientific Illustration," *Science Museum Group Journal*, no. 2 (Autumn 2014). http://dx.doi.org/10.15180/140208

medium, our histories risk overlooking an opportunity to define and historicize data visualization, and to consider the merits of a more nuanced conceptualization of photography's involvement in analogical thinking.

10.2 James Nasmyth, Normal Lunar Crater, Plate 17, Source: Nasmyth and Carpenter, The Moon: Considered as a Planet, a World, and a Satellite, 1874.

Public Domain.

Trained by his artist father to sketch everything around him – alongside his likewise artistically talented siblings – Nasmyth approached science from a perspective that was not purely positivist or concrete, but expressive, imaginary, and visual. His approach thus embraced what this book explores: "the virtual." Philippe Quéau proposes that "the virtual" is "neither the opposite of the real (the unreal) nor the opposite of the actual (the potential)," but as a hybrid of both.[14] Nasmyth's nimble movement from 2D, to 3D, and back again (via photography) to access new understandings of volcanism, offers a conceptual precursor to the current processes of scientific information visualization using 3D printing to make models from photographs to access new perspectives and scientific insights. In addition, Nasmyth also drew analogies between the

14 Quéau, "Virtual Multiplicities," 107.

geological processes on the Earth and those of the Moon, and between random everyday phenomena – such as wrinkles on his outstretched hand or the wrinkling of a spoiling apple to the formation of mountains – using photographs (Fig. 10.3). Nasmyth's plaster models were based on copious sketches and presuppositions of the crater's appearance based on views from other angles and his drawings of Moon craters through telescopes. He looked to the Moon to understand the Earth – and vice-versa. This analogical strategy helped make the remote Moon more accessible, familiar, concrete, and grounded in the accessible logic of everyday-life phenomena.

10.3 James Nasmyth, Back of Hand and Wrinkled Apple to Illustrate the Origin of Certain Mountain Ranges Resulting from the Shrinking of the Interior, Plate 11, Woodburytype. Second edition. Source: Nasmyth and Carpenter, The Moon: Considered as a Planet, a World, and a Satellite, 1874.

Public Domain.

Nasmyth's process of analyzing the Moon makes him an important forefather to today's practices of information visualization. He trafficked in the "virtual" and "hypothetical" by introducing the appearance of the craters, synthesized, analyzed, and processed not by artificial intelligence and algorithms, but by his mind. As Nasmyth wrote, "Where the material eye is baffled, the clairvoyance of reason and analogy comes to its aid. The mind's eye fills in the sensual gaps and constructs its moonscape, filling it up with processes over time, and things in space."[15] His models and stereo photographs also convey a way of making unprecedented, speculative, inaccessible, impossible, and virtual views *possible,* yet also *believable,* and portable as photographs. Nasmyth contributed an understanding of these geological features in a tactile way that formed new multi-dimensional knowledge.

Theoretical Implications of "Virtual" Photography: An Expanded Epistemology

Media theorist Joanna Zylinska suggests that the digital and post-digital ages are synonymous with the increasingly common use of applications to create photographic images that "can be mobilized to help us imagine, visualize and frame the future."[16] Furthermore, Zylinska sees in today's Anthropocene moment a unique wrangling with "truth" and "post-truth," a struggle that has been encouraged, echoed, problematized, and kindled by digital media.[17] Part-optimism over reinventing and revisualizing the future, and part-pessimism over our fatal destiny to remain mired in an existential and polarized battle over truth and fiction, Zylinska's conceptualization of the Anthropocene sees human consciousness itself as the subject to digital media's molding.[18]

However, other media theorists – pointing to our embrace of virtual reality and hyper-realistic video games – have suggested that not only have humans possessed the temporal capacity to understand a range of various realisms, but humans are not so undiscerning that we associate "the digital" with "the virtual." Philosopher Brian Massumi has suggested that "the virtual" is an antonym for "the real," and thus is part of the binary relationship Zylinska characterized.[19] As an alternative that speaks more directly to the operation of images such as Nasmyth's and ASTER's, this chapter's leaning on Quéau's concep-

15 James Nasmyth and James Carpenter, *The Moon Considered as a Planet, a World, and a Satellite* (London: J. Murray, 1874), 158.

16 Joanna Zylinska, "Does Photography Have a Future? (Does Anything Else?)," *The Future of Media* (London: Goldsmiths Press, 2022), 319–320.

17 Ibid., 4.

18 Ibid., 326.

19 Brian Massumi, *Parables for the Virtual: Movement, Affect, Sensation* (Durham: Duke University Press, 2002), 137. Other suggestions from digital-culture discourses for defining "the virtual" have included "the imagined" and "the fictional." Nathan Wildman and Richard Woodward, "Interactivity, Fictionality, and Incompleteness," in *The Aes-*

tion of "the virtual" accommodates a sliding scale of realism*s* that resist categorization as wholly fact or fiction, but which instead has the capacity to convey different truth*s* for the sake of ideation and knowledge-production.

Conclusion

In the composite volcano imagery by Nasmyth and ASTER, "the virtual" is implied to be an experimental space where data are collected as lithophanes (from drawings or from photographic satellite feeds), synthesized by either Nasmyth or human-generated algorithmic directives (in processes the viewer is not privy to experiencing), and converted into plaster models and photographs for further discussion and analysis. This is to say, the goal of these images – whether analog and digital – is innately synthesized, innately both "real" and "actual." They aid in accessing new understandings of how volcanos are structured, how they function, and predicting and hypothesizing what volcanos are likely to do in the future. All of this knowledge – though expressed in photographic composite form (as a model photograph of photograph in itself) – is deeply rooted in scientific materialism, existing objects and conditions, and concrete realities.[20] Thus, Nasmyth's analog photographs and ASTER's digital volcanic images collectively call for a redefinition of a photographic realism and "the virtual," inspired by Quéau, that enables nuance, multidimensional synthesis, and embraces analogical thought, as it highlights continuities across analog and digital image-making practices.

thetics of Videogames, eds. Job Robson and Grant Tavinor (New York: Routledge, 2018), 7; Grant Tavinor, *The Aesthetics of Virtual Reality* (New York: Routledge, 2002), 9.

20 ASTER algorithms are recalibrated to make images as accurate as possible. National Aeronautics and Space Administration, "Aster: Advanced Spacebourne Thermal Emission and Reflection Radiometer," N.A.S.A.: Terra – The E.O.S. Flagship," (accessed September 7, 2023): https://terra.nasa.gov/about/terra-instruments/aster
Nasmyth also went to great pains to make his drawings and composite models as accurate as possible: James Nasmyth, *James Nasmyth, Engineer: An Autobiography* (London: J. Murray, 1883), 329.

11. Virtual Photography as a Visual Method of Communicating Scientific Hypotheses about Architecture

Dominik Lengyel and Catherine Toulouse

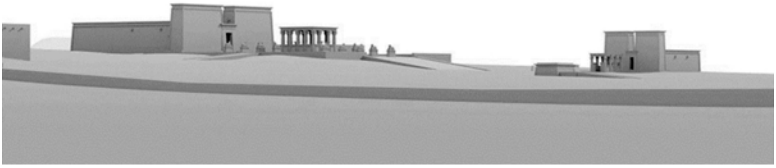
In the context of the visual mediation method of scientific hypotheses about architecture, the term *virtual photography* is intended to emphasize the importance of the projection of virtual models. The reason for this is that the virtual model usually represents the final product in the visual mediation of ancient architecture. This model is often referred to as a reconstruction and its projection as a rendering, which means that the technological aspect is central to the concept. The authors counter this position with the importance of photography as the decisive factor in visual mediation. In the visualization of the imperial palaces on the Palatine in Rome, the actuality of the architectural design of the interplay of the courtyards and their connections via gallery corridors becomes particularly clear and effective from a pedestrian perspective (Fig. 11.1). This corresponds to the claim in archaeology to establish visual representations as a counterpart to verbal hypotheses. The aim is therefore to create representations that also reflect the uncertainty of knowledge and not, as is usual in the entertainment industry, predominantly fantasies. In the visualization of the Meroitic Royal City of Naga in present-day Sudan, whose architecture, like that of classical antiquity, was polychrome, the temples and residential buildings are only shown in their spatial arrangement in order to avoid any speculation regarding their specific color scheme (Fig. 11.2). The substance of hypotheses of uncertain knowledge is not the actual appearance, which in most cases is lost forever, but rather the intention behind the architecture, i.e. the building intention that led or more precisely could have led to the realization of architecture. In the visualization of the construction phases of Bern Minster, one specific pillar, which has since been built over, had to be portrayed in order to convey the spatial impression that would originally have been achieved (Fig. 11.3).

A visualization that takes these circumstances into account can therefore only attempt to reproduce the actual characteristics of the architectural idea and at the same time the hypothetical content of its uncertain components. This is where the potential of such a visualization lies. It is achieved by combining the two traditional architectural representation methods of the design model and the architectural photography. In the visualization of the choir of Cologne Cathedral around the year 1856, immediately before the laying down of the partition wall to the later crossing from the year 1320, contemporary watercolors served as a basis, but through graphic liberty they were able to counteract the extreme distortion of the photographic projection of the vaults (Fig. 11.4). Modelling and photography help to translate the archaeological hypothesis into a visualization that assigns different geometric abstractions to the different levels of uncertainty in the knowledge – and thus reveal the uncertainty in an intuitively recognizable way. At the same time, it employs methods of traditional architectural photography in order to create a spatial impression that is as realistic as possible despite the abstraction. In the visualization of the construction phases of Cologne Cathedral, around the year 1320 CE the Gothic choir, half of Hildebold Cathedral from the 10th century, of which a dedication picture from the 11th century survived, and Santa Maria ad Gradus, of which only the foundations can be verified, co-existed simultaneously (Fig. 11.5).

With abstract geometry in particular, however, this means meticulous composition. Both steps are genuine disciplines of design. However, while the importance of the spatial model is undisputed, the significance of its projection is generally underestimated. This is the reason why the projection of the virtual model is called *virtual photography*. The term is therefore intended to emphasize that the projection is an indispensable part of the concept of the *visualization of uncertainty*. The illustrations in this chapter are taken from some of our projects, which were developed in close co-operation with archaeologists and art historians.

11.1 Palatine Hill in Rome around 300 CE. Commissioned by the German Archaeological Institute, Berlin. Displayed, among others, in the exhibition "Jenseits des Horizonts" of the Excellence Cluster TOPOI at the Pergamon Museum Berlin, 2012, and in "Antike Architektur im Blick – 40 Jahre Bauforschung am Architekturreferat des Deutschen Archäologischen Instituts, Berlin" at the Science Center Bonn, 2014.

11.2 Royal City of Naga in Sudan around 350 CE. Commissioned by the Association for the Promotion of the Egyptian Museum, Berlin. Displayed at the State Museum of Egyptian Art Munich, 2011, and at the Art Forum of the Berliner Volksbank, 2011–2012.



11.3 Hypothetical representation of a wall pillar before the addition of a reinforcing tie beam in Bern Cathedral. In Bernd Nicolai and Jürg Schweizer, eds., "Das Berner Münster – Das erste Jahrhundert: Von der Grundsteinlegung bis zur Chorvollendung und Reformation (1421–1517/1528)." Regensburg: Schnell & Steiner, 2019.

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11.4 Cologne Cathedral choir after a watercolor by Johann Peter Weyer around 1856 CE. Displayed at the exhibition commemorating the 150th anniversary of the Cologne Cathedral choir at the Conference Center of the Archdiocese of Cologne, 2013–2014.

© Lengyel Toulouse Architects, Berlin.

11.5 Cologne Cathedral with Hildebold Cathedral around 1025 CE. Commissioned by the Cathedral building administration under the Cathedral master builder Prof. Barbara Schock-Werner. Displayed in the 2010 state exhibition of North Rhine-Westphalia at the Roman-Germanic Museum of the City of Cologne, 2010, since 2010 as a permanent installation in the entrance area to the archaeological zone of Cologne Cathedral.

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Visualization of Uncertainty

The *visualization of uncertainty* is a method for the visual representation of spatial hypotheses that takes into account scientificity, hypothetical character, clarity and reflection in equal measure. This means not so much a juxtaposition as a weighing and balancing of sometimes conflicting, mutually constraining requirements. Such a visualization creates an immediate spatial image for the viewer that corresponds as closely as possible to the scientific hypothesis and at the same time reveals its hypothetical character. It thus pursues the goal of acquiring and communicating knowledge by reflecting on this knowledge throughout the entire process of perception. However, while the hypothetical character is due to the scientific nature of what is presented, its vividness depends on the architectural design. This emphasizes the two complementary competencies of the two interlinking disciplines: science is responsible for the hypothesis, design is responsible for communicating it. Some thoughts on this:

Architecture and archaeology appear to be very different disciplines: architecture creates space, archaeology researches the past. Nevertheless, architecture and archaeology both work with the fragmentary. While archaeology attempts to derive past knowledge for scientific insight, architecture approaches concretion about the future from the sketch of an idea in the design process. Dealing with the uncertain is therefore motivated differently, but is comparable in essence, insofar as it also involves methods of development and communication. The commonality can be used in the visualization of the uncertain for archaeology, as architecture has developed a differentiated set of representation methods in the course of its disciplinary development, which are able to develop and convey not only the architectural intention, but also explicitly what is not yet defined in it.

Uncertain knowledge is an essential part of science, and this raises the question of an appropriate visual representation of this knowledge. The most urging question, however, is what should be visually represented at all. In most cases, the knowledge base is not sufficient for a photorealistic reproduction of lost architecture in a scientific manner. An overwhelming proportion of attempts to realistically depict lost architecture, i.e. to simulate its original appearance, consist of pure fantasy, as demonstrated by the entertainment industry. The risk that these imaginative visions are assumed to be authentic, as suggested by the term reconstruction, is not only scientifically problematic. They give us no reason to doubt what we have seen or even to infer its hypothetical origin.

If, on the other hand, the focus is on scientificity, i.e. the hypothetical content of the architecture, then it would be appropriate to make the fact itself, that it is a hypothesis, the subject of the visualization. This also creates an image of architecture, but not the simulation of a fictitious reality. What emerges instead is the image of an architectural thought, an architectural idea. The visualization then explicitly – and at the same time intuitively recognizably – shows the vagueness of knowledge and thus the scientific nature of archaeology by explaining and at the same time questioning what is shown. Still, to empathize with a picture, it needs to look like an excerpt from a consistent world. This is achieved by limiting the field of vision, as photographer, sculptor, painter, graphic artist and film maker Werner Graeff expresses it, "particularly noteworthy that every viewer involuntarily endeavors to imagine the further course of cut forms beyond the edge of the picture. One is tempted to fill in what is missing."[1] However, coherence is not only dependent on the image section, but also a question of materiality and color. A black and white photo, for example, makes no statement about the colorfulness of the subject.

Photography as a Composition

The view upon the information described above, the composition of the image – and thus above all subtle information – is just as decisive for its communication and interpretation. The same geometric content can be viewed in an infinite number of ways. But as the aim of the mediation is to introduce the viewer to the scientific hypothesis, although it is a hypothesis, this is best understood when it appears both natural and intuitive. For architectural hypotheses, this means that they appear as if they were built architecture. For this, the geometric detail, materiality and polychromy are abstracted, but not the spatial impact. So while the abstractions challenge the viewer to engage intensively, reflexively and sometimes controversially, the projection, i.e. the virtual photograph, can recapture the viewer, reassure him at least with regard to the space. This succeeds if the projection corresponds as closely as possible to the natural perception of space. This is precisely what the concept of *virtual photography* is intended to express, i.e. projecting abstract geometry as if it were built architecture. However, this is not limited to technical aspects, but also the design of the composition.

This is how the photographer Julius Shulman answered Joseph Rosa's questions about which aperture to set for a particular shot, "That's not important. You can learn that anywhere. Learning to see is the important thing."[2] In this short answer, with which "he brushed the question aside," has already said the essentials, namely that his architectural photography is not about a fixed canon, but about the photographer's inner attitude towards photography as an image, the composition of the image, the "constructed view."[3] The concept of constructing, i.e. the direct translation of perceptual seeing, describes the

1 Raoul Hausmann and Werner Gräff. "Wie sieht der Fotograf? Gespräche [1933]," in *Texte zur Theorie der Fotografie*, ed. Bernd Stiegler (Stuttgart: Reclam, 2010), 190.

2 Esther McCoy, "Persistence of Vision," in *A Constructed View: The Architectural Photography of Julius Shulman*, ed. Joseph Rosa (New York: Rizzoli, 1994), 10.

3 Joseph Rosa, "A Constructed View," in *A Constructed View. The Architectural Photography of Julius Shulman*, ed. Joseph Rosa (New York: Rizzoli, 1994), 35–110.

special attention of the architectural photographer, and it is significant how Shulman adopts this term, coined by Rosa, for himself: "The title he chose opened up a whole new perspective on my life's work."[4]

Despite this supposed programmatic opening of architectural photography, there are some constants in the constructed images that take visual perception into account and are responsible for the fact that the image statement corresponds to the architecture. The extent to which this claim corresponds to the image of traditional architectural photography is made clear by Ralph Melcher in the volume accompanying an exhibition on *Architecture in Contemporary Photography*, when he contrasts the deliberate construction of photography with painting by arguing, "that both artistic techniques – at least in the 19th and early 20th centuries – are characterized by capturing the essence and character of what is depicted as far as possible, by being 'accurate'."[5] Immediately afterwards, Melcher opens up the spectrum of means used to achieve this very essence beyond the supposedly objective depiction, at least for painting, by including the artistic means: "This is why also expressionist or constructivist painting styles are realistic in the sense that they want to express a special content, the essence of things and events."[6] It is significant that Shulman, as a photographer, opens up this subjective reference to painting even further and also refers to clearly technical aids in his photography when he describes a surrealist alienation, the effect of which, however, only becomes apparent at second glance: He is vehemently opposed to the accusation that the use of infrared film does not depict "the true nature"[7] of a building: "I always felt that this was a ridiculous attitude: the photographer can 'see' the potentials and, with [various types of] film, can go one step beyond dullness to produce something that is ›there‹, but is not necessarily seen by the eye."[8] This is significant insofar as *virtual photography* in the *visualization of uncertainty* is particularly united with virtual modelling in that it has a direct influence on what is captured by the virtual camera. On the other hand, in the *visualization of uncertainty*, something invisible ("something … not … seen by the eye"[9]) is explicitly depicted as a con-

4 Julius Shulman, *Architektur und Fotografie*, (Cologne: Taschen, 1998), 299.

5 Ralph Melcher, "Die Architektur als künstlerische Bildgattung," in *In Szene gesetzt. Architektur in der Fotografie der Gegenwart*, ed. Götz Adriani (Ostfildern-Ruit: Hatje-Cantz, 2002), 71.

6 Ibid.

7 Shulman, *Architektur und Fotografie*, 77.

8 Rosa, "A Constructed View," 76.

9 Shulman, *Architektur und Fotografie*, 77.

stituent element; namely the – if hypothetical – architectural idea. That such artistic – or artificial – distortions do not necessarily alienate the character of what is depicted results from the independence of architecture, photography and mental models: architecture is a spatial phenomenon that is not only perceived stereoscopically, but with all the senses.

A photograph, by contrast, is a two-dimensional image and thus an initially independent object, while the mental model, the image of architecture that arises in the viewer's mind, is the actual goal of the mediation. Rolf Sachsse writes in *Raumbilder – Bildräume*, characteristically a publication about photographs taken by architects: "The image of space, however large it may be, is always a model of perception, an offer to the viewer in the hope of a broad level of similar experiences as a basis for understanding."[10] The first delimitation – between the object and its photographic representation – is particularly important for the *visualisation of uncertainty* because the architectural idea, i.e. more than just the geometric content of the virtual model, is to be conveyed in *virtual photography*. The second delimitation – between the visual and the mental image – exists because each form of visual perception creates an independent – individual – model in the viewer's mind. And this even applies when the documentary character, the depiction of what has been discovered, is in the foreground, as Gilles Mora writes in a review of Walker Evans "Le photographe n'est plus là pour travailler la composition, mais cadrer le pré-composé, l'ordre et la configuration préexistante des surfaces visuelles s'offrant au regard."[11] And Roland Barthes also emphasizes that, in contrast to drawing, "photography cannot intervene in the object despite the choice of subject, point of view and angle of vision,"[12] which, technically speaking, already covers most of the point. Similarly, Ulrich Loock emphasizes the challenge to the viewer's imagination in Thomas Struth's illustrated book *Unbewusste Orte* (Unconscious Places): "And with its perspectival character, photography demands that the viewer create a world for himself from the inventory."[13]

10 Rolf Sachsse, "Raumbilder – Bildräume. Architekten fotografieren," (Munich: Deutscher Kunstverlag, 2009), 4.

11 Gilles Mora, "Introduction," in *Walker Evans* (Paris: Contrejour, 1990), 12.

12 Roland Barthes, "Rhetorik des Bildes [1964]," in *Texte zur Theorie der Fotografie*, ed. Bernd Stiegler (Stuttgart: Reclam, 2010), 39–52, 86.

13 Ulrich Loock, "Photographien aus der Metropole," in *Thomas Struth. Unbewußte Orte*, eds. Thomas Struth and Ulrich Loock (Cologne: Schirmer, 1987), 79.

In contrast, in the early days of photography, the viewer's ability to "involuntarily read his hypothetical explanation into the image,"[14] as Anton Martin noted in 1865 in his *Handbuch der gesamten Photographie*, was initially viewed critically; hypotheses were therefore considered unobjective. The importance of passing on sensory impressions and information from one form of representation to the next in photography was also emphasized in Daniela Mondini's laudatory speech at the Bauhaus-Archiv in 2015 for the exhibition by contemporary photographer Hélène Binet: "Although it is addressed to the human eye, the photographic message evokes multisensory associations, such as hearing and touch, comparable to the perception of an architectural space."[15] Association and interpretation as well as the passing on of attributed meaning across several forms of representation are the central aim of architectural photography, even when taking virtual photographs of virtual architecture. This is because the mental image of architecture should be as close as possible to the verbal hypothesis. This is precisely why *virtual photography* represents one of the two central translation processes from the hypothesis via its geometric representation and photographic composition to the mental model. Shulman is naming this translation: "What are the benefits of this particular branch of photography and where might it be heading? You could say that we are literally 'translating' architecture."[16]

But whether photography actually directs the gaze to what is depicted or to itself is a controversial issue. Art historian Hans Belting takes Thomas Struth's images, which seem so everyday, as an opportunity to point out the historical dimension of this ambivalence:

> My view has ignored the surface of the photograph in order to perceive what lies 'behind' and is in the picture. This brings me to the famous question of whether photography offers an image of reality and what it shows of itself in the process. Vilém Flusser reversed a thesis by Roland Barthes when he wrote that technical images 'are not windows, but pictures,' i.e. mere surfaces with information. 'It is not the world out there that is real …, but only photography that is real' … It seems, however, that I confirm

14 Lorraine Daston and Peter Galison, "Photographie als Wissenschaft und als Kunst [2007]" in *Texte zur Theorie der Fotografie*, ed. Bernd Stiegler (Stuttgart: Reclam, 2010), 67.

15 Daniela Mondini, "Architecture in Photography," in *Dialogues. Photographs by Hélène Binet*, ed. Daniela Mondini (Berlin: Bauhaus Archiv, 2015), 61.

16 Shulman, *Architektur und Fotografie*, 17.

> Barthes' thesis when I initially do not notice the photograph at all and only ever speak of what I discover in it. He spoke of the photograph as pure contingency. 'Whatever a photograph shows, it is always invisible: it is not the photograph that one sees,' but the thing itself.[17]

That this interpretation is resolute but essentially ambivalent is interesting in that *virtual photography* is directly affected by this ambivalence. It does not want to direct the view to the depicted object itself, neither does it want to stop at the depicted architectural idea. Instead, it wants to go further, it wants to direct the view to the underlying hypothesis – and to do so with such clarity that the necessity of the subsequent next step of translation – from the visual image to the mental image – should become obvious to the viewer. In this way, the viewer cannot avoid reflecting on which of their own thought processes are stimulated by the image. Shulman postulates an almost salutary prospect for "good" photography:

> Good photography is a joy. It reflects the human ability to reflect, weigh up and evaluate! With a careful approach, we can learn to rediscover these born skills. Then photography will no longer be a mystery. Rather, it will broaden our mental horizons.[18]

Nevertheless, the question remains as to how this can be achieved. The simple basic rules of photographic composition fulfil the purpose of emphasizing the reference to reality in the *visualization of uncertainty*: The aim is to visually understand the architecture behind the abstract form. Rosa attributes this almost didactic approach to Shulman's entire oeuvre: "Shulman's work is based on persuading the viewer to understand visually the architecture that he is depicting."[19]

This recourse to the tradition of architectural photography relies on the appropriately trained eye in the interpretation of these images and thus compensates for the abstract content. The first priority is therefore given to those components of the composition that reproduce the spatial visual impression of the hypothetical space as undistorted as possible. This includes the position of the viewers in space. The viewers should not only actually be at a natural eye level

17 Hans Belting, *Photographie und Malerei. Der photographische Zyklus der Museumsbilder von Thomas Struth* (Munich: Schirmer Mosel, 1993), 7.

18 Shulman, *Architektur und Fotografie*, 286.

19 Rosa, "A Constructed View," 63.

above a position that can be taken up in the architecture, they should also realize this to be able to rely on it. In case the viewers are at a greater height, they should also be able to perceive this clearly, for which not only aerial photographs are suitable, but especially those with an extended focal length. These correspond geometrically to the view from a satellite. The ideal geometric form of such images is the parallel projection, which has no point of view in space, as the projection of the geometry is parallel and no longer directed to a projection center. The most unadulterated spatial impression possible also includes the reliability of what is perhaps the most important basic constant of spatial perception, the vertical. It is the processing of the integral of visual perception in movement, of the body, the head and the eyes, which orients the mental model of space in the imagination. This succeeds despite the hemispheric projection on the retina. It is therefore the task of photography to take this phenomenon of spatial vision into account and to carry out the photographic, i.e. planimetric, projection onto the image plane in such a way that verticality is maintained. If the projection resembles the mental model as closely as possible and thus fulfils the clear purpose of reliability, it constitutes the starting point of architectural photography as Shulman describes it on the occasion of a review of the commissioning of a new camera: "I quickly realised how to achieve the most important function, which was to prevent the vertical lines of a building from collapsing."[20] His judgement of those photographers who do not fulfil this basic requirement can be directly applied to the current practice of digital architectural visualization: "In this day and age of advanced camera technology, you often see photos with poor, distorted views of buildings."[21]

Just as, for Shulman, technical progress is leading to more and more amateurish photographs being created, the increasing ease of use of computer programs in visualizations is leading to a detachment from fundamental insights from architectural representation, such as the eye-catching distortion caused by an arbitrarily tilted image plane. The reason for this is a phenomenon that lies in the translation between the physiological image on the hemispheric retina and the perceived image in the mind. The curved projections on the retina are not only corrected by the brain so that straight lines are interpreted as straight lines – a phenomenon so natural that it is rather difficult to imagine that the image on the retina is curved. Line correction also

20 Shulman, *Architektur und Fotografie*, 235.

21 bid., 236.

means that the mind largely interprets the spatial orientation of objects correctly, for example whether an object is orientated vertically or horizontally in space. The simplest example of this, and Shulman also refers to this, is vertical building edges, which "prevent the vertical lines of a building from collapsing" (see above). Geometrically, this is due to the orientation of the image plane of the perspective projection. For Shulman, it is the technical adjustability of the lens; for computer visualization, it is a question of conscious image composition. Additional technical effort, as in camera photography, is no longer necessary in the computer.

That the creative quality of a photograph has a significant influence on the reception of what is depicted – within the *visualization of uncertainty* this is the underlying hypothesis – may not come as a surprise, but is explicably postulated by Shulman for architectural photography:

> As I know from decades of experience, photographs become part of history and therefore the documentation of a building must be done in such a way that the viewer is first attracted by the visual expression of the image. Only then will the quality of the architecture become visible and be able to appeal to the viewer.[22]

That this can also succeed under the conditions of abstract content is already reflected in architectural photography, from outside photography, when Walter Benjamin describes the added value that arises when no people are depicted in photographs: "But where man withdraws from photography, for the first time the value of the exhibition becomes superior to the value of the cult,"[23] as from within photography, when Shulman describes, in the spirit of Winckelmann, that omitting color improves the legibility of contours: "Black and white … in its monochromatic state tends to emphasize form and tone at the expense of the total exposition possible by color photography."[24]

With regard to color in particular, it cannot be avoided that misunderstandings arise in terms of architectural meaning, since architecture in the tradition of classical modernism sometimes radically dispenses with color. White cuboids often stand for a certain architectural direction, which can lead

22 Ibid., 16.

23 Friedrich Meschede, "Statt Ansichten – Stadt an sich," in *Thomas Struth. Unbewußte Orte*, ed. Thomas Struth and Ulrich Loock (Cologne: Schirmer, 1987), 87.

24 Rosa, "A Constructed View," 76.

to a misinterpretation of visualized hypotheses. The viewer must be aware of this potential misinterpretation not to be subject to it. To ensure this, the visualizations can be accompanied by an explanatory text, as can several representations of different variants. However, the legibility demanded by Shulman also favors the monochrome representation ("emphasize form and tone"[25]). This is because the clarity with which monochrome images reveal and emphasize spatial relationships is overlaid or even prevented by polychromy. Spatial relationships therefore benefit from the abstraction of color.

The conscious treatment of the two exemplary aspects of people and colorfulness should be exemplary for all possible abstractions in traditional architectural photography, the significance of which extends decisively further in the *visualization of uncertainty*. On the one hand, the value of the architecture allows it to be transferred to the present day and to be re-evaluated from today's perspective as a reference for architectural planning. On the other hand, the omission of color in black and white photography not only emphasizes "form and tone" in general, but in particular, in accordance with the intention of the hypothesis, to place form in the foreground to avoid a statement about the much more uncertain polychromy.

Despite the creative composition described above, the documentary character remains preserved, as the aim of *virtual photography* in the *visualization of uncertainty* is always to convey something concrete, namely the architectural hypothesis. This in no way turns architectural photography into documentary photography; however, it consciously distinguishes itself from purely artistic photography, just as for instance Albert Renger-Patzsch claimed for himself: "Let us therefore leave art to the artists and try to use the means of photography to create photographs that can stand the test of time thanks to their photographic qualities – without borrowing from art."[26] And even if the obvious concept of objectivity does not really lead any further at first, when László Moholy-Nagy actually demands "The secret of their effects is that the photographic apparatus reproduces the purely optical image and thus shows the … distortions …. Therefore, in the photographic apparatus we possess the most reliable aid to the beginnings of objective vision,"[27] the concrete example of distortion in

25 Ibid., 76.

26 Meschede, "Statt Ansichten – Stadt an sich," 85.

27 László Moholy-Nagy, *Malerei Fotografie Film*. Reihe Bauhaus Bücher 8 (Munich: Albert Langen Verlag, 1927), 26.

architectural photography is explicitly and almost pointedly rejected by Shulman: "Such a failure ... urges the photographer to weigh up his compositions carefully."[28] In conclusion, the rules of design should also be applied to photographic documentation, i.e. the difference to artistic photography lies not in the significance of the design, but in the intended message of the image.

From the point of view of architecture, *virtual photography* is thus defined from two sides, documentation on the one hand and artistic design on the other. Furthermore, it is based on the specific architectural way of thinking of understanding buildings not only as a visual or spatial phenomenon, but also as a functional structure whose functionality ("cult"[29]) is always also constituent. How important an understanding of the functional context of a building is when composing a photograph is expressed by Shulman as follows:

> There are no differences in the construction of the images, it is always about finding a reference to the architecture. It is not so difficult to work out the floor plan, location and architectural features. The composition results from the ability to read the floor plan of a room correctly and to establish a connection between the motifs.[30]

Summarizing, the creative spirit cannot be ignored in architectural photography, be it a more artistic or a more documentary approach. And in this respect, despite all due diligence, the subjective is ultimately decisive in architectural photography, and this also applies to the *virtual photography* of virtual models. The artist and photographer Raoul Haussmann consequently juxtaposes a selection of necessary technical decisions with the subjective composition as a whole:

> The choice of aperture, the photographic film material, the speed of the shutter and the correct reproduction of color tones are not determined by rules, but by a more or less strong feeling of the personality behind the camera for the characteristics of the given circumstances. The individual case decides.[31]

28 Shulman, *Architektur und Fotografie*, 18.

29 Meschede, "Statt Ansichten – Stadt an sich," 87.

30 Shulman, *Architektur und Fotografie*, 122.

31 Henri Cartier-Bresson, "Der entscheidende Augenblick [1952]," in *Texte zur Theorie der Fotografie*, ed. Bernd Stiegler (Stuttgart: Reclam, 2010), 196.

This already gives rise to a starting point, a relationship between architectural design, which outlines the space in three-dimensional form, and architectural photography, which optically defines its projection.

Conclusion

The *visualization of uncertainty* remains a delicate balancing act, as it combines opposing phases of architectural creation: modelling from the first – the design phase – and photography from the last – the documentation phase. The abstraction of the virtual model contrasts with the realism of photography, although they are similar in their shaping design intentions. But it is a matter of negotiating a balance between abstraction in favor of the hypothesis and vividness in favor of the spatial impression.

As a consequence, there are opposing strategies that need to be brought into balance with each other: If the abstraction goes so far that a spatial interpretation, a recognition of the depicted as architecture, is no longer possible, the visualization can no longer fulfil its goal, which is to convey the architectural idea. Conversely, too many additions in favor of vividness lead to the scientific hypothesis being covered up. The great challenge lies in the balance between these two demands, in the weighing up of fidelity to the hypothesis and vividness, i.e. creating a spatial vision that is as close to the hypothesis and as spatially impressive and credible as possible. It is obvious that abstraction increases with decreasing certainty in knowledge, but at the same time there are higher expectations regarding image design. Realistic images are much easier accepted, people tend to believe what they see as soon as it looks real. Abstract images of architecture, on the other hand, are being questioned. This is understandable, as they demand a reflective examination, one's own imagination in the completion of architecture. The composition of visualizations is correspondingly complex, for despite the detailed definition of the methodological principles in modelling and projection, it is architectural questions that control the entire procedure and whose mastery, like architecture as a whole, only develops over time. Shulman's "learning to see" can easily be transferred to "learning to build."

This is because the cooperation between archaeology and architecture offers reflective perception as an added value of visualization that increases knowledge. Both disciplines benefit from the cooperation between archaeology and architectural visualization due to the mutual exchange. The reflection of the hypotheses in the visualization process provides both disciplines with impulses that would be missing in a purely archaeological visualization on the one hand or a visualization based not on dialogue but only on literature on the other. However, the abstract modelling of hypotheses is only the first step. The equally important, final step is their communication via composed projections, the *virtual photography*.

12. Just-Beyond-Human-Vision Photography

Helen Westgeest

The invention of microscopes, telescopes, and infrared and x-ray photography are commonly considered as successful attempts to extend the physiological limitations of human vision. These technological developments can be said to emphasize our superiority as human beings, who are capable of developing devices to overcome limitations of our sense of sight. Despite all these devices, however, most of the photographs we take on a daily basis merely copy the things we see with our bare eyes in what we call "the visible world." We apparently do not want to take photographs of our surroundings beyond the things we are able to see ourselves, and therefore it is enough for these images to serve us only as an *aide-memoire* (of what we saw). For this reason, producers of standard cameras for amateurs limit the spectrum of cameras to the limitations of human vision.[1] A rarely discussed byproduct of the various conventions of photography – including limited frames, one-eye perspective, still images, and limitation in visible spectrum – is in fact that these confirm to us the superiority of our vision in comparison to what is seen by the camera and represented in photographs.

In this chapter I put these various tendencies to experience superiority into perspective through a focus on what lies "just beyond" our limited vision. My argument aims at increasing our awareness of the limitations of human vision by means of discussing just-beyond-human-vision photographs in processes that center on bringing something into existence in a contact zone, thus potentially allowing a meeting of human vision and vision by animals or machines. I will develop this concern by discussing near-infrared (NIR) photography by Martine Stig, which I briefly relate to the *Animalcams* project designed by Tuula Närhinen. The artistic research of both artists prompted me to question how

1 Information derived from my interview with Martine Stig in Amsterdam on March 13, 2024. For more on this issue, see my discussion below in this chapter.

"just-beyond-human-vision" photography in their human-nonhuman projects increase awareness of our human vision's limitations, rather than just extending our vision.

I will also link up these two case-studies with concepts derived from interdisciplinary studies. Specifically, I address "post-optic," as coined by Carolyn L. Kane, "phasmagraphy" coined by Elke Reinhuber, and "nonhuman" and "afterphotography" as discussed by Joanna Zylinska. Finally, I rely on a study about animal eyes by Michael F. Land and Dan-Eric Nilsson to support my visual analyses of the artistic research projects by Stig and Närhinen.

NIR-photographs in a Contact Zone between Human Vision and a Post-optic World

12.1 Martine Stig, Near, edition#4, 2023, NIR-photograph, inkjet print on paper, 14.8 x 21 cm.

Courtesy of the artist.

When looking at *Near, edition#4*, a photograph by Dutch artist Martine Stig, one will first perceive a grey-pink color covering a whole photograph, in which only some lines and shadows indicate parts of a human body, including a pattern of veins (Fig. 12.1). Close-up observation of this image does not provide any more clues. On the contrary, it becomes increasingly harder to relate such concentrated effort to what we are used to see in close-ups of human skin with our bare eyes. How does this perception change after we are informed to be looking at a NIR-photograph? In order to understand how Stig's NIR-photograph critically relates to infrared photography, I first provide a brief historical overview of its discovery and subsequent use, after which I invoke several theoretical concepts to provide additional insights into this particular photograph.

In "Beyond Human Vision: Towards an Archaeology of Infrared Images" (2018), film and visual culture theorist Federico Pierotti and art historian Alessandra Ronetti offer a historical survey of infrared images for laypersons.[2] Motivated by the increasing popularity of the use of digital infrared in thrillers and war movies, they begin their historical overview of analog infrared in the early nineteenth century when scientists started to measure the color spectrum as an electromagnetic wave. After setting the boundaries of human vision (400–700 nanometers), the next step was to push the boundaries of the visible spectrum into both directions: toward the infrared and ultraviolet. The infrared that is invisible to human eyes has a longer range of wavelengths (700 nm-1 mm) than that of the visible spectrum, while it is commonly divided into a far portion (3,000 nm-12,000 nm) and a near one (700 nm-3,000 nm). Stig uses near-infrared in the range of 700–1,000 nm, or, to be more specific, 850 nm wavelength in the case of *Near, edition#4*.

Pierotti and Ronetti are particularly interested in the period of the 1930s to the 1960s, when the first films for recording infrared photographs were released (with a sensitivity range of 680–860 nm) by big companies like Kodak and Agfa. These films were mainly used in military, technological, and medical fields. Recently, some artists have critically interrogated this history, such as the Irish artist Richard Mosse, who produced IR-photographs and moving images on analog 16mm-film, such as in *The Enclave* (2013), which focuses on surveillance, and on roots of IR-photography in military industry. *The Enclave* presents uncanny effects, resulting from the bright pink colors as striking and fictional aesthetic characteristics while presenting conflict situations in

2 Federico Pierotti and Alessandra Ronetti, "Beyond Human Vision: Towards an Archaeology of Infrared Images," *Necsus* (Spring 2018); issue *Resolution*, unpaged. Https://necsus-ejms.org/beyond-human-vision-towards-an-archaeology-of-infrared-images/ (accessed March 6, 2024).

Congo. From an equally critical perspective, media theorist Carolyn L. Kane has analyzed the twenty-first-century use of digital infrared, and she notes that this has become part of debates about the role of information algorithms for the subjects of vision. In "Digital Infrared as Algorithmic Lifeworld" (2014), she describes the use of it as: "a system of control used to regulate bodies, realities, and experiences …, using progressively pervasive and intrusive means."[3] Quite different from Mosse's and Kane's explicit response to surveillance and systems of control, Stig's NIR-photograph *Near, edition#4* rather encourages contemplation about near infrared as just-beyond-human-vision.

If the bright pink colors in Mosse's work and the grey-pink color in *Near, edition#4* seem to relate to "red" in the term "infrared," one should not forget that infrared is invisible to the human eye. The early visual devices to record infrared were only able to present black or white: whites in the case of high reflection and blacks resulting from low reflection. For instance, pioneer Robert W. Wood's infrared photographs from the 1910s displayed leaves of trees as white as snow against a completely black sky. In the mid-twentieth century, it became possible to alter these tones into colors by means of certain technical adjustments. Only in the 1960s, color infrared films became available, used for psychedelic and hallucinatory effects in films, album covers, and magazines.[4] In an artist statement, Stig explains that the colors in her NIR-photographs – such as the grey-pink – resulted from random white balance presets; the unnatural colors "chosen" by her modified full spectrum camera would demonstrate the lack of standards and present a "slightly different reality."[5] This means that, depending on the so-called "pass filter" selected (e.g., 720, 850, or 950 nm), the camera creates a preset, but does not detect a specific subject, such as a body or landscape.[6]

Evaluating the historical examples provided by Pierotti and Ronetti, I conclude that almost all the applications mentioned were applied to provide knowledge, either of the infrared region beyond human vision itself or of factual information for scientific or military use. Even psychological results of psychedelic effects may deliver knowledge. In passing, the authors mention an

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3 Carolyn L. Kane, Chapter 6, in *Chromatic Algorithms: Synthetic Color, Computer Art, and Aesthetics after Code* (Chicago, Ill: University of Chicago Press, 2014), 1/36.

4 Pierotti and Ronetti, "Beyond Human Vision," unpaged.

5 Stig in exhibition catalog *Martine Stig: Close Encounters* (Barcelona: Marlborough Gallery, 30–11-2023 – 10–02-2024), unpaged.

6 Email correspondence with artist on April 9, 2024.

interesting feature of near infrared rays, already applied in the early twentieth century: to penetrate beyond the surface of skin and tissue – a discovery that was the basis of today's facial recognition systems. The ability of near infrared to penetrate tissue as deep as a few centimeters led some doctors to apply infrared photography for detecting and examining the veins beneath the skin. This in turn provided doctors or surveillance-systems with an opportunity to gain factual knowledge. It is hard to consider Stig's photograph as conveying or representing factual knowledge of the presented body. When we realize that it is a NIR-recording, it becomes even harder to understand what we are looking at: if we are looking beneath the skin indeed, this implies that we do not see the skin color of this body, nor can we identify the color of its hair. The grey-pink color – a random choice by the camera as explained above – does not provide any clues either.

For this kind of photography, the artist and media theorist Elke Reinhuber coined the term "phasmagraphy" in her 2017 article "Phasmagraphy: A Potential Future for Artistic Imaging." She proposes an expansion of the term photography to *phasmagraphy*, a synthesis of the Greek words *phasma* for spectrum and *graphé* for drawing/writing (analogous to photography, as drawing with light). This means that phasmagraphy encompasses a much broader part of the spectrum of electromagnetic wavelengths than human vision in both directions.[7] As a result, this term is too broad for Stig's just-beyond-human-vision photograph *Near, edition#4*, even though the artist used a modified full spectrum camera.

Stig aims at delving into visual realms that are just beyond being visible to the naked eye, but that can be perceived by machines or animals, in order to reimagine possibilities that allow for a gradual blurring of the boundaries between human beings and other beings. This might render us more aware of our natural environment and come closer to it, as an intrinsic part of it, thus extending our conception of reality. An important source of inspiration for her is James Bridle's *Ways of Being: Animals, Plants, Machines: The Search for a Planetary* (2023). Bridle reflects on the concept of the "more-than-human world," coined by the ecologist and philosopher David Abram, referring to a way of thinking

7 Elke Reinhuber, "Phasmagraphy: A Potential Future for Artistic Imaging." *Technoetic Arts: A Journal of Speculative Research*, vol. 15, no 3 (2017), 262.

aimed at overriding our human tendency to separate ourselves from the natural world.[8]

The question arises whether we are able, in one way or another, to imagine not looking through human eyes, but through nonhuman eyes, i.e., eyes of a specific animal or "machine eyes." This query led me to the fascinating in-depth study *Animal Eyes* (2012) by evolutionary biologists Michael F. Land and Dan-Eric Nilsson. Their book compares all known types of eyes in the world of animals. This means that the authors discuss the structure and function of each kind of eye, with a special interest in the natures of optical systems and physical principles involved in image formation. They conclude that there are at least ten distinct ways in which eyes form images.[9] Regarding the visible range of wavelengths, they state that for some animals (including birds, fish, and many arthropods) their spectrum extends toward the short wavelength of the ultraviolet from 400 to about 320 nm. Toward the long wavelength, some fish and butterflies have visual pigments in their eyes with sensitivities of up to 60 nm further into the red than human visual pigments.[10] Stig mentions several examples of animals that use portions of the infrared spectrum for vision: mosquitoes, vampire bats, bed bugs, and some snake and beetle species. A crucial difference with her NIR-photographs is that these animals, just like humans, see a spectrum, whereas Stig's NIR-photograph was shot in a single wavelength. From this perspective, her photographs are more alike machine visions that are "narrow band," using a single wavelength or very small spectrum.[11]

If nonhuman eyes belong to the research field of biologists, photography theorist and practitioner Joanna Zylinska has discussed the concept of nonhuman photography in several studies over the past eight years.[12] She does not consider human and nonhuman elements as opposites because the two merged in the photographic event ever since the inception of photography. She mainly "expands the notion of photography beyond 'things that humans

8 James Bridle, *Ways of Being: Animals, Plants, Machines: The Search for a Planetary* (London: Penguin Books, 2023). Interview by the author with the artist on March 13, 2024.

9 Michael F. Land and Dan-Eric Nilsson, *Animal Eyes*, 2nd edition (Oxford: Oxford University Press, 2012 [2002]), Preface.

10 Ibid., 32.

11 Email correspondence with the artist on April 9, 2024.

12 For instance, Joanna Zylinska, "The Creative Power of Nonhuman Photography," in *Photomediations: A Reader*, eds. Kamila Kuc and Joanna Zylinska (London: Open Humanities Press, 2016), 201–224.

do with cameras' to embrace imaging processes from which the human is absent," such as microphotography and space photography.[13]

She derived the concept from media theorist Richard Grusin's *The Nonhuman Turn* (2015), in which he observed a decentering of the human.[14] Zylinska made this more specific through aiming at positioning the human as just one element in a complex assemblage of perception, in which various forms of organic and technical agents come together for "functional, political, or aesthetic reasons." She even wonders what or who actually "takes" a photograph, and whether the human in fact would be able to do this.[15] Stig's NIR-photographs present a nonhuman vision while still being close to human vision. From this angle, it might come as a surprise that Stig uses the term "post-optic" in reference to her work, a term coined by Kane in *Chromatic Algorithms* (2014). Kane observes a paradigm shift in which an optical and visual epistemology have turned into a post-optic, algorithmic lifeworld. As a result, experience and perception are ever more shaped by "the logic of informatics and data capture systems." Regarding infrared images, Kane argues that even when supported by optical prosthetics, these digital images are exemplary for being fully produced "by and through information technologies – algorithms – not optics and hence they are 'post-optic.'"[16] This would imply that NIR is technically post-optic. However, Stig does not seem to call her NIR-photographs entirely post-optic, as she rather positions them in-between human vision and a post-optic world: "The *post-optic* invites us to expand our parameters of normality and opens doors to the extrasensory. It can contribute to a shared and interconnected reality that fosters interactions between all entities – be they machines, humans or other entities."[17]

Words applied in this quote, such as "invites," "opens doors," "contribute," and "fosters," in fact suggest a stage in-between. Although it is possible to refer to this in-between zone as a "liminal zone," this would suggest that the human is potentially able to transcend thresholds into the domain of nonhuman machines and animals. Because this is not at issue here, I prefer to use "contact zone," in the sense of meeting each other halfway in a dynamic relationship.[18]

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13 Joanna Zylinska, *Nonhuman Photography* (Cambridge, MA: MIT Press, 2017), 7.

14 Ibid., 5.

15 Ibid., 130.

16 Kane, *Chromatic Algorithms*, Chapter 6, 34/36.

17 Stig in *Martine Stig: Close Encounters*, unpaged.

18 The concept of "contact zone" was coined by literary scholar Mary Louise Pratt to identify the spaces in which two or more cultures, with competing worldviews and uneven

Stig rightly notes that nonhuman data do not only concern differences between machines and humans. If the prefix "post" suggests that perception through eyes always was optic, Land and Nilsson discuss some intriguing cases of animal eyes of which scientists still do not know whether these eyes produce images or just data. Much is still unclear as well about the viewing angle of animal eyes. Stig's NIR-photographs offer a frontal just-beyond-human-vision photographic view at the world, which is a human perspective. Some animals and machines are able to look as well into different directions at the same time. In the case-study addressed below I briefly consider an instance of spatial just-beyond-human-vision photography, after which I return to Stig's NIR-photograph in order to discuss it as a print.

Contact Zone of Human Eyes and Animal Eyes as Cameras

Land and Nilsson describe the human eye as "a single-chambered camera-like structure with a retina in place of the film, or the CCD array" and a cornea-lens combination that is "not particularly popular in the animal kingdom."[19] In addition, they declare that even though we know that insects have compound eyes with many lenses, biologists still hardly know whether these insects "see" a multitude of images or a single one. They mainly agree about the diversity of eye types, and the distinct ways images are formed. Some of the types are familiar, such as pinholes and lenses. Others are non-customary to us, for instance concave mirrors, arrays of lenses, and corner reflectors.[20] This means that the designs of eyes also vary from camera-type eyes to compound eyes and mirrorlike-eyes. Moreover, there is a difference in number of eyes; ragworms, for instance, have two pairs of eyes, while spiders even have four pairs.[21]

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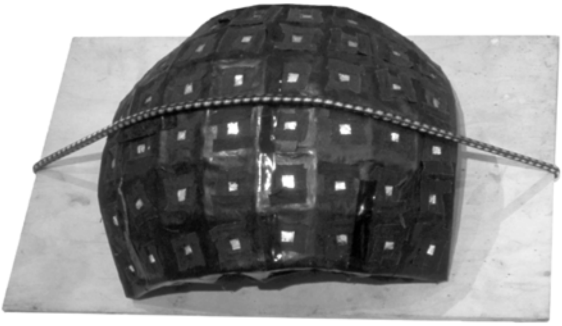
power relationships, meet and interact. See Mary Louise Pratt, "Arts of the Contact Zone," *Profession* (1991), 33–40.

19 Land and Nilsson, *Animal Eyes*, Preface, 119. A CCD (Charge-coupled device) array is positioned behind the lens of a digital camera.

20 Ibid., Preface.

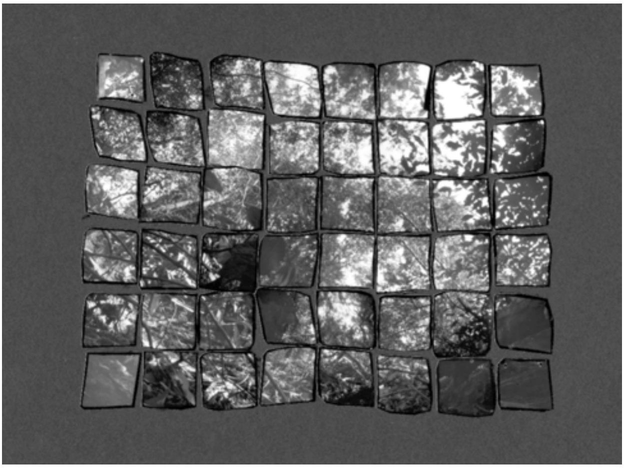
21 Ibid, 1.

12.2 Tuula Närhinen, Flycam, 2002, assemblage of 48 pinhole cameras.



Courtesy of the artist.

12.3 Tuula Närhinen, Flycam, 2002, 48 photographs recorded by pinhole cameras, presented in grid composition.



Courtesy of the artist.

In 1999, the Finnish artist Tuula Närhinen started a photographic project, entitled *The Landscape Seen Through Animal Eyes*, based on a quite similar fascination if from an artistic perspective. She wanted to explore questions like: "what if, instead of the human eye, the camera's structure were to be based on the eye of some other creature? How does the camera affect the photographs produced with it?"[22] Närhinen aimed at constructing visual interfaces in order to find out what the environment looks like through the eyes of, for instance, a fly, bird, or a moose. She tried to reconstruct their eyes by means of various kinds of assemblages of pinhole cameras, called *Animalcams*.[23] This does not mean that the artist believes that humans are able to look through the eyes of animals. She emphasizes that we may collect data, but that we can "never perceive or experience reality exactly as an animal does." What is actually involved here is more like a kind of self-inquiry, including "analysis of the way we understand the world through photographic discourse."[24]

Although Närhinen emphasizes that her artistic research should not be confused with scientific biological research, and that she neither intends exactly to replicate animal vision, the constructions consisting of multiple pinhole cameras encourage spectators to think of "viewing systems" far more complex than human vision. In an interview with curator Susanna Santala, the artist described this intention by saying that she "tried to show that photographs and cameras could look quite different from the ones we are used to."[25] Närhinen's search for how photography constructs our idea of reality, which could also provide insights into other ways of perception, led her to start with looking on the basis of a pinhole camera, being the most basic form of a camera. This kind of photographic seeing is easy to imagine for us, because it is far more simple than human vision. The pinhole camera does not need a lens, because light enters the black box through a tiny pinhole. Next, the artist studied structures of eyes of animals and made construction drawings of assemblages of multiple pinhole cameras. For instance, the *Flycam* – measuring 30 x 25 x 17 cm., and consisting of 48 pinhole cameras – is a kind of "compound

22 Tuula Närhinen, "Imag(in)ing the Non-Human Condition," in *Altern Ecologies: Emergent Perspectives on the Ecological Threshold at the 55th Venice Biennale*, eds. T. Elfving and T. Haapoja (Helsinki: Frame Contemporary Art Finland, 2016), 111.

23 Https://www.tuulanarhinen.net (accessed March 25, 2024).

24 Närhinen, "Imag(in)ing the Non-Human Condition," 120, 109.

25 Susanna Santala, "Documenting the Invisible and the Vanishing," *Frame News*, 1 (2003), 32.

eye," as identified by Land and Nilsson (Fig. 12.2). Through installing the *Animalcams* in the natural habitat of particular animals, the recordings in the pinhole cameras offer us initial access to a contact zone with animal vision. In addition to this zone of mediation, Närhinen included several photographs she took of herself with her standard camera as a way to show her awareness of the voyeuristic character of her desire to observe the habitat of animals.

Närhinen's project calls forth the title of Joanna Zylinska's recent book *The Perception Machine* (2023). Zylinska focuses here on imaging "after photography," not in the sense of overcoming, but rather as a mediation "modelled after photography" in order to emphasize that what "has come after" can still be called photography.[26] This also means that Zylinska defines the "perception machine" much broader than only the physical camera. Using perception as a lens, she examines the ontology of the photographic event rather than that of the photographic object.[27]

The *Animalcams* project was not limited to recording photographic events, however. Närhinen also chose to exhibit the recordings as grids of physical prints. And so did Stig in her NIR-project.

Problematized Embodied Perception of Printed JBHV Photographs

Some of the NIR-photographs were printed by Stig in various sizes. *Near, edition#4* (Fig. 12.1) materialized into a physical object in A5 format (14.8 x 21 cm). This just-beyond-human-vision photograph in fact looks quite similar to a familiar analog photograph. However, it has not lost its exceptional "just-beyond-human-vision" character in printed form. This is the case in particular because this NIR-photograph shows body parts: holding the print in my hands becomes a "just-beyond-human" experience. If Zylinska tends to focus in her studies increasingly on big issues such as debates on climate change, extinction, and the Anthropocene, Stig's *Near, edition#4* limits our attention to what literally is closest to us: our body.[28] The strange embodied perception of touching this photograph can best be explained on the basis of studies by

26 Joanna Zylinska, *The Perception Machine: Our Photographic Future between the Eye and AI* (Cambridge, MA: MIT Press, 2023), 2–4, 6.

27 Ibid., 65.

28 Zylinska, *Nonhuman Photography*, 15. In many other NIR-photographs, Stig presents close-ups of landscapes, though does not explicitly address these big issues.

visual anthropologist Elizabeth Edwards on the relationship between materiality of photographs and affect. She emphasizes that photographs, partly due to their small size and everyday use,

> are made to mean in relation to social actions across a range of sensory experience … These arguments insist on the sense of the relationship between the body and photographic images, how users position themselves in relation to photographic images and perform a sense of appropriateness through relationships with the photographic image … Photographs are seldom talked about without being touched, stroked, kissed, clasped, and integrated into a range of gestures.[29]

Touching Stig's printed photograph feels strange. I cannot imagine negating the surface of the picture in order to look and feel "through" the medium and to experience the "real" world/body, discussed as an act of "immediacy" by media theorists Jay David Bolter and Richard Grusin.[30] As a consequence, the NIR-photograph does not appear to invite us to touch or caress it.

How does our perception change when the printed images are presented in an exhibition? From December 2023 until February 2024, Stig presented grids of printed NIR-photographs on the walls of the Marlborough Gallery in Barcelona in her solo-exhibition *Close Encounters*. Among close-up recordings of landscapes, close-ups of human bodies were included. Glancing over the images, given that touching them was not allowed, evokes complex associations with film theorist Laura U. Marks's study of "haptic visuality." Marks calls images haptic when they evoke a strong sense of touch, and invite the viewer to glance over the surface of the film screen.[31] In particular close-ups of human skin would be experienced by us as if we are touching the surface of the skin with the eyes, rather than looking into depth or literally touching them with our fingers. Quite differently, the NIR-photographs of body parts do not invite our eyes into an embodied experience of touching the surface of skin, yet neither do they invite a disembodied perception.

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29 Elizabeth Edwards, "Objects of Affect: Photography Beyond the Image," *Annual Review of Anthropology*, vol. 41 (2012), 228–229.

30 Jay David Bolter and Richard Grusin, *Remediation: Understanding New Media* (Cambridge, MA: MIT Press, 1999).

31 Laura U. Marks, *The Skin of the Film: Intercultural Cinema, Embodiment, and the Senses* (Durham/London: Duke University Press, 2003 [2000]), 162–163.

How, then, can we describe this viewing experience? Kane warns us to treat IR-images as if they are optical images, because fundamental reductions and translations have occurred. Rather than a direct indexical relationship, what is actually registered, according to Kane, is "a set of changes *between* states, a drama occurring within the system's elements and not the empirical or physical entity it simulates."[32] But in what terms can we characterize our viewing experience of IR- and NIR-images? Reinhuber rightly suggests at the end of her essay that "phasmagraphic" images need a new vocabulary "to create, decipher, and interpret these images." She does not provide a new vocabulary herself but instead expresses the hope that future generations will develop criteria to investigate "the hidden qualities of yet-unseen phenomena."[33] I suggest to describe *Near, edition#4* as a virtual photograph, in the sense of a non-customary, never-lived experience in human vision, while meeting a mode of nonhuman vision halfway in a contact zone.

What about the complexity of visualizing and presenting the photographs taken by the multiple pinhole *Flycam* in a grid composition (Fig. 12.3)? It is impossible to perceive this grid as a photograph taken by a fly. Rather than applying photography to make the fly's vision visible, its vision is brought into a certain kind of existence and to the spectator's awareness. As the artist emphasizes, the project "reminds us that the world of perception is not as unproblematically and self-evidently present to us as everyday experience would perhaps suggest."[34] More specifically, in the case of looking at the images taken by the *Flycam*, and different from when perceiving familiar photographs, it is hard to imagine looking into the distance. On the contrary: one is looking "into" the 48 parts of the fly's virtual eye, as a kind of reverse perspective.[35] Or, to complicate the issue even further: compound eyes use multiple optical systems, but do not necessarily form multiple images. Even if each of the lenses in an insect's eye

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32 Kane, *Chromatic Algorithms*, Chapter 6, 19/36 (emphasis in original).

33 Reinhuber, "Phasmagraphy," 271–272.

34 Tuula Närhinen, *Visual Science and Natural Art: A Study on the Pictorial Agency of Natural Phenomena*, Doctoral Thesis in Fine Arts (Helsinki: University of the Arts, 2016), 366.

35 Highly interesting theoretical and artistic projects from new and uncommon spatial perspectives are created by artists, critics and scholars of the practice and research-based art foundation Radical Reversibility. Stig is co-founder of this foundation. https://radicalreversibility.org.

forms a tiny image, this is not what the insect actually sees.[36] As spectator, I become aware that I fail visually to understand what I am looking at.

In 2019, Kane shifted her interest from chromatic algorithms to the phenomenon of failures in *High-Tech Trash: Glitch, Noise, and Aesthetic Failure*. She opens her book with this greeting: "Welcome to the Failure Age." On the one hand, she addresses literal failures by observing that eighty to ninety percent of all innovation projects fail, and that nobody talks about them. On the other hand, she approaches failures from a more philosophical perspective, by intending to transcend personal failures in order to consider them as meaningful metaphors for broader human struggles. The positive spin of her argument is that through "working *with* our failures and shortcomings, and facing them head-on, we can grow in new and intellectually humble ways."[37] Stig's and Närhinen's aims are in line with this view, but seem to come even closer to Zylinska's prophecy: "Embracing nonhuman vision as both a concept and a mode of being in the world will allow humans to see beyond the humanist limitations of their current philosophies and worldviews, to unsee themselves in their godlike positioning of both everywhere and nowhere, and to become reanchored and reattached again."[38]

Conclusion

As I argued above, the NIR-photograph *Near, edition#4* produced by Martine Stig and *Animalcams* built by Tuula Närhinen encourage us to realize that if particular animals and machines would be able to inform us how *they* "see" the world, we would not talk about *the* visible world anymore, but about the limited part we are able to perceive. Although it is often assumed that all our visual tools have increased the superiority of our human vision in relation to our environment, I showed that studies of nonhuman vision by both scholars and artists have made us more aware of the limitations and deficiencies of human vision. The "just-beyond-human-vision photographs" created by means

36 Land and Nilsson, *Animal Eyes*, 157. The compound (superposition) eyes of nocturnal insects and deep-water crustaceans would operate in concert to form a single deep-lying image.

37 Carolyn L. Kane, *High-Tech Trash: Glitch, Noise, and Aesthetic Failure* (Oakland, CA: University of California Press, 2019), 2–3 (emphasis in original).

38 Zylinska, *Nonhuman Photography*, 15.

of NIR and *Animalcams* demonstrate that we cannot imagine a viewing experience of our own when looking at these virtual photographs, because these photographs rather actualize – bring into existence – than visualize a world just beyond our visual limitations. Stig's and Närhinen's projects do not let us enter nonhuman visions. They rather invite us into a contact zone, where virtual photography enables a first step toward meeting nonhumans halfway. The aims of their projects come close to what Zylinska described as a desirable effect to us, human beings: "to unsee" ourselves in our "godlike positioning."

Appendix

Biographies

David Bate is a photographer, writer and currently Professor of Photography at the University of Westminster, London, UK. He was recipient of the Royal Photographic Society *Education Award* in 2018 and is co-editor (with Liz Wells) of *Photographies* photography theory journal. Recent books are *Photography after Postmodernism* (Routledge, 2022); *Photography: Art Essentials* (Thames & Hudson, 2021, translations in various languages); *Photography as Critical Practice: Notes on Otherness* (University of Chicago/Intellect, 2020); *Photography: The Key Concepts* (Routledge, 2019, various translations); *Art Photography* (Tate Publications, 2015). In addition to these, he has published 24 book chapters and more than 100 exhibition/catalogue essays and reviews across many journals and magazines.

Kris Belden-Adams is Associate Professor of Art History at the University of Mississippi where she specializes in the history of photography. Currently she is Dorothy Kayser Hohenberg Research Chair of Excellence in Art History at the University of Memphis, TN, USA. She is the author of *Photography, Temporality, Modernity: Time Warped* (2019), and *Photography, Eugenics, 'Aristogenics': Picturing Privilege* (2020). In addition, she is an editor and contributor to the volumes *Photography and Failure: One Medium's Incessant Entanglement with Mishaps, Flops, and Disappointments* (2017) and *Diverse Histories in Photographic Albums: 'These Are Our Stories'* (2022). With Karen Barber, Belden-Adams is a Content Co-Editor for Smarthistory's/Khan Academy's coverage on the history of photography.

Martin Charvát is Associate Professor at the Department of Media Studies at the Metropolitan University Prague. He is a member of the Operational Images research project led by Jussi Parikka at FAMU in Prague. He has published fifty articles, most recently in *Philosophy of Photography and Publizistik*.

His recent monograph publications are: *The Electro-Photographic Imaginary: Spectres between Photography and Electricity* (Academy of Performing Arts in Prague, 2023, in Czech); *Jussi Parikka: From Media Archaeology to Geology of Media* (Academy of Performing Arts in Prague, 2022, in Czech); and *On New Media, Modularity and Simulation* (Togga Publishing House, Prague, 2017, in Czech).

Natasha Chuk, PhD, is a media theorist, writer, and educator whose work focuses on the relationships between art, philosophy, and creative technologies. She is the author of *Vanishing Points: Articulations of Death, Fragmentation, and the Unexperienced Experience of Created Objects* (Intellect, 2015). She is currently working on a monograph called *Traces in the Image: The Photographic in Post-Photography* (Intellect, forthcoming). Her work has been published in *Millennium Film Journal*, *Ultra Dogme*, *Kolaj Magazine*, *Virtual Creativity*, *Baltic Screen Media Journal*, and *FLAT Journal*. She lives and works in New York City.

Marco De Mutiis is Digital Curator at Fotomuseum Winterthur in Switzerland where he leads the museum research on algorithmic and networked images. He is a doctoral candidate at the Centre for the Study of the Networked Image at South Bank University (UK), focusing on the relationship between computer games and photography. With Matteo Bittanti, he has recently co-curated a group exhibition called *How to Win at Photography – Image-making as Play*. He has written, edited, and contributed to several publications, including *Screen Images – In-Game Photography, Screenshot, Screencast* (co-edited volume with Winfried Gerling and Sebastian Möring) and "Photographing the Game Glitch: Between Ghost Photography and Immaterial Labour" (article in *Philosophy of Photography* journal).

Francesco Giarrusso received his PhD in Communication Sciences in 2013 at the Nova University of Lisbon (Portugal). Since 2012, he has been a member of the Center for Philosophy of Science at the University of Lisbon, where he collaborates on the research project "Science and Art." Currently, he is pursuing a second PhD in Humanistic Studies, Tradition and Contemporaneity at the Catholic University of Milan (Italy), conducting research on images and astronomical devices. Alongside his academic activities and publication of articles in national and international journals, he also dedicates himself to photography and cinema (e.g. *Tracce-fantasma* and the medium-length film *Waterland Song* produced by Terratreme filmes).

Paula Gortázar is a lecturer, artist, and writer. She is a founding member of the Expanded Photography Research Centre at the University of Westminster in London. Her work has been published in several academic journals, including *Photography and Culture*, *Third Text* and *Fotocinema*. Her current research practice investigates the function of the photographic frame within immersive and extended reality environments. Her most recent article is "Plastic Borders: On the Photographic Frame and its Virtual Experience." In 2022 she organized a 'Virtual Photography Symposium' at the University of Westminster, focusing on the future of photography within the new, virtual spaces where still images operate.

Dominik Lengyel is full university Professor and holder of the Chair for Architecture and Visualization at BTU Brandenburg University of Technology Cottbus-Senftenberg. He is a member of the European Academy of Sciences and Arts in Salzburg. Since 2006 he has been the co-founder of an office for architectural visualizations with **Catherine Toulouse**, who has been Assistant Professor at the same Chair from 2006 until 2022. Lengyel and Toulouse have studied architecture at the universities of Stuttgart in Germany and worked as architects in the planning division of the architectural office of Prof. O. M. Ungers in Cologne, Germany. They have delivered numerous international lectures and publications as well as visualizations in other author's publications.

Jens Schröter, is full university Professor of Media Studies and Chair for Media Studies at the University of Bonn since 2015. He is co-director (together with Anna Echterhölter; Andreas Sudmann and Alexander Waibel) of the VW-Main Grant, entitled: "How is Artificial Intelligence Changing Science?" (Start: 1.8.2022, 4 Years). He has received various research fellowships, such as: Senior-fellowship IFK Vienna, Austria, Winter 2018; Senior-fellowship IKKM Weimar, Winter 2021/2022; and Fellowship at the Center of Advanced Internet Studies. His most recent publications are *Medien und Ökonomie* (Springer, 2019) and *Media Futures. Theory and Aesthetics* (co-authored with Christoph Ernst, Palgrave, 2021).

Ali Shobeiri is Assistant Professor of Photography and Visual Culture at Leiden University (NL). He is interested in interdisciplinary theoretical research at the intersection of photography, phenomenology, aesthetics, and human geography. His recent books include: *Psychosomatic Imagery: Photographic Reflections on Mental Disorders*, co-edited volume (Palgrave Macmillan, 2023); *Place:*

Towards a Geophilosophy of Photography, monograph (Leiden University Press, 2021); *Animation and Memory*, co-edited volume (Palgrave Macmillan, 2020); and *Oikography: Homemaking through Photography*, co-edited volume (Leiden University Press, forthcoming).

Amanda Wasielewski is Associate Senior Lecturer of Digital Humanities and Associate Professor of Art History at Uppsala University in Sweden. Her research investigates the use of digital technology in relation to art/visual culture and spatial practice. Her recent focus has been on the use of artificial intelligence techniques for the analysis and creation of art, photography, and other visual media. Wasielewski is the author of three monographs, e.g., *Computational Formalism: Art History and Machine Learning* (MIT Press, 2023). Recent articles include "Authenticity and the Poor Image in the Age of Deep Learning" (*Photographies*), and "'Midjourney Can't Count': Questions of Representation and Meaning for Text-to-Image Generators" (*IMAGE: Zeitschrift Für Interdisziplinäre Bildwissenschaft*, 2023).

Helen Westgeest is Associate Professor of Modern and Contemporary Art History and Photography Theory at Leiden University. Her research focuses on comparative studies of media in contemporary visual art, in particular the role of intermediality in the meaning production of artworks. She has published articles in peer-reviewed journals, as well as several monographs and edited volumes. Her book publications include: *Slow Painting: Contemplation and Critique in the Digital Age* (Bloomsbury, 2020); *Video Art Theory: A Comparative Approach* (Wiley-Blackwell, 2016); *Photography Theory in Historical Perspective: Case Studies from Contemporary Art* (co-authored with Hilde Van Gelder, Wiley-Blackwell, 2011, Chinese translation 2013).