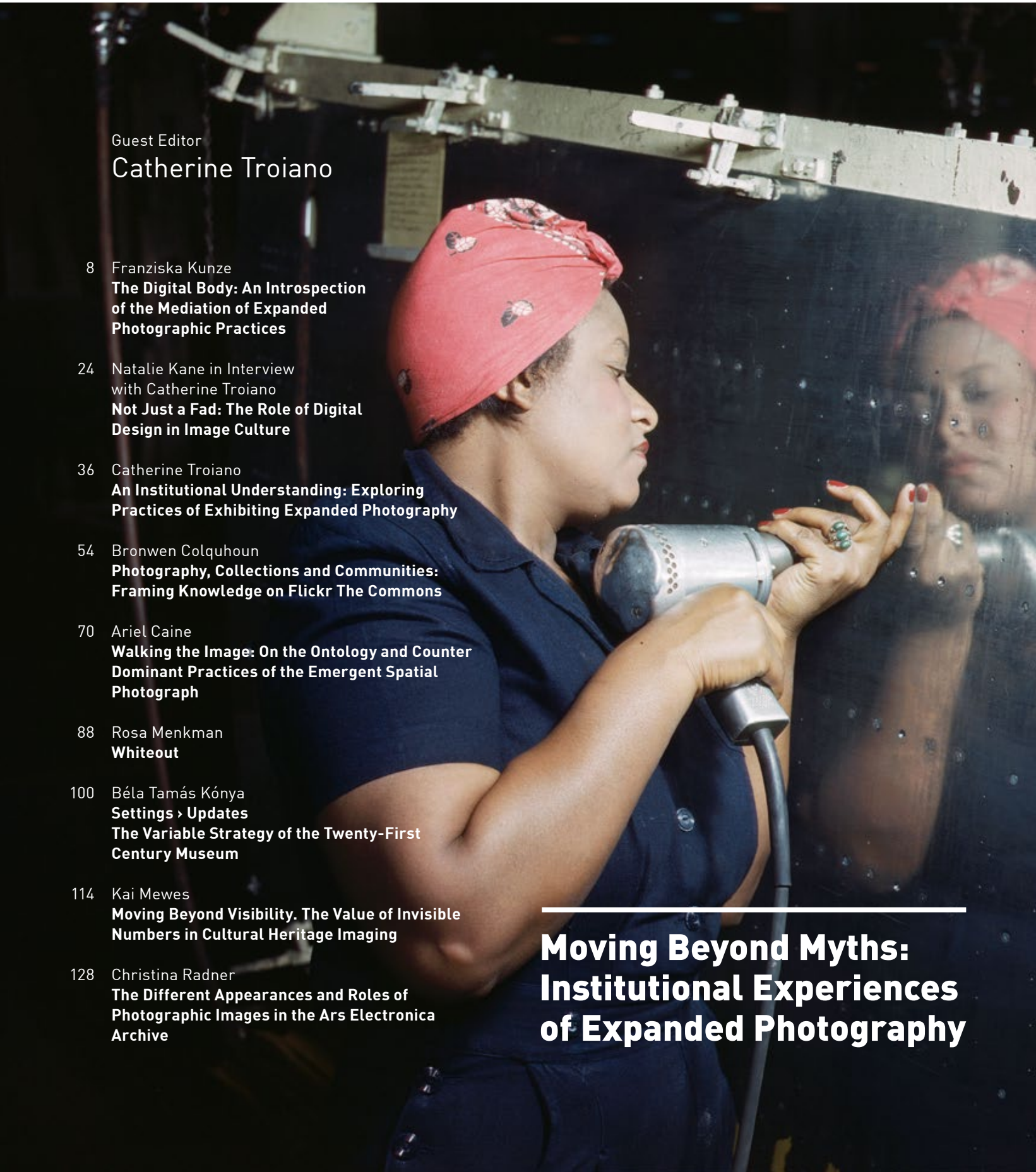
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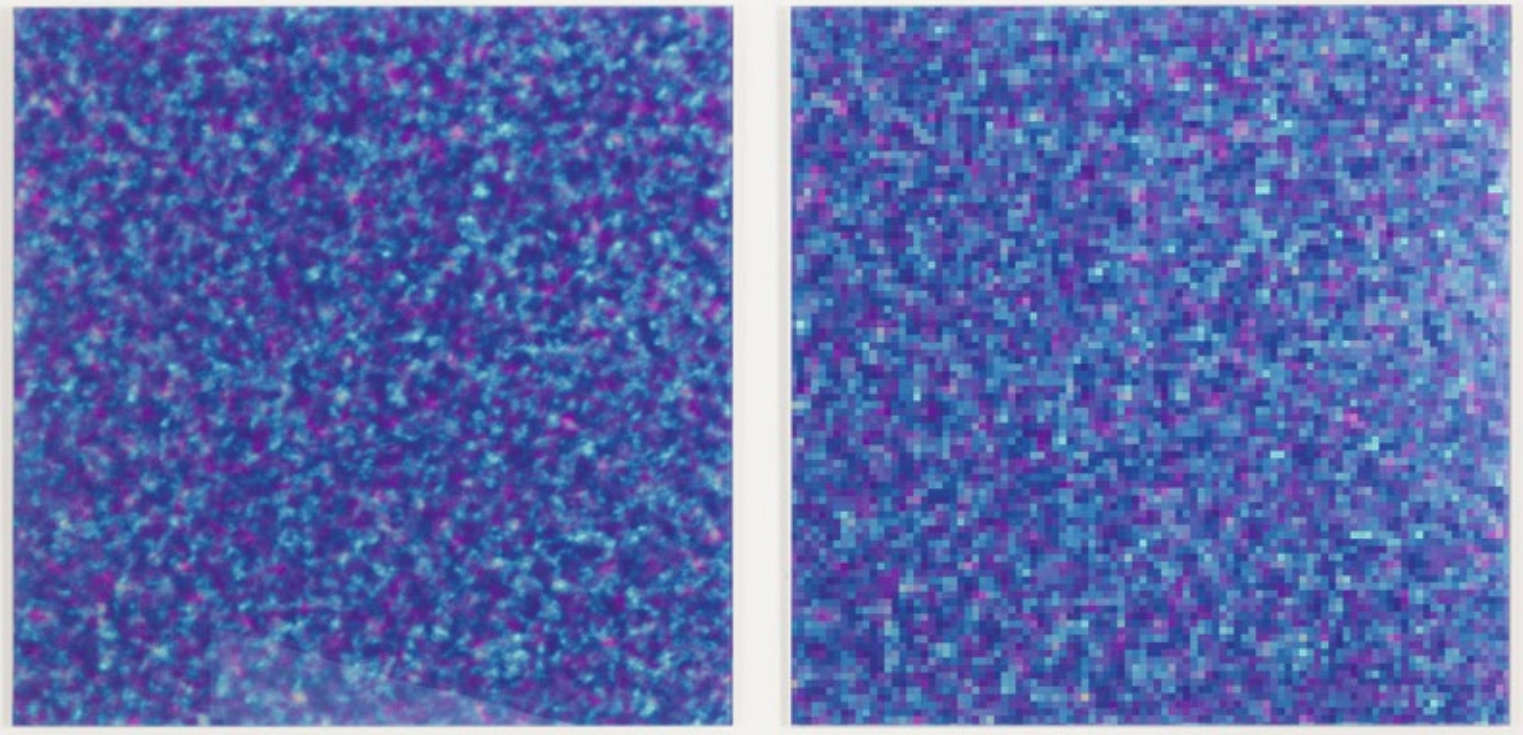
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Moving Beyond Myths: Institutional Experiences of Expanded Photography



The Digital Body: An Introspection of the Mediation of Expanded Photographic Practices

Franziska Kunze

Together with three of my friends I am standing – prepared and armed – in the middle of an abandoned factory. We know our mission: to fight against an ever-increasing number of zombies whilst making our way through the condemned building. I am focussed, shouting instructions to my fellow campaigners, always ready to duck, run and fire. During breaks in the firing, I cannot help but think of the fact that we are, actually, standing in a big, empty room merely equipped with full-body tracking systems and plastic rifles. The game master stands somewhere, watching us acting foolishly yet seriously in this room full of nothing. I smirk whilst taking in the surrealism of the situation. Then the next crowd of zombies appears and I am back in the game – duck, run and fire – absorbed in this virtual reality that feels, in fact, more real than virtual.[1]

This was both an intriguing and alarming experience for a passionate non-gamer and pacifist, as I would describe myself. Seeing and knowing the practical environment before entering a virtual world does not, evidently, preclude one from falling for it. You are in a space but, at the same time, you are not. You can see things but you cannot quite feel them, even if technological developments are close to achieving this. The sensation of haptics is already embedded in daily actions; for example, when smartphones vibrate underneath our fingertips. Here, devices are programmed for users to experience a direct physical interaction between digital images, transmitted through screen-based displays, and their own human senses. However, it is not the image itself that is felt.

What is a digital image made of? The prompt answer to this question might recall its numeric representation, referring to a binary number expressed in the base-2 numeral system which operates with just two symbols '0' (zero) and '1' (one).[2] In this system, the so-called bits (binary digits) are defined as the smallest unit of information a computer system can work with. Yet, 'being made of' triggers the notion of materiality, the physical experience of something that could be described with corporeality. Since digital imagery is increasingly capable of resembling lived experiences, this article aims to go all the way back to the origins of a digital image; back to the very make-up of base digital matter. What is it that digital artists work with? What is it that curators for expanded photographic practices and new media exhibit? What is it that conservators need to preserve? Again, what is a digital image made of?

Figure 1
Inge Dick, *Bleu du ciel, analog-digital,* 2001/2004/34, 2004, Ilfochrome prints on aluminium 50 × 50 cm each. Museum im Kulturspeicher Würzburg, collection Peter C. Ruppert © VG Bild-Kunst, Bonn 2020.

When looking at publications on digital cultures that have emerged mainly since the 1990s, theoretical engagement with the embodiment of digital matter is often overlooked. Instead,

1. Philosopher and media theorist Markus Rautzenberg credibly proposes to use the term *digital reality* instead of *virtual reality.* See Markus Rautzenberg, 'Wirklichkeit. Zur Ikonizität digitaler Bilder', in: Marcel Finke, Mark. A. Halawa (eds.), *Materialität und Bildlichkeit. Visuelle Artefakte zwischen Aisthesis und Semiosis,* Berlin 2012, 121.
2. Joe Farace, *The Digital Imaging Dictionary,* New York 1996, 24.

such texts tend to underline the so-perceived immaterial, transient, almost flawless existence of the digital image, full of endless possibilities. However, in 1997, when digital imagery started to rise on the horizon of creative production, Steve Holtzmann did not only reference the binary code as the 'nature' of digital representations. He also marked this fact as 'the ultimate limitation of digital technology'.[3] He continued that:

> [A]s fine as the granularity may be of any digital representation, even zooming in for seemingly infinitesimal resolution, there is ultimately a 0 or a 1. [...] By its nature, the digital world is discontinuous, so there will always be a gap of some sort in any digital representation.[4]

At a point when a wider circle of artists was beginning to explore the practical and creative opportunities afforded by digital technology, Holtzmann stressed its limitations resulting from the binary system. But he did not do so in order to dismiss these new processes as being incapable of offering anything new or unexpected. Instead, he seemed to express his admiration that, despite limiting code, a huge universe of possibilities was unfolding at the hands of programmers: "Today, however, when we peel away the layers of a digital world, strip it down to the equivalent of the flatness of Stella's canvas, we find only the binary nature of digital processes."[5]

But as pointed out at the beginning of this text, when facing digital imagery, one is scarcely able to peel away these layers. Digital imagery has reached a level of idealism within the representation of reality that some draughtsmen, painters and, especially, photographers and filmmakers have tried to achieve their whole lives within their media – chasing the idea to create images that resemble the reality they depict in the most convincing way. And some of them came very close. There are a number of images which, given their art style, reach this idea of aesthetic idealism that almost denies the artistic hand that created them. When looking at pictures such as these, they offer us a world far beyond the paper, canvas or film holding them; making it hard to draw one's attention back from the pictorial world and redirect it to the physical substances images are built with: the pencil line, the brush stroke, the grain ... and, of course, the pixel.

In 1996, Joe Farace published *The Digital Imaging Dictionary.* In the entry on 'pixel' he stated: "Pixels – the stuff digital photographs are made of – behave similarly to the silver grains that make up the

3. Steve Holtzmann, *Digital Mosaics. The Aesthetics of Cyberspace,* New York 1997, 164.
4. Holtzmann 1997 (reference 3), 164.
5. Holtzmann 1997 (reference 3), 165.

negative or positive images in the film you use. Thinking of pixels as film grain will get you on the road to understanding how digital imaging works."[6] Farace's suggestion to substitute pixel for the well-known silver grains within the chemical layers forming the film-based analogue photograph in order to understand their function was deliberate. There are other writings on digital technologies in which pre-existing picture vocabularies are incorporated without clear explanation. When speaking about the limitations of digital technologies – the binary code – Holtzmann used terms such as 'granularity' and 'zooming in'[7]; even Farace could not help himself using such language, when, similar to Holtzmann, he referred to its disadvantages: "At lower resolutions, photographs have a coarse, grainy appearance that make it difficult to evaluate the image."[8]

In these early days of dealing with digital imagery, there was no genuine digital vocabulary. Instead of creating new words, practitioners and theorists built on vocabulary that was already established, even if belonging to different technologies.[9] Pictures created with digital technologies resembled so-called analogue images more than other image production processes; or, to be more precise, they were crafted in a way that recalled an analogue photography aesthetic. This may also be one of the reasons why almost every filter and action performed in early image-editing programmes, such as Photoshop, owe their titles to a darkroom equivalent. Using such vocabulary may have contributed to easing the shift towards digital processes; however, it also obscured the fundamental technological and practical changes that accompanied that shift.

Transformation

What is a pixel, this "stuff digital photographs are made of"?[10] As an acronym for picture element, a pixel is a quadratic coloured dot of light. In combination with more of these dots it forms a raster image. Hence, the quantity of pixels determines the resolution and, therefore, the quality of a digital image. To be fair, a practical similarity to the silver grain cannot be dismissed. When zooming in to a photographic image, either grain or pixel becomes visible. The artist Inge Dick (b. 1941) reflected on this analogy in an artwork from 2004. *For Bleu du ciel, analog-digital, 2001/2004/34* (fig. 1), she made a colour film photograph of the blue of the sky. Then she scanned this image and turned it into a digital clone. In the final step, she selected a part of both images,

6. Farace 1996 (reference 2), 150.
7. Holtzmann 1997 (reference 3), 164. See the quotation behind reference 4.
8. Farace 1996 (reference 2), 149/150. Farace demonstrates this even further when he states at the beginning of his book: "Among the many advantages of a digital darkroom is that you don't have to work in the dark or get your hands wet – and there are no annoying smells to deal with." Farace 1996 (reference 2), 11.
9. Even the analogue photograph's language is derived from a comparison to known objects. One of Talbot's first records on the photographic apparatus reads: "The object glass is the *eye* of the instrument – the sensitive paper may be compared to the *retina*. And, the eye should not have too large a *pupil:* that is to say, the glass should be diminished by placing a screen or diaphragm before it, having a small circular hole, through which alone the rays of light may pass," William Henry Fox Talbot, *Pencil of Nature,* London 1844. Although one would not refer to the apparatus and its parts as eye, pupil or retina, there are still terms in use such as lens, which refers directly to the transparent and biconvex structure on the eye, or focus, which relates to human or animal physics.
10. Farace 1996 (reference 2), 150.

magnified them and arranged them as a diptych.[11] While the resulting images share the same colour values, they show significant differences in their aesthetic appearance.

The magnifying process rendered the uninterrupted blue surfaces of both images unique landscapes either of smooth hills of the now visible grains or staccato-like craters of pixels. It should be stressed that Dick's digital image was based on a film photograph. The original image – a view of the sky captured in-camera on light sensitive colour film – passed through a number of transformation processes which altered not only its appearance but also its make-up, which evidently impacted its physical manifestation. Dick executed both images using the Ilfochrome (also known as Cibachrome) printing process, which conceals, to some extent, the fact that they originated from differing techniques. However, arranged as a diptych their dissimilarity is yet revealed, leaving the spectator with a riddle to solve.

The powerful ambivalence within results of such transformations has been demonstrated by Rodrigo Alcocer de Garay's (b. 1980) *Waterfall* series (fig. 2) (2015). According to the viewer's first impression, the images, which appear to be strongly pixelated, follow a clearly digital visual language. But *Waterfalls* relied upon a whole range of transformation processes, which on closer inspection appeared to have inscribed themselves, palimpsest-like, into the final images. To make this work, Alcocer first tracked down GIF (Graphics-Interchange-Format) animations of waterfalls on the internet; already based on computer animations of several superimposed individual images. Then, he projected these GIFs onto a wall and – using long-term exposures – captured them on a black-and-white film. The GIF, which already had a certain degree of blur, developed an incomparably greater fuzziness as a result of the long-term exposure.[12] Finally, the resulting single image was regulated by means of a raster system so the pixel structure of the original GIF source could be seen.

At the same time, information about the intermediate product was obtained, whose chemical structure is not composed of pixels but – literally analogously to it – of grains. In this, Alcocer's *Waterfalls* were so often translated and retranslated through analogue and digital processes that they seem to be condemned to oscillate continuously between these two pictorial languages. As a consequence, *Waterfalls* does not provoke a particular format. Previous displays of the work have included prints ranging from 30 × 45 cm to 120 × 150 cm; small negatives placed on

11. See Henrike Holsing, 'Concrete Photography Today. Analogue and Digital', in: Henrike Holsing, Gottfried Jäger (eds.), *Light Image and Data Image. Traces of Concrete Photography,* exhibition catalogue, Heidelberg, Berlin 2015, 59.
12. See also Katja Böhlau: 'Lumen – Amen Transformationen des Lichts', in: ag friedhofsmuseum berlin e. V., Benjamin Kummer (ed.), *Lumen – Amen Transformationen des Lichts,* exhibition catalogue, Berlin 2016, 9.



Figure 2
Rodrigo Alcocer de Garay, (untitled), from the series *Waterfalls,* 2015, dimensions and output media vary. Owned by the artist © Rodrigo Alcocer de Garay.

lightboxes; or an installation dissecting the original moving GIF into individual, projected pixels.[13] This unfinished, processual approach to the series' presentation adds another layer to their already complex expanded identity; a phenomenon raised by Katrina Sluis, who pointed out the importance of curatorial strategies when exhibiting photographs that follow an expanded approach, as photographic representation is still valorised over reproduction.[14] Alcocer's plural approach to presenting *Waterfalls* references the range of paradoxes that underpin twenty-first century visual culture, the supremacy of which can even serve to undermine itself.

Pixel

While the pixel is the smallest controllable element of an image on an electronic screen, it is actually made up of bits. Therefore, the pixel itself is already a mediated version of a digital idea in which bits form a distinct, perceivable and usable shape. Although colour monitors process 8-bit RGB images, which means they use just red, green and blue signals, the spectrum of colours achievable is so enormous and colour tones so subtly graded that their variance is barely noticeable. The 16,777,216 different possible results are an astonishing, almost incomprehensible number. This number is the result of a complex mathematical calculation which artist Adrian Sauer (b. 1976) explains as follows:

13. Franziska Kunze and Rodrigo Alcocer de Garay, personal communication, October 2019.
14. Katrina Sluis, 'Post-Photography Should Not Be Curated?', in: *Still searching* …, Fotomuseum Winterthur, 29.10.2019, ‹https://www.fotomuseum.ch/en/explore/still-searching/articles/156569_post_photography_should_not_be_curated› (10.11.19).

> The number 16,777,216 results from technical considerations that have evolved from various requirements. In order to blend colours according to the additive colour system in the first place, the three primary colours are required: red, green, and blue (RGB). In order to perform calculations, the computer in turn requires numbers that are products of the power of 2, that is, that can be represented according to the binary system. [...] The human eye is deceived into perceiving the graduated transition from white to black in 250 steps. The power of 2 nearest to 250 is 256, or 2^8. Eight-bit means nothing more than 2^8. However, because three colours need to be combined in order to represent the entire spectrum of visible light, each of the 256 gradations are used in the three aforementioned primary colours. If one now wants to use each of the possible combinations between them, one arrives at 256^3. That results in 2^{24} or 16,777,216.[15]

Sauer gave this vast number a face, naming one of his works after it: *16,777,216 Farben* [eng. *16,777,216 Colours].* For this work, the artist effortlessly navigated the mathematics of the computational system and its aestheticised outcome, developing a bespoke computer programme capable of producing images containing all of these colours exactly once. Sauer arranged the 16,777,216 coloured pixels randomly using an algorithm also generated by him, resulting in digital C-type prints up to 125 × 476 cm in size. When looking from a distance, the image appears to have an even and grey surface (fig. 3). But approached more closely, the exceptional range of possible colours becomes discernible to the observer (fig. 4). Thereby, "[t]he picture is a meditation on the possibilities, and the lack of possibilities of digital colour mapping," Kathrin Schönegg argues, "because it shows that while the scope of the new media appears to be endless, in fact it isn't."[16]

Yet, the experience when approaching the work can be described as overwhelming. It is hard to say at what distance the shift from a plain grey to a flickering, colourful perception of the artwork's surface takes place. The limitation of colour range – if, given the number of tones, this term is even appropriate – seems to mirror the limitations of perception in the human eye, which cannot discern the richness of colours from a distance nor distinguish between the subtle range of colour hues coming from the same spectrum. Sauer's highly calculated and manipulated method emphasised this gap in ability between the viewed and the viewer, reinforcing the notion that the pixel's pure existence, autonomous from human volition, can hardly be experienced in any digitally created image.

15. Adrian Sauer on: ‹https://www.adriansauer.de/arbeiten/16-m/i/214#anchor› (23.09.19).
16. Kathrin Schönegg, 'Mirror Without a Memory', in: *Adrian Sauer. Spektren,* Stadt Kornwestheim, Museum im Kleihues-Bau, Saskia Darms (eds.), exhibition catalogue, Altenried 2019, 26.

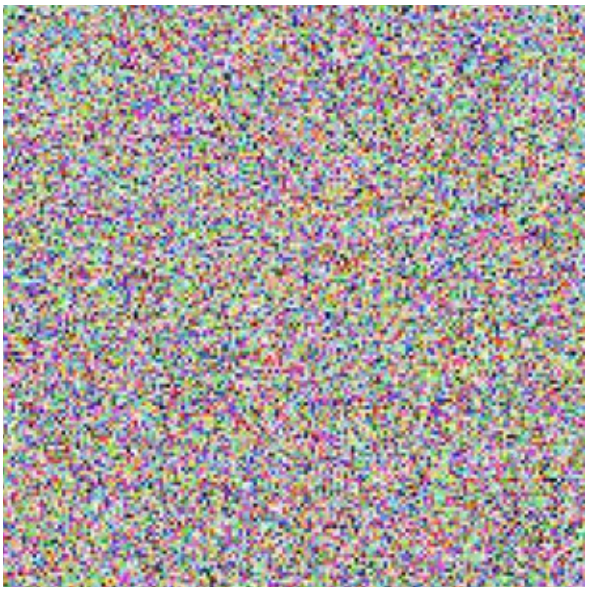
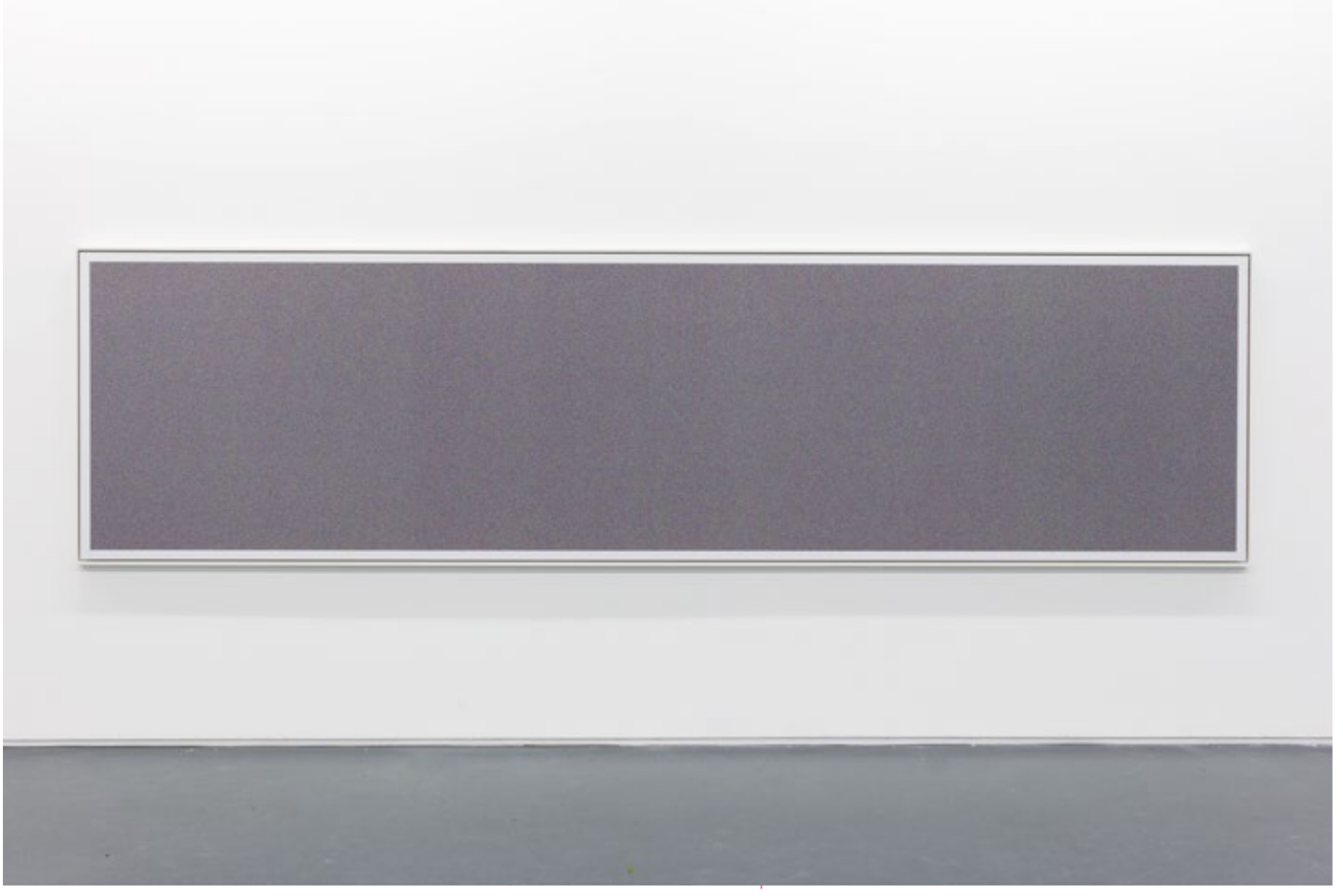


Figure 4
Adrian Sauer, 16.777.216 *Farben* (detail), 2010/11,
digital C-type print 125 × 476 cm.
Museum Folkwang Essen © Adrian Sauer.

Figure 3
Adrian Sauer, 16.777.216 *Farben* (exhibition
view), 2010/11, digital C-type print 125 × 476 cm.
Museum Folkwang Essen © Adrian Sauer.



Christian Doeller (b. 1987) tried to find a way to obtain "the minimum image,"[17] as he put it. On this ambitious search, he used his digital camera as a black box by leaving the cap on the lens and then forcing the camera to release its shutter. At first glance, the 134 × 201 cm inkjet print on aluminium titled *730331879* (fig. 5) appears to be a pure black rectangular surface. On closer inspection, the image reveals a similar sensation to Sauer's work: a galaxy of small coloured pixels scattered over the otherwise deep, black picture surface. Unlike Sauer's image, these do not appear in a constant rhythm; sometimes as single, errant solitaires, sometimes in small randomly arranged groups (fig. 6).

What the viewer faces here are defective pixels, so-called 'hotpixels'. These deviations of information are primarily caused by increased temperatures of the image sensor during long exposure times, expressed in the appearance of coloured pixels. But no matter how random their arrangement may look, the position of these pixels is uniquely fixed for each digital camera. Consequently, the title *730331879* refers to the manufacturer's serial number of the camera used by Doeller. The artist wanted these hotpixels to be understood as "self-portraits of the sensor"[18], thus freeing them from the accusation of error. Furthermore, his valuing of the digital image production process is exactly what stimulates a view of the digital image's 'body'.

However, this picture poses a challenge. It is unexpected, it can hardly be read: it is anything but easily recognisable from the outside world. The title does not attempt abstraction, which could have been easily achieved by naming the image 'galaxy', aligning the supposed motif and its title, and granting the spectator a feeling of satisfaction. Instead, it refuses any sort of common imagery and, hence, legibility, leaving viewers without these often-applied frames of reference.

17. Franziska Kunze and Christian Doeller, personal communication, March 2017.
18. Christian Doeller cited in *Light Image and Data Image. Traces of Concrete Photography,* Henrike Holsing, Gottfried Jäger (eds.), exhibition catalogue, Heidelberg, Berlin 2015, 196.

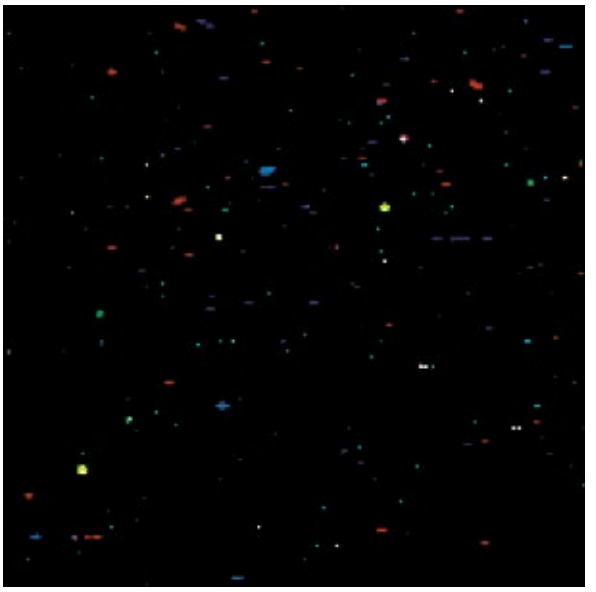
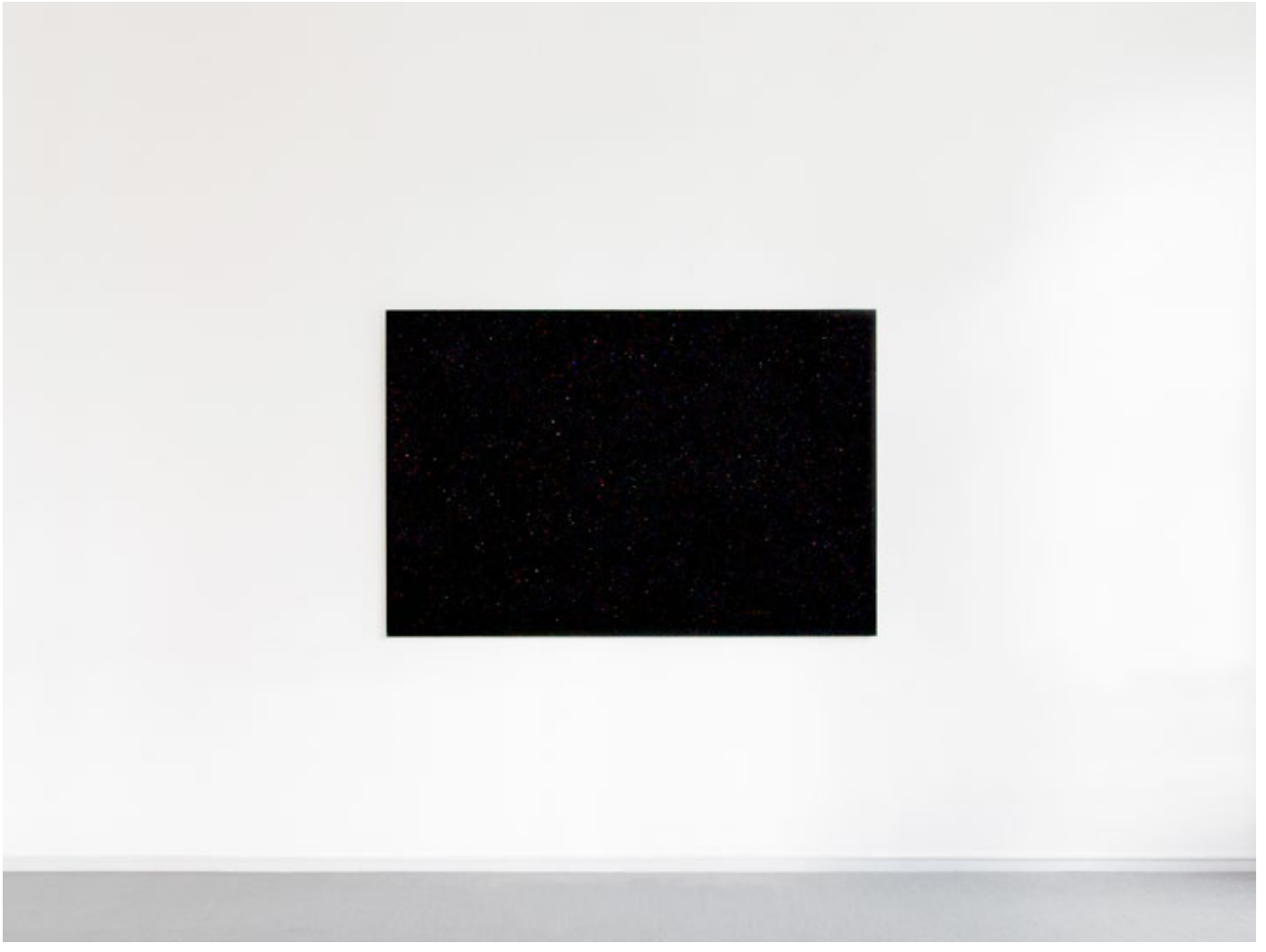


Figure 6
Christian Doeller, *730331879* (detail), 2014, inkjet print on aluminium from a digital photograph 134 × 201 cm. Owned by the artist
© Christian Doeller.

Figure 5
Christian Doeller, *730331879* (exhibition view), 2014, inkjet print on aluminium from a digital photograph 134 × 201 cm. Owned by the artist
© Christian Doeller.



Glitch

Aside from manipulation-led approaches, unforeseen flaws, errors, mistakes and accidents have often led to new insights by revealing distinct information about how a photographic image is composed and how it functions. The notion of *glitch* is known to almost everyone who uses digital cameras or computers to process images. Glitches can occur in different stages of image processing; for example, when compressing or uploading, or when altering file format. Suddenly, distortions, blurs or completely pixelated areas take over and obstruct the illusion of reality created by the source image.

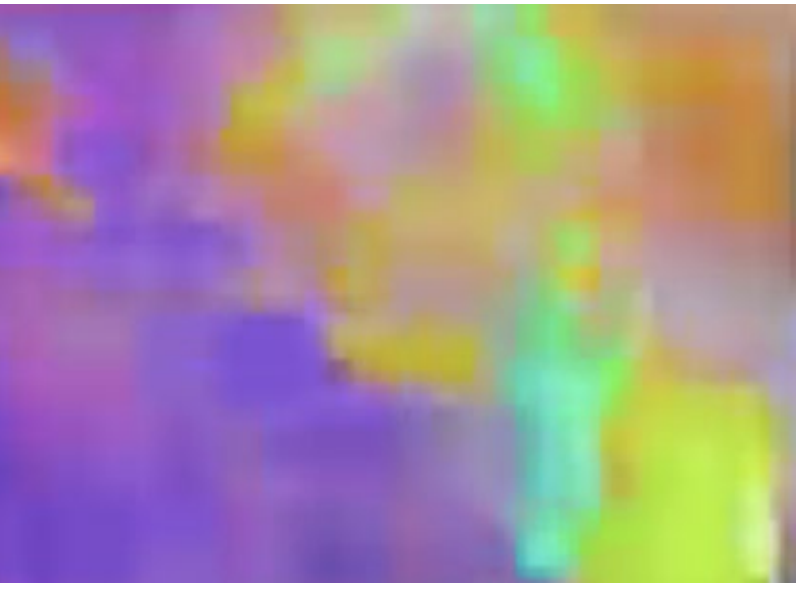


Figure 7
Esther Hunziker, *Frequency* (video still), 2008, digital video 16:12 format, 3' loop. House of Electronic Arts Basel © Esther Hunziker.

Rosa Menkman (b.1983) fathoms, in an almost alphabetised manner, the potential of digital glitch, discussing digital glitches from a theoretical, as well as an artistic, point of view in publications such as *A Vernacular of File Formats* (2010) and *The Glitch Moment(um)* (2011). Esther Hunziker's (b. 1969) work embodies many of these theories. To make *Frequency* (2008), Hunziker used found film footage of a live concert, compressing the movie file repeatedly until the band's motions dissolved into continuously changing colour fields (fig. 7). This was looped into a three minute-sequence and underlaid with a bespoke soundtrack:

> Signals, noise, frequencies, snatches of sound, distant voices. The movie signal is hardly to be recognised. Blurred edges, smeared images. Everything melts. Melts away. The absence of concrete images and the electrospheric soundtrack from overlapping radio frequencies, causes an abstract hypnotic void, a space without beginning or end, without clear structures.[19]

Visually, this leaves the spectator with post-compression matter, presenting a parallel universe of the original file. Despite its relationship to the original, this matter is alien to spectators who are used to images that resemble their world. This is lost in translation in a universe of barely decipherable code.

19. Esther Hunziker on: ‹https://estherhunziker.net/frequency/› (23.09.19).

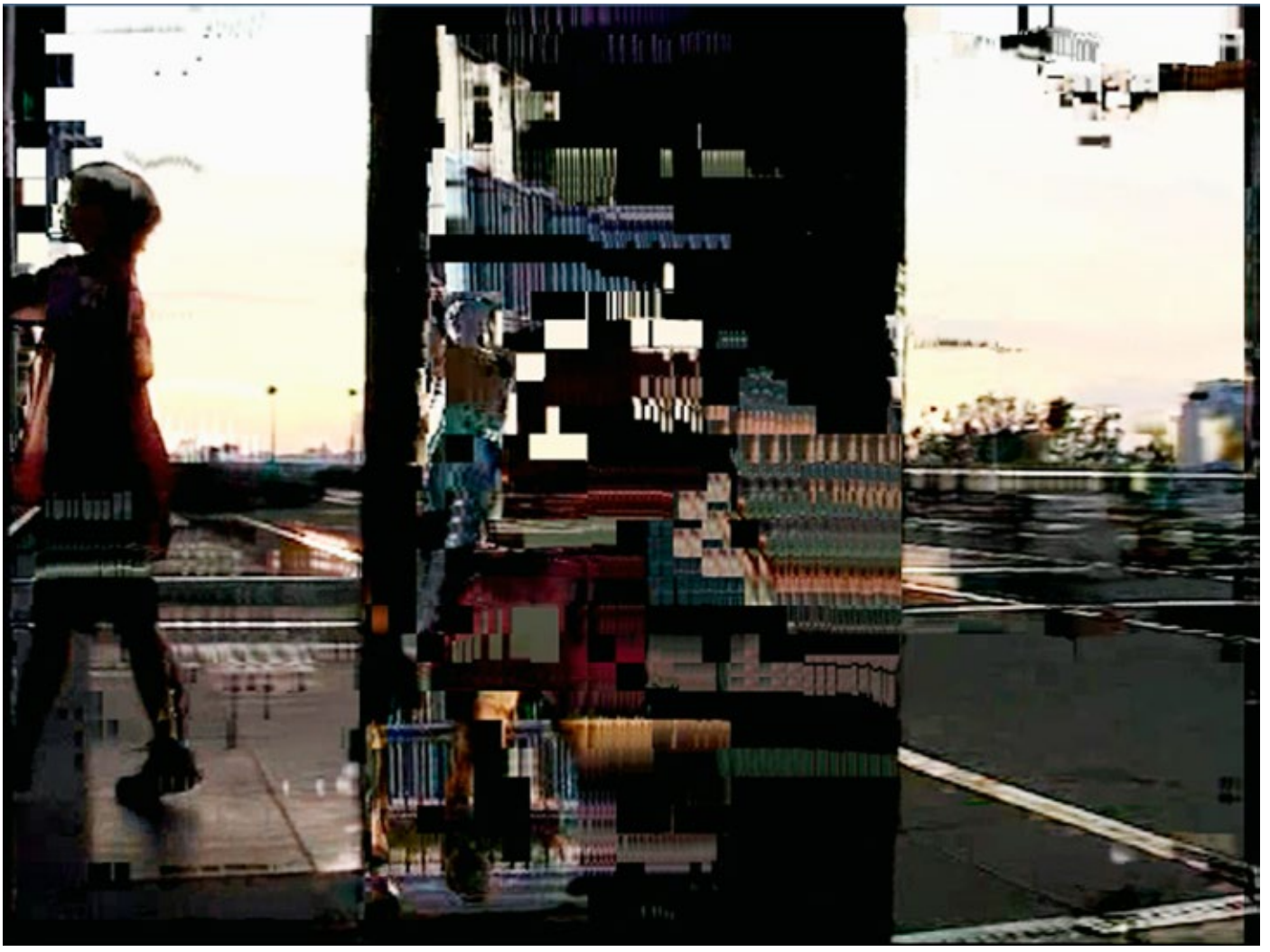


Figure 8
!Mediengruppe Bitnik, *Download Finished – The Art of Filesharing, Study 3 from (Ballet Modern) Anne Teresa De Keersmaeker – CounterPhrases.avi___finished.avi, downloaded by Oscar de Franco* (video still), 2006, web archive digital video, 3 films in PAL MPEG-2, 720 × 576 px format, website consists of 1420 static pages and 1409 films in HTML5, web server (Nginx, Apache) with PHP5 enabled; server space: ca 140 GB, 5' loop. House of Electronic Arts Basel © !Mediengruppe Bitnik.

A similar approach was pursued by !Mediengruppe Bitnik, an artist duo (Carmen Weisskopf (b. 1976) and Domagoj Smoljo (b. 1979)) who collaborate with filmmaker and researcher Adnan Hadzi (b. 1973) and reporter Daniel Ryser (b. 1979) to unleash a creative group dynamic. In 2006, !Mediengruppe Bitnik, in collaboration with Sven König (b. 1975), realised the digital project titled *Download Finished – The Art of Filesharing.* It is based online as a resource which transformed and re-published films from P2P networks and online archives, allowing users to share and upload movies through the website www.download-finished.com. This 'found' footage is the rough material the group then runs through their transformation machine, which translates underlying data structures of films onto screen-based displays (fig. 8).[20]

What looks like glitch and irritates human perception is actually the now-visible hidden data structure of uploaded moving images, consciously brought to observation through numerous complex transformation processes: "it has been digitized, encoded and compressed, applying complex mathematical transformations to the original data."[21] In 1992, William J. Mitchell

20. See !Mediengruppe Bitnik on: ‹https://www.bitnik.org/d/› (23.09.19).
21. !Mediengruppe Bitnik on: ‹http://www.download-finished.com/faq.html› (29.09.19).

asserted that any digital file copy is indistinguishable in quality from the original.[22] !Mediengruppe Bitnik disproves this assumption, inscribing digital translations and adding image layers that are brought into seeing through their technical approach; showing "the digital nature of the input data."[23] "Download Finished questions the relationship between the original and its copy in a digital environment"[24], the artists underline. They demonstrate the modification of original data during processing:

> A film found in a filesharing network is the sum of [>1] the original film, [>2] the work of the mathematicians who laid the theoretical foundations for [>3] the programmers who designed the encoding software / the codec and [>4] the file sharer who finally uses all that software to intentionally make the [>5] film widely available. the processes behind [2] - [4] usually stay invisible, leading to the wrong assumption that [1] = [5]. download finished transforms [5] such, that the processes behind steps [2] - [4] become visible and show that films found in file sharing networks are actually collaborative works. the transformation process in download finished shows the collaborative effort behind the sharing of cultural contents and clearly shows that [1] ≠ [5].[25]

It is often said by a digitally sceptic audience that digital works of art lack the notion of singularity, uniqueness and craftsmanship. Evidently, this opinion derives from a lack of knowledge about digital processes employed by artists. For example, as Fred Ritchin argued, the visual representation of a jpeg-image is just the tip of the iceberg; behind this image is an incomparably more extensive algorithm.[26] !Mediengruppe Bitnik's approach demonstrates this fact by literally unpacking the allegedly 'immaterial' body of the digital image, showing what is usually hidden beneath its surface nevertheless constitutes the image.

Matter/Material

As a result of such transformation processes, the idea of the so-called master tape has become crucial in relation to digital artworks. It claims to be the original copy – created directly by the artist – which can be used to produce other copies; for example, for exhibition displays. Moreover, it guarantees that any copy originates directly from the master tape, guaranteeing minimal divergence. Master tape hardware needs to be chosen, stored and preserved with care. However, the media through which digital artworks are experienced play another important role, they

22. See William J. Mitchell, *The Reconfigured Eye. Visual Truth in the Post-Photographic Era,* Cambridge, London 1992, 6.
23. !Mediengruppe Bitnik (reference 20).
24. !Mediengruppe Bitnik (reference 20).
25. !Mediengruppe Bitnik (reference 21).
26. Remark by Fred Ritchin during his presentation on 'Image/Text – Image/Hypertext' at the conference *image/con/text. Complementary Testimonies in Documentary Discourse,* University of Applied Sciences and Arts Hanover, 29. October 2019.

assign a certain shape and, therefore, a material body. Bits are the substance at the base of digital image matter, but pixels take on their mediated form. These pixels can materialise in numerous ways, depending on how they are further mediated to be perceived.

'Virtual', 'immaterial', 'ephemeral' and 'disembodied' are all terms used when describing digital technology-based images. Already in 1995, Martin Lister came to an enlightening conclusion in the very first sentence of the introductory essay published in *The Photographic Image in Digital Culture.* He wrote: "On any socially significant scale, digital images first became visible on computer and television screens, and on the pages of magazines and newspapers, in the late 1980s."[27] With this, Lister began his anthology by thinking about the fact that a digital image owes its visibility to a certain output format. In 2018, Anna-Kaisa Rastenberger stressed the fact that any technological device forms its own material network, however, they remain somehow unnotified by offering the idea of a window to look through. Eventually, these devices lose any immaterial character when they stop working: "[W]e suddenly become very much aware of the physicalness of the obstinate glass, which becomes a barrier to our productivity,"[28] not to mention to our desire to look at a moving or still image.

A digital image is no less material than a painting. Both derive from an idea – nothing more than a thought – that their creators once had and, by using different tools, materials, techniques, result in a visually perceivable object. However, making use of computational processes adds a certain complexity to the image creation process that may appear as autonomous; in fact, computational processes are man-made, based on programmes or algorithms written by human authors such as Adrian Sauer.[29] Like Sauer, all the discussed artists needed to consider display of their works. While Rodrigo Alcocer de Garay changes his approach with practical circumstances, Adrian Sauer and Christian Doeller chose a distinct and final form: a digital C-type print for the former and an inkjet print on aluminium for the latter. Each screening or projection of digital videos made by Esther Hunziker or !Mediengruppe Bitnik has the power to change the experience of those works significantly. Since these images and films were created or at least altered with a computational device, their material output is not absolute.

Considering the increasing number of artworks that involve electronic screens, Rastenberger identifies the variance of the verb 'to display' in the context of art exhibitions.[30] Whereas a

27. Martin Lister, 'Introductory Essay', in: Martin Lister (ed.), *The Photographic Image in Digital Culture,* London 1995, 1.
28. Anna-Kaisa Rastenberger, 'Why Exhibit? Affective Spectatorship and the Gaze from Somewhere', in: Anna-Kaisa Rastenberger and Iris Sikking (eds.), *Why Exhibit? Positions on Exhibiting Photographies,* Amsterdam 2018, 104–105. See also Ruth Maurer-Horak, 'Die Krise des Motivs in der Fotografie', in: Tamara Horáková + Ewald Maurer, Johanna Hofleitner and Ruth Maurer-Horak (eds.), *Image:/Images Positionen zur zeitgenössischen Fotografie,* Vienna 2001, 178.
29. In her book *Nonhuman Photography* (2017), Joanna Zylinska calls the interaction between the device and the photographer/artist a "human-nonhuman assemblage" (p. 198), clarifying that both take part in the imaging process and that all photography has had to defend itself against the accusation of being purely technical.
30. See Rastenberger 2018 (reference 28), 101.

screen offers the possibility to zoom in and out, the spatial requirements of a physical exhibition space may not facilitate this. The printed individual images earlier discussed necessarily come in large-scale formats, so single pixels can be discerned. This applies to their publication in books or magazines: the aspiration to publish images in their entirety, even in this article, requires an additional picture to give a detail view. Furthermore, printed publications render all images equal, regardless of their original format and unique or reproducible processes, either on paper pages or a screen.[31] This reiterates the notion that though the circulation and experience of images has changed, their allocation as 'immaterial' is false.

The urgency to deal with the significance of digitally-mediated imagery – its structure, (re-) presentation, usage and perception – is reflected by the rising theoretical interest in the so-called post-photographic era.[32] Institutions such as Fotomuseum Winterthur have dedicated significant efforts to this topic. In their SITUATIONS cluster *Lab* (2018), they offered an elaborate insight into their research on photography's increasingly expanded mediations. Within this cluster, SITUATION #145: *Mapping Post-Photography* presented the most popular and influencing terms on the photographic coined by scholars, artists and theorists. By presenting these in loose groups within the exhibition space, they did not only create relationships but visualised the mutual search for appropriate terms to describe elusive forms of photography, including poor, dubitative, operational, post- or nonhuman, soft, programmable and many more.[33]

Additionally, the increasing number of study programmes for the history and theory of photography at universities in Essen (Germany), Zurich (Switzerland), Leiden (the Netherlands), London and Leicester (both England) make evident that photography cannot anymore be treated as one item on the agenda of art history programmes; although, tendentially digital and expanded aspects of photography could feature more prominently on the emerging photography-specific courses. Recurring photography conferences, such as Helsinki Photomedia or After Post-Photography in St. Petersburg, aim to discuss photography with a mentionable focus on digital matter with an invited group of international experts. Book projects such as *Why Exhibit? Positions on Exhibiting Photographies* edited by Anna-Kaisa Rastenberger and Iris Sikking are a symptom for the need to discuss the path of the digital image through different perspectives.

31. Captions can also help to differentiate between these various media. Although captions can simplify images by typifying audience responses, they are also powerful and underestimated tools which impact readers' understandings of images that are published (and therefore mediated).
32. The term 'post-photography' was coined in the 1990s, specifically used by Marie Carani in 1999 as a term to function as an alternative to 'postmodernist photography'. Since this point, it has changed substantially in meaning and implementation; here, and in its implementation at Fotomuseum Winterthur, it is intended to signpost an awareness around the technological, social, behavioural, cultural and political shifts around photography, for which better terminology has not yet been developed.
33. Find the list of texts they considered on Fotomuseum's website: ‹https://www.fotomuseum.ch/en/explore/situations/155203› (10.11.19).

Consequently, the introduction of digital curators to art museums – for instance at Fotomuseum Winterthur and The Photographer's Gallery, London – likewise mirrors the great demand for expertise in this field. It feeds other, more radical, museological approaches: for example, House of Electronic Arts Basel exclusively collects new media art works; the digital museum teamLab Borderless, Tokyo is not made for but made of digital art; and, using VR equipment, the Digital Museum of Digital Art (DiMoDA) offers a full body experience on-site at changing venues or online.

"What is real? How do you define 'real'? If you're talking about what you can feel, what you can smell, what you can taste and see, then 'real' is simply electrical signals interpreted by your brain,"[34] Morpheus ponders in the movie *The Matrix.* Taking into account that, in most modern computing devices, a bit is usually represented by an electrical voltage or current pulse,[35] in the end killing zombies in a VR game likewise is an interpretation by the brain and, hence, real.

34. Morpheus in *The Matrix,* directed by Andy und Larry Wachowski, 1999, minute 40 approximately.
35. See Konrad Zuse Internet Archive, ‹http://zuse.zib.de/bit› (29.09.19).

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