ARCHIVAL SAMPLING, ITS PROVOCATION BY SIGNAL RECORDING, AND FINAL SYNTHESIS IN DIGITAL SIGNAL PROCESSING. "Photofilm" in a media-epistemological perspective

[lecture at conference *Photofilm: Sampling the Archives* Samstag, November 18, 2017, at Open Society Archive, Budapest, 14th VERZIO Human Rights Documentary Festival]

Foreword

Academic analysis, especially in cultural studies, has been concerned with "the archive" for years, in its sense as agency of cultural memory. More recently, a kind of Heideggerean *Kehre* has happened, turning the perspective upside down by focussing on the precise technologies of storage (be it analog, or "digitally" coded) which is the kernel of what becomes cultural "tradition" at all.

Therefore media archaelogical will less concentrate on "photofilm" as genre and its roots in the contemporary image archive, but lay the conference theme *Sampling the Archive* one level deeper, which is the techno-logical layer of time-discrete digital *sampling* as the core operation of transducing, transforming and quantizing analog signals from the physical world into binary information - a "transsubstantiation" indeed, almost in terms of Catholic religious liturgy. This functional technical operation is embedded within a media-epistemological frame (the Heideggerean *Ge-stell*), inducing a chronopoetic analysis of "technified" temporal intervals / cuts / slices. The discrete nature of the archive, thereby, is not identified in its administrative sense as institutional agency of cultural memory (especially Photo- and Film Archives and related Media Libraries), but in its micro-archival operations. This comes close to Foucault's neologistic application of that term (French *l'archive*), which rather relates to the Kantean notion of (archaeo)logical "conditions of possibility" (*a priori*) for memory in media culture at all. Central topics therefore are

- *l'archive* behind the so-called "digital archive"

- the techno-numerical micro-drama of A/D-conversion (the essential media-theatrical scene) as a concretisation of photofilm-like discretization of the present moment, and finally

- the algorithmic essence of digitisation as micro-archival operation (French *triage*, English *discard*, "Kassation" in German archival terminology), which is: *sampling* resulting in data compression.

Different from the electronic video or television image which is analog 625 line-by-line sampling of visual evidence given within twice the temporal half-frame of a 25th of a second, cinematography has initially been most literally "photo-film" already: the chrono-photographical sampling of movement or objects with a 24 frames / sec. frequency. If the essence of kinematographic analysis on celluloid is understood in its time-discrete act of recording, it is not simply an old medium outdated by "digital cinema", but re-appears as the core operation of digital sampling. Sampling the archive of the past may be a way of creative artistic research and recollection; but if the term sampling is used as a

terminus technicus of digital recording, recent technologies are archiving the present, first of all.

An intermediary level between the genre "photofilm" and operative sampling are experiments with the chrono-photographic form, such as the uncanny Ken Burns-effect, or Angela Bulloch's macro-pixel slowdown of (almost) "stilled" film classics like Antonioni's *Zabriskie Point*; or Douglas Gordon's installation *24 hours Psycho* from 1993 which slows down Hitchcock's film classic *Psycho* from 24 frames/sec. to 2 frames/sec., resulting in a projection of 24 hours.

The other side / site / sight of photofilm is Hiroshi Sugimoto's classic long-time photographic exposure of classic movie theatre screens when finally all the projected images merge into one bright light - "an extreme condensation of time"[1] - which immediately reminds of a parallel world, the "sonofilm" or "fotosound", such as the half-millenium extending "performance" of John Cage's composition Organ²/ASLSP (As Slow as Possible) in Burchardi church at Halberstadt, Germany, where a every tone lasts for years until the next key is dramatically struck. In synaesthetic consequence, the DVD "documentary" of the Halberstadt organ installation is partly "photofilm", partly chronophotography.[2]

Furthermore, there is Martin Reinhard's *tx-Transform* which implements the Slitscan recording technique reversing the time- and the space-axis (just like an "explosion" diagram of a technical artefact), and other technological or algorithmic explorations in cinematic multi-dimensional time axis manipulation. The archaic chrono-photographic sampling of the present moment returns within current digital signal processing itself.

A real archive of movements: The *Encyclopaedia Cinematographica*

"Photofilm deconstructs cinema into single frames, language, sound, music - and treats its elements as independent components" (*Photofilm* conference draft). In that sense, photofilm is counter-balanced by the oxymoron of "photography of mouvement" which is kinematography in its most literal sense. At the Göttingen Institute for Scientific Film, between 1952-1994, on initiative by Gotthardt Wolf and ethologist Konrad Lorenz, the *Encyclopaedia Cinematographica* project has collected up to 4000 2-minute film samples (so-called *Bewegungspräparate*) of periodically repetitive expressions, mostly animal motion like birds on-the-fly, and occasional ethnologic ritual dance - which is a media-archaeological recursion of Muybridge's *Animal Locomotion* and Marey's chronophotography. The filmic encyclopedy has been organised in a systematic matrix, intended to map the world of movements. Instead of sampling the film archives, film here, by samples of the moving world, results in an archive of motion - which is the true, media-archaeological message of cinematography, below its apparent success as big frame rate carrier for

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1 Mary Ann Doane, Has Time Become Space?, in: Liv Hausken (ed.), Thinking Media Aesthetics. Media Studies, Film Studies and the Arts, Frankfurt/M. et al. (Peter Lang) 2013, 89-108 (90)

2 See DVD edition booklet Groschup / Weckwerth (eds.) 2013

narrative content. "Film has been reduced to its very essence: the depiction of movement."[3]

[See "Demo-Video" Encyclopaedia Cinematographica, https://www.youtube.com/watch?v=ojNJPWUiz-E (accessed November 11, 2017)]

In the case of the Encyclopaedia Cinematographica, the kinematographic recording itself is the message; elementary so-called "Kinematograms" gain coherence not from external (i. e. alphanumeric, metadating) criteria but from the sequence of "stilled movements" itself.

The EC, while (mostly) being composed of animal locomotion, comprises non-organic physical "dance" as well: material mouvement performed by inanimate matter like the steam machine. With the machine rhythm, the film-mouvement becomes subject and object of cinematography itself.

Typographic temporality

Has "photofilm" in its aesthetics of apparently motionless image sequences realized what Henri Bergson has missed in early cinematography which is film itself as endurance, *durée*? Or is it a re-mediation of photography to film, a quality which Marshall McLuhan claimed for an appropriate "media ecology" where the new technologies do not discard with the old media but rather subtly displace them, while maintaining qualities and virtues of the preceding ones?[4]

The phonetic alphabet as cultural technique of speech-writing once "made possible the visual and uniform fragmentation of time. <...> In the space-time world of electric technology, the older mechanical time begins to feel unacceptable."[5] McLuhan affiliates cinematography to the Gutenberg era of mechanical print technology, in contrast to the "flying spot" of the cathode ray tube, with its beams of electrons with no real "momentary" fixation (except the Iconoscope capacitor mosaic for intermediary storage and amplification). In linear scan line video and television, there is no discrete "picture element" like in alphabetic writing or photo-based film, rather a volatile, transient electron bombardment. The subtitle of Otto von Bronk's patent from 1902[6] expresses the descriptive dilemma for that new form of media-temporal existence: "Verfahren und Vorrichtung zum Fernsichtbarmachen von Bildern bzw. Gegenständen unter vorübergehender Auflösung der Bilder in parallele Punkreihen." *Nota bene*: the floating image is arrested here into punctual stills. The inverse correlation to the "photofilm" is the hypothesis of so-called "picture

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3 Comment by hypnotix321, published on Apr 14, 2011; https://www.youtube.com/watch?v=ojNJPWUiz-E (accessed November 11, 2017)

4 See Baruch Gottlieb, Towards a Reasonable Ecology among the Media themselves, on occasion of the symposium *Moment of Truth. For a Reasonable Ecology between the Media*, Royal Academy of Art, The Hague, September 2017, Den Haag (West) 2017

5 McLuhan 1964: 147

6 No. 155528, granted since June 12, 1902

elements" in electronic images indeed - an oxymoron which erraneously oscillates between the analog scan line video image and the digital pixel.

Geometrization of time?

Film-artistic "communicating and processing of archives" deals with its "personal, subversive reinterpretation" of official documents, and "is concerned with the emergence of memories that result from the programmatic processing of photographic archival material, as well as the archaeological excavation of previously stored 'impressions'" (as expressed in the *Photofilm* conference draft). But let us not be seduced by the archaeological metaphor. Any film-artistic working with(in) an archive is only phenomenologically "based on the experience of memory" (ibid.), but in fact subject to the radically non-mnemonic logics of administration (the symbolic order) and the techn-logics of storage.

The field of media theory is split between two very different approaches to this photographic and cinematographic memory: Media archaeologists describe the nondiscursive practices of the techno-logical archive, while media phenomenologists "analyze how phenomena in various media appear to the human cognitive apparatus, that is, to the mind and senses"[7].

The media-archaeological understanding of the archive is biased by the technomathematical analysis (the techno-*studium*), not mistaking storage for memory or even remembrance. The phenomenological reading of the archive corresponds with the Barthesean *punctum* when miracolously something like an electric spark crosses and short-circuits the temporal gap between the record from the past and its present reading.

But caution: An encounter with the past as personal "unearthing" of various material at an official place of memory authority only in the human imagination consists of a "search for the lost time" (*Photofilm* conference draft). The term *temps perdu* itself, even if is has the literary connotation of *A la recherche du temps perdu* nowadays, in fact has been borrowed by Marcel Proust from Hermann von Helmholtz' techno-physiological measuring of human nerve signal runtime and latency[8], which is time-critical, pre-cinematic nervous (re-)action in the subconscious.

[Fig.: "virtual laboratory" GIF animation FROSCHWECKER resp. KYMOGRAPHIONVERSUCH]

According to Bergson, the human act of memorization is kind of an inner cinematography; the philosopher criticized the chrono-photographic sampling of continuous movement as a "mathematic" delusion. This technical metaphor matches G. W. F. Hegel's concept of cold mechanic memory as opposed to remembrance as subjective interiorization, literally expressed in the German term "Er-Innerung". While photography geometricizes the temporal moment

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7 Kjetil Jakobsen, Anarchival Society, in: Eivind Røssaak (ed.), The Archive in Motion. New Conceptions of the Archive in Contemporary Thought and New Media Practices, Oslo (Novus) 2010, 127-154 (141), referring to Wendy Hui Kyon Chun, in: Chun & Keenan 2006, xxx, 3 f.

8 See Henning Schmidgen, xxx; further Thorsten Lorenz, xxx

into two-dimensional space, chrono-photographical recording, just like digital signal processing, mathematizes movement itself indeed.

Sampling the archive?

The photographic image suspends the volatile present moment from passing away, for future memory. The momentary recording exempts the present moment from disappearance, resulting in negentropic storage; on the other hand, such a recording is itself subject to entropic time at work: material decay and technical obsolescence. Once digitized, the speed of access and migration of photographic data increases, realligning the past to the present. Is photography and the cinematographic film from the past, once translated into pixels, still an archival medium at all?

Conventional film reel or videotape extraction in archives of moving images did not grip on the single frames (like in post-production editing tools like the Steenbeck or the AVID), but on the whole reel tape, the storage medium only - entering the archive, but not accessing its smallest elements which are called *stocheia* in ancient Greek, the name for both physical atoms and alphabetic letters or mathematical numbers.

The primordial archival act, in fact, *is* sampling already, discretely filtering the (administrative) present, as symbolic ordering: discrete alphabetic notation, different from mechanical and electronic signal recording by the kymograph, magnetic recording and wireless transmission of audio or video). But with(in) computing, the symbolic order or the archive returns, with a decisive / crucial, literally: time-critical difference: discreteness is introduced by clocking.[9]

Is the archive about the past at all? "Storage is just a slowed-down transmission of an event - like the "freeze frame" in cinematography.[10] Archival stillness and processual media time are interlaced.[11]

Frequency rate: 24? Chronophotographic sampling

As long as there is celluloid-based cinematography, every film is photofilm in the most literate sense. if not subjected to narrative emplotment, chronophotography results in the "statistic image" (Abraham Moles), rather diagrammatical than iconic. Marey decomposed movement into a multiplicity of

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9 See Alan Turing, State of the Art, xxx

10 See Stefanie Diekmann / Winfried Gerling, Freeze Frames. Zum Verhältnis von Fotografie und Film, Bielefeld (transcript) 2010. See as well Gusztáv Hámos / Katja Pratschke / Thomas Tode (eds.), Viva photofilm. bewegt/unbewegt, Marburg (Schüren) 2010

11 See David Green / Joanna Lowry (eds.), Stillness and Time. Photography and the Moving Image, Manchester (Cornerhouse) 2006

equal and discrete units[12], while for Bergson, chronophotography are images not of movement through time, but of position and succession[13].

At its time, the chronophotograpical frame series has been perceived as a "true" representation of moving life; the cognitive apparatus quickly adapted to the cinematographic frequencies of technical time axis manipulation. A 90 minute film contains around 130000 single frames. With its frequency rate of 24 frames / sec., each single frame is optically visible to human perception for a temporal micro-interval (Delta-*t*) of roughly 0,4 seconds. The kinematographic frequency of 24 frames/sec. already performs a micro-differential form of "photofilm" already.

[Synaesthetically, this almost corresponds with the threshold of hearing which turns the perception of discrete sequential acoustic impulses into the sensation of a deep continuous tone (beween 16 and 20 wave cycles per second).]

In terms of cultural techniques, the coding of time in the frequency rate of 24 has been anticipated on the symbolic level; both comes together in films like Hollis Frampton's *24 h calendar* or Gordon's video installation *24 hours Psycho*. Cinema, as a discrete medium which slices time into 24 still pictures per second a bit like the alphabet slices sound into twenty something letters.[14]

The edited diary of classic German cultural hero Johann Wolfgang von Goethe is named *Goethe von Tag zu Tag* which is patterned by the 24 h rhythm[15]; different from the actual chrono-biological human temporal rhythms which counts 25 hours / day. This is unvoluntarily closer to the alternating current network of 50 hz for electronic television / video image timing (the interlacing frame rate) in Europe); from such time-critical asymmetries in the coppling of astronomically oriented cultural time and machine time result subliminal, rather unconscious irritations of human time consciousness.

Even machine time is irritated by asynchony in "hardwired temporality"; the difference to the US-American video frame rate of 60 cycles / sec. requires temporal translation by the Timebase Corrector.

In Salcher's and Mach's ballistic photography, the aim to catch a projectile on the fly, required ultra-short momentum photography - actually positivizing Zenon's arrow paradox, achieved by short-circuited electric sparks both for illumination and triggering the photographic camera. Nowadays, Femto-photography is "computational photography", coupled with realtime analysis of the present moment. With a frequency of 1 billion / sec., the elementary event of what is called "light", the photonic emission itself, has been registered in "slow motion", folding the term "chrono-photography" upon itself.[16]

12Martha Braun, Picturing Time. The Work of Etinne-Jules Marey (1830-1904), University of Chicago Press, Chicago / London 1992, 277
13 Ibid., 280
14 See Lev Manovich, The language of the New Media, Cambridge, Mass. (MIT Press) 2001
15 Robert Steiger, Goethes Leben von Tag zu Tag, Bd. 1: 1749-1775, Zürich / München (Artemis) 1982
16 Information by Péter Pettendi Szabo, Metropolitan University, Budapest

Different tempor(e)alities in digital culture - a micro-archival regime

The 16mm and 35mm film frame in traditional cinema relates to the pixelised new media imagery indeed. Digital culture, when analyzed from the perspective of storage theory, is a set of "moving still".

As technical media event (the intermittant celluloid transport) there has been the "moving still" always already, of which the experimental sub-genre of the "photo film" is a secondary re-entry on the media-dramaturgical level.

This correspnds with contemporary digitally computed images, since the digital computer in its von-Neumann-architecture can not but perform one step at a time. In contrast to the discrete frame mechanism of the cinematographical apparatus, analogue signal recording media like electronic video registers even stillness by "moving" scan lines which is the physical nature of the time-signal. Remember the anlog video "still": When striking the video recorder "pause" key, the resulting "still image" still flickered, since the cathode ray tube had to re-write it again and again.

Mechanical cinematography belonged to the "digital" regime already while the phonograph has been its radical alternative - which leads to a configuration of media which is different from the familiar history of technologies. Digital sampling reconnects to chronophotographic film, by-passing the line-based electronic CRT image.

The immediate technical recording of the present has been a phenomenon of media culture since the shrinking exposure times of classical photography and cinematography, before electro-magnetic waves were applied to transmit signals with the speed of light. But different from "live" transmission in analog electronic radio and television, digital communication happens in "realtime" which suggests instantaneity but - when viewed under a time lense - is a process of constant micro-archiving of data for further processing.

Whereas analog electronic broadcast media like radio and television have been "live" indeed in terms of electro-magnetic signal transmission, digital data processing is "archival" per definition: it takes intermediary computation. "Should the record-based approach to the archive be replaced by the functional approach in terms of algorithmic processing?"[17] Digital media culture is an archival structure - though a micro-archival one, the "algorithmic archive". With digital culture, for the first time, we are really living in an archive culture - not in its institutional cultural memory sense but in terms of micro-archiving procedures which dominate digital data processing.

The *moving still*

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17 Arnoud Glaudemans / Jacco Verburgt, The Archival Transition from Analogue to Digital: Revisiting Derrida and Flusser, in: Frans Smit / Arnoud Glaudemans / Rienk Jonker (eds.), Archives in Liquid Times, 's-Gravenhage (Stichting Archiefpublicaties) 2017, 121-137 (135)

Like the photographic film already, but more radically, digital images are entirely never transmitted "live". With CCD chip based digital photography, in the microprocessor memory the image desintegrates into single lines which are attributed with its own numerical address; thereby the rendering of a still image - this time different from flickering video electronic image - as well as nonlinear forward and backward search can be achieved if not live, but in computational realtime.[18]

There has been 'Slow-Motion' and 'Fast-Motion' almost co-originary with the mechanization of cinematography itself. The digital difference, though, is in its mathematization, becoming an intelligent micro-archive.

Lev Manovich identifies random access as the "key quality of digital media"; "once a film is digitized and loaded into the computer memory, any frame can be accessed equally fast", in nonlinear time. While celluloid film samples time but still preserves its linear ordering on the micro-level, digital media abondon with the human-centered phenomenology of temporal sequence, to put time fully under algorithmic control, transforming time into space, mapping the one-dimensional time signal into a multi-dimensional matrix.

Still, the digital computer was not born from time-discrete cinematography. Indeed, a diagram of the Universal Turing Machine, when supplied with a perforated tape for forwarding the program and data punched into a tape, looks like a film projector, but the tape can not only by read but written upon at the same time.[19] The turingmachine diagram reminds of the typewriter as well, with its rhythm controlled by a clock mechanism. All such highly differentiating machines arise from one overarching epitemic dispositive which is time-discrete data processing.

While for Roland Barthes photography has been a message without code, the digital image is "only code and nothing else"[20], the "fusion of the image-creating apparatuses, tablets, smartphones and internet cross-media [...] demand a conscious decision for using photo or film" (*Photofilm* conference draft). This apparent decision, thought, is already an aesthetic anachronism, a retro-nostalgia where the content of the new medium is the older one for "remediation" (Bolter / Grusin). The deeper media-epistemological truth is the always already discrete essence of both chronophotogratography and digital media.

In an unexpected techno-logical (rather than evolutionary or "historic") recursion, the digital image returns to the time-discrete mechanics of cinematography . Cinema had prepared for digital media since it has already been based on sampling the present moment[21], or rather: movement, which in

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18 Webers 1991, chap. 1.3 *Abtaster mit Halbleiter-Zeilensensoren*, 561
19 Manovich, Cinema and Digital xxx, 1996
20 Rodowick 2007, as quoted in: Eivind Rossaak, Algorithmic Culture: Beyond the Photo / Film Divide, in: idem ((ed.), Between Stillness and Motion. Film, Photography, Algorithms, Amsterdam (AUP) 2011, 187-203 (198)
21 Lev Manovich, in: Hans Peter Schwarz / Geoffrey Shaw (eds.), Perspektiven der Medienkunst, Karlsruhe (ZKM) / Ostfildern (Cantz) 1996

Aristotle's definition generates the notion of "time" by discrete counting in numbers "between the before and the after".

Decisively (time-critically) different from the electronic video and television image in analog signal tranduction, the so-called "pixel" again provides for an elementary unit in digital *imaging* indeed. Even if it still contains a minimum amount of electric energy (voltage), different from the high-voltage produced cathode ray, its significance is not in its energy any more (apart from its secundary effect of light emission by LED) but a micro-embodiment of information as defined by cybernetic communication theory (Wiener / Shannon). When single photographic frames are digitally sampled, "photofilm" escalates from the humanly perceived screen event into technology itself.

Media artist Angela Bulloch took a film sequence of Michelangelo Antonioni´s film *Blow up* (1966) - where the closer the camera looks, the less is the apparent murder an evidence. Bulloch enlarged its digital scan in great blocks of its single pixels[22] - a desillusion of the image betrayal of the human eye, reavealing the scanner-gaze of the computer which is media-archaeological, looking at a different kind of film archive. Pixelization is the radical up-dating of "photofilm". Bulloch's digital sampling of Antonioni's film *Zabriskie Point* (one frame / sec., instead of 24 in mechanical projection) not only slows down the projection of its single image pixels, but enlarges them to 50 x 50 cm shining cubes, like an archival monument of the units of sampling and a media-archaeological reminder of what actually happens within a CCD chip in digital photography and video.[23]

[Fig.: Macro-pixel insteallation of *Zabriskie Point* by Angela Bulloch at Kunsthaus Glarus, Switzerland, 2002; https://frieze.com/article/angela-bulloch?language=de (accessed November 11, 2017]

It requires media archaeological aesthetics for an *analytic* "close reading" of high-speed media processes, by freezing the motion, slowing it down, and enlarging the single frames. This is *archaizing* in the spatial & temporal sense, reducing movement to its smallest units.

[cp. Léon-Scott's "phonautographs" recording speech for slowed-down graphic analysis of the signal event]

Konrad Zuse's first programmable binary computer Z1 operated / driven by hand crank, thereby calculating with cycles of 4 Hz. Close to the transport mechanism of a film camera; in fact, Zuse later, for his improved Z3 computer, applied punched celluloid film from discarded cinema rolls for program instruction input: a re-entry of the conceptual discreteness from within the materiality of film storage medium itself; with the rhythm of the time-discrete, escapement-driven clock-work.

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22 Installation *Blow_Up T.V.* by Angela Bulloch, gallery Shipper & Krome, Berlin, gallery Schipper & Krome, Berlin, Oktober / November 2000
23 Exhibition *Z Point* Switzerland, Kunsthalle Glarus, September / November 2001, exhibition catalogue ed. Beatrix Ruf

Digital no-time

"In the world of the digital time in encoded in a bit-map", therefore: time itself is inverted into diagrammatics; there can be no physical entropy but Shannon entropy as the essence of information value.[24] At least in principle (as mathematical "theory" of communication), "time is fixed as in a map in digital and is totally repeatable with no degradation due to copying loss, while silver-based film is structure dby time as entropy" (ibid.).[25]

Rodowick criticizes the digital image for its inability to convey a sense of passing time / pastness. The digital "image" is just a function of numerical symbols, not iconic at all[26], resulting in counting with numerical differences (*zählen*) rather than operating within time (*erzählen* in the sense of Ricoeur, *Temps et récit*).

In return, this allows for sampling the digital archive by similarity-based image matching. In algorithmic space, not only every film sequence, but every still in a film, even more: every pixel in a film frame can be discretely addressed, no longer subject titles reduce images to words, but alphanumerical source code refers to alphanumerical numbers. The archive transforms into a mathematically defined space; genuinely image-based image retrieval (similarity-based, f. e.) generates an archive beyond iconologicial semantics

Turning movement into a techno-mathematical archive: MPEG

While "photofilm" is a sequence of repetitive stills, arranged in a poetic order, metadated by narrative text or voice-over into drama, its single *Einstellung* consists of identical photographic frames which are redundant in terms of communication theory - which is the reverse ratio of digital video compression by interframe coding.[27]

"In the compression algorithm of a digital image, only what changes in the shot is renewed."[28] Digital video compression as basis for *streaming images* is sublimely based on algorithmic operations, resulting in a qualitative reduction of movement into mathematical vectors. Only parts and sections of the image are updated at a temporal moment. MPEG technologies for video compression transform the plenitude of movement into partial sampling of stills and below, dividing each frame into small blocks of pixels in order to analyze changes from one frame to the next. Therby, the elementary unit of photofilm is deconstructed into the sub-frame segment. A group of frames is established around one key frame at intervals. On the basis of key frames, predictive pictures are established in between to predict the location of each block of pixels. Movement only takes place through updates of certain sections of the

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24 Mangolte 2003: 264
25 See Hagen, Entropie der Photographie, in: Wolf (ed.), Paradigma Photographie, Frankfurt/M: (Suhrkamp) xxx
26 D. N. Rodowick, The Virtual Life of Film, Cambridge, MA (Harvard UP) 2007
27 See Owen, The Internet Challenge to Television, M.I.T. 2000: 176
28 Mangolte 2003: 264

image, while the rest of the frame is replayed as before.[29] In such a delicate operation based on micro-temporal events; only parts and sections of the image are updated at a temporal moment. The conventional film frame is not simply transsubstantiated by digitization; it is numericized and thus becomes accessible for computation, making explicit operative reality of Bergson's critique of the implicit mathematicity of discrete chrono-photographic image sequences. At that moment, photofilm has imploded into micro-archival action.

29 See Trond Lundemo, In the Kingdom of Shadows. Cinematic Movement and Its Digital Ghost, in: Pelle Snickars and Patrick Vonderau (eds.), The YouTube Reader, Stockholm (National Library of Sweden) 2008, 314-329 (316 f.)